

*Addis Ababa
University*

(Since 1950)



**ADDIS ABABA UNIVERSITY
SCHOOL OF INFORMATION SCIENCE AND SCHOOL OF PUBLIC
HEALTH
M.SC IN HEALTH INFORMATICS PROGRAMME**

**DESIGNING A FRAMEWORK FOR HOSPITAL INFORMATION
SYSTEM: METTU KARL REFERRAL HOSPITAL**

BY: Bizuneh Buli (BSC)

**A PROJECT WORK SUBMITTED TO THE SCHOOL OF
GRADUATE STUDIES OF ADDIS ABABA UNIVERSITY IN
PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE
DEGREE OF MASTER OF SCIENCE IN HEALTH INFORMATICS**

JULY, 2017

ADDIS ABABA, ETHIOPIA

ADDIS ABABA UNIVERSITY
SCHOOL OF INFORMATION SCIENCE AND SCHOOL OF PUBLIC
HEALTH
M.SC IN HEALTH INFORMATICS PROGRAMME

DESIGNING A FRAMEWORK FOR HOSPITAL INFORMATION
SYSTEM: METTU KARL REFERRAL HOSPITAL

BY: Bizuneh Buli (BSC)

Name and Signature Of The Members Of The Examining Board:

- | | |
|---------------|-----------|
| 1. _____ | _____ |
| Examiner Name | Signature |
| 2. _____ | _____ |
| Examiner Name | Signature |
| 3. _____ | _____ |
| Advisor Name | Signature |
| 4. _____ | _____ |
| Advisor Name | Signature |

Declaration

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

Student

Signature

Date

Acknowledgment

First of all I would like to thank my almighty God Jesus Christ for giving me life and chance to be a candidate of this profession.

I would also like to pass my greatest appreciation to my two project advisors, Dr Ababi Zergaw and Dr. Temtim Asefa , the wavering support and inspiration that they both accorded me and made it possible to undertake the study conclusively. They were both very friendly and such a wonderful team to work with them. Thank you.

Special thanks also goes to all respondents in Mettu Karl Referral Hospital, Health centers and Regional Health bureau for their kind support and interest to sacrifice their time to provide and conduct interviews.

Finally, I would like to thank my son and daughter, for being understanding and choosing the best for me. I promise I will surely compensate my absence and your sufferance without a Dad.

Lastly but not least I would like to thank Mettu Health Science College HIT team for their support and encouragement in all aspect.

Table of contents

Acknowledgment	iii
List of tables.....	vi
List Of Figures	vii
List of acronyms	viii
Abstract	ix
CHAPTER ONE	
1. Introduction.....	1
1.2. Statement of the problem	3
1.3. Objectives.....	4
1.3.1. General objective.....	4
1.3.2 Specific objectives	4
1.4. Significance.....	4
1.5. Scope	5
1.6. Limitation.....	5
1.7. Ethical clearance	5
CHAPTER TWO	
2. Literature review.....	6
2.1. Basic concept.....	6
2.2. Enterprise architecture.....	7
2.3. Oracle enterprise architecture frameworks	8
2.4. The Federal Enterprise Achitecture Framework (FEAF).....	10
2.5. Integrated Eterprise Architecture Framework (IEAF)	11
2.6. Enterprise Architecture for Hospital Information System	12
CHAPTER THREE	
3. Methodology.....	14
3.1. The study setting	14
3.2. Source and study population	14
3.3. Data collection.....	15
3.3.1. Interview.....	15
3.3.2. Observation	15

3.4.3. Review of documents	16
3.4 Tools and techniques	16
3.5 Data analysis & framework design	18
3.5.1 Data analysis	18
3.5.2 Framework development	18
CHAPTER FOUR	
4. Data analysis, design and discussion of the results.....	20
4.1. Requirement analysis	21
4.1.1. Functional requirements.....	21
4.1.2. Non-functional requirements.....	25
4.2. Existing system architecture.....	35
4.2.1. The proposed his architecture framework.....	35
4.2.2. Architecture service and activity of hospital information system	36
4.2.3. Business rules.....	36
4.2.4. Description.....	38
4.2.5. System Evaluation	53
CHAPTER FIVE	
5. Conclusions and Recommendations	55
5.1. Conclusions	55
5.2. Recommendations	56
References.....	57
Annex 1	62

List of Tables

Table 1. Comparison of Enterprise frameworks	14
Table .1. Selection criteria	19
Table 2: Log- In use case description	30
Table 3: Use case patient register	30
Table 4: Use case description for patient admission	31
Table 5: Use case description for patient discharge	32
Table 7: Use case Description for appointment	33
Table 8: Use case description for patient referral	33
Table 9: Use case description for prescribe treatment	34
Table 10: Use case description for generate report	34
Table 11: Organization and HIS architecture framework service statement	36
Table 12. Name Patient (patient)	39
Table 13. Name: Health Professional	39
Table 14. Name: Community participation	39
Table 15. Name FMOH	40
Table 16. Name Regional Health Bureau	40
Table 17. Name NGO's and partners	40
Table 18. Name other stockholders	40
Table 19. Activity	41

List of figures

Figure 1. Enterprise Architecture Framework Components.....	8
Figure 2. Oracle Enterprise Architecture Framework Components	9
Figure 3. The Common Approach to Federal EA	11
Figure 4 . High Level System Use Case For Mettu Karl Referral Hospital	25
Figure 5. Patient Information System Use Case Diagram	28
Figure 6. User Controlling Use Case Diagram For MKRH	29
Figure.7. class diagram	42
Figure 8. Login Sequence Diagram for hospital information system	43
Figure .9. Login Sequence Diagram for patient registration	44
Figure 10 Sequence diagram for patient admission	45
Figure 11 Sequence diagram for patient discharge	45
Figure 12 Sequence diagram for patient prescription	46
Figure 13 Sequence diagram for patient appointment	47
Figure 14 Sequence diagram for patient referral	48
Figure 15 Sequence diagram for patient generating report	48
Figure 16 Sequence diagram for database design	49
Figure 17 User Interface for MKRH Hospital Information System	52
Figure 18. login forms for Mettu Karl Hospital information system	52
Figure 19. New Patient Registration Form For MKRH HIS	53

List of acronyms

ART: - Anti retroviral

EA: - Enterprise Architecture

FEAF: - Federal Enterprise architectural frameworks

HIS:-Hospital information system

HMIS:- Health Management Information System

HRIS:- Human Resource Information System

HIV/AIDS: - Human Immune Virus/ Acquired Immune Deficiency Syndrome

ICT:-Information and Communication Technology

ICU: - Intensive Care Unit

IEAF:-Integrated enterprise architecture framework

MCH: - Maternal and Child Health

NICU: - Neonatal ICU

OADP:-Oracle Architecture Development Process

Obs: - Obstetrics

OEAF:-Oracle Enterprise architectural frameworks

OPD: - Out Patient Department

Ped ICU:-Pediatric Intensive Care Unit

TB: - Tuberculosis

VCT: - Volunteer Counseling and Testing

ZEF:-Zachman Enterprise Framework

Abstract

Background: Hospitals information system is a system for collecting, processing, analyzing, disseminating and using information about a patient health service and community health desires of the population.

Hospital Information Systems (HISs) contribute to an efficient patient care with high quality and comprise data transfer with the associated hospital employees, at the right place and time, promoting interoperability among them. In other words, HIS is principally focused on the patient, as well as on medical and nursing care, and the administrative and management issues needed to support these kinds of care.

Objective: The general objective of this research project is to design a framework of hospital information system for Mettu Karl Referral Hospital, Ilu Ababora Zone ,Oromia Regional State, South West,Ethiopia.

Methodology: An institution-based cross sectional study was conducted at Mettu Karl referral hospital from January to June 2017. For data collection interview, observation, document and literature review was done. For the framework development the FEAF and the Oracle Enterprise architectural frameworks were used. Iterative system development methodology was used for over all framework development.

Discussion of Results: By using the perspectives of the FEAF and the Oracle Enterprise architectural frameworks template different business, data and information architecture works were done. Taking the hospital service and activity in to consideration, the investigator identified the architecture service, activity and information principles, information flow between different departments and different customer that have impact on hospital information systems. The hospital will be benefited from this hospital information system framework in that the system will provide quality improvement and good patient management by improving the flow of information in a computerized way.

Conclusion: Information is a critical resource for hospitals to provide services 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 health professionals and different customers.

CHAPTER ONE

1. Introduction

In the early days of computing, technology simply automated manual processes with greater efficiency. As technology evolved, new innovations enabled new capabilities and processes in the enterprise that were driven by IT. Gradually, IT changed the business but not necessarily in alignment with the business strategy. This lack of alignment resulted in significant waste of resources and missed opportunities, and placed the organization in a competitive disadvantage in the market. To align the strategies of business with IT, a new approach for managing IT has been developed called Enterprise Architecture. Just as architecture provides a blueprint for constructing a building, Enterprise Architecture provides a blueprint and roadmap for aligning Information and Communication Technology with business strategy. ICT is revolutionizing our life, our ways to interact with each other, and day-to-day life and work [1].

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 FEAF, "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]. The Common Approach to Federal Enterprise Architecture promotes increased levels of mission effectiveness by standardizing the development and use of architectures within and between Federal Agencies. This includes principles for using EA to help agencies eliminate waste and duplication, increase shared services, close performance gaps, and promote engagement among government, industry, and citizens [2].

A study done in Malawi on determinants of Use of Health Information in Nathenje Health Area of Lilongwe District, showed that information use was low at the facility level since only 30% of the facilities used information for monitoring, 40% of the facilities was having discussions about RHIS information, and 20% were making decisions after the discussions. Ten percent of the

facilities showed promotional activities for using information, indicating that low level of senior management support to promote the use of information [3].

According to a national HMIS assessment done in Ethiopia by FMOH in collaboration with WHO, CSA and HMN reported that among the six major components of Health information system parameters (resource, indicator, data source, management, products and dissemination and use) the core three components were found very weak. These were resources, data management, and dissemination and use, while the other three components are more or less categorized as good. The study also listed the weakness observed during the assessment which was inequitable resource distribution between urban and rural areas, lack of trained man power and attrition of human resource [4].

A country wide hospital quality improvement project done in 14 selected Hospitals reported that low staff morale; shortage of financial resources, medical equipment, drugs and other supplies; limited opportunities for staff training; poor infection control and a lack of community participation in hospital governance were the major problem for the low quality. After one year intensive intervention on identified and prioritized problems post implementation assessment indicated that 45 of the 75 (60%) selected key management indicators showed improvement in the domains of human resources, medical records, nursing standards and practice, infection prevention and control, quality management and financial management; although improvements were not uniform across all hospitals and across all indicators [5].

A study conducted in Addis Ababa on mental health information system shows that 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 [6].

Study conducted at Addis Ababa public hospitals on assessment of HMIS indicated that the processes of data collection; storage and dissemination on the supply and provision of resource, regular supervision and feedback were weak. The reasons were the technical, organizational and

behavioral factors. There was low commitment of decision making bodies in allocating resource (human, material, financial), training skilled personnel and infrastructure [7].

There are several benefits produced by a HIS. They are a way of providing accurate, consistent information about 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 service [9].

Currently the services provided by Metu Karl hospital are includes:

- OPDs, Emergency OPD, Dental Clinic, Ophthalmology Clinic, TB Clinic, Laboratory, ,Obs and Gyn Wards, NICU, Ped ICU, Adult ICU, Pharmacy, Radiology, Operation Room, Medical Ward, Surgical Wards, triage, MCH service, VCT service and ART service.

1.1. 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 [10]

“In today’s complex public service 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” [11].

Some of the problems encountered in the existing system are the following as observed by the investigator [11].

- There is no standardized way of information flow and access
- Lack of information integration.
- Duplication of Patient data
- Different reporting systems
- Poor data quality

- Inadequate knowledge/understanding of Patient in knowing health professionals and department or different service area.

Therefore designing hospital information system framework that will provide guidelines for decision making coordinate different components of organizations and enable to better understanding of IT capabilities by aligning relevant IT resources to the business functionality

1.2. Objectives

1.2.1. General objective

To design a framework of hospital information system for Mettu Karl Referral Hospital.

1.2.2 Specific objectives

The specific objectives of the project were:

- ✚ To design a framework for hospital information system.
- ✚ To identify how information flows within and between different case teams.
- ✚ To investigate problems in existing hospitals regarding to hospital information management.

1.3. Significance Of The Project

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

Designing a hospital information system framework will have the following benefits. It

- ❖ Improves data quality and reliability.
- ❖ Provides structured way of data collection.
- ❖ Improves on time reporting of hospital information system and to FMOH and different funders.
- ❖ Improves patient care and quality by providing available, accessible, and consistent and on time patient information.
- ❖ Allows access to, and better use of, improved hospital information system for health professionals and decision makers and even other stockholders.
- ❖ Provides an opportunity to share/ exchange standardized patient information between different hospitals.
- ❖ Support decision making functions of the hospitals by using the available information.

- ❖ Improves data collection.
- ❖ Facilitates integration and reuse of new systems that will be designed to support hospital information system.

1.4. Scope Of The Study

The scope of the project was to design hospital information system framework for Metu karl hospital. From oromia hospitals Mettu karl was selected to collect requirements and to design hospital information system framework. The project was conducted from February 2016 to May 2017 in Ilu ababora Zone

This project used the FEAF and the Oracle Enterprise architectural frameworks to develop the framework. The FEAF framework allows for the identification and description of both the organization's existing and planned component parts, as well as their common relationships.

OEAF provides a common sense, practical and effective method for developing enterprise architecture. Due to time constrain, from the nine FEAF framework perspectives this project included only three of the perspectives, i.e. scope (contextual) perspective aimed at the planner, the business model (conceptual) perspective aimed at the owner and the system (logical) perspective aimed at designer. From OEAF 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 designing the hospital information system framework.

1.5. Limitation Of The Study

The major limitation of this project was time and financial constraints. Because of this it was difficult to develop the hospital information system framework. It was also difficult to implement and evaluate the framework.

1.6. Ethical Clearance

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

CHAPTER TWO

2. Literature Review

2.1. Basic concept

Hospitals are very complex institutions with large departments and units intended to coordinate care of the patients [12]. It consists of different groups performing highly specified functions that lead to the generation of large amount of data. An endless flow of data begins with the outpatient and inpatient departments and emanates from every department throughout the hospital. Some data is vital for the care and well-being of patients, while other data enhance the overall efficiency of hospital itself. The way the hospital responds to the challenges of managing these data determines the quality of patient care and hence its success [13].

Over the last few decades, Information and communication technology has played a vital role in managing healthcare data that are getting generated from the various sources in the hospital. A Hospital Information System (HIS) as one of the important application of information and communication technology, support the health-care provider in managing variety of information generated in a hospital on a day to day basis. It is a comprehensive and integrated information system designed to collect, retrieve, manipulate and use of information to support all the administrative and clinical activities of a hospital [14].

Hospital Information Systems (HISs) contribute to an efficient patient care with high quality [15] and comprise data transfer with the associated hospital employees, at the right place and time, promoting interoperability among them(16). In other words, HIS is principally focused on the patient, as well as on medical and nursing care, and the administrative and management issues needed to support these kinds of care [17].

The HIS offers indisputably significant opportunity for the development of the efficacy and the efficiency of the health care [18] through their frequent application in Medical Informatics [19]. The implementation of HIS affects the structures, the processes and the outcomes in the health care environment [20].

2.2. Enterprise Architecture

According to Boer B.H. Enterprise Architecture (EA) is a method and an organizing principle that aligns functional business objectives and strategies with an IT strategy and execution plan. The Enterprise Architecture provides a guide to direct the evolution and transformation of enterprises with technology. This in turn makes IT a more strategic asset for successfully implementing a modern business strategy [21].

An Enterprise Architecture typically produces deliverables such as:

- Current State Enterprise Architecture model
- Future State Enterprise Architecture reference model that is needed to execute on the proposed business strategy
- Gap analysis that identifies the shortfalls of the current state in terms of its ability to support the objectives and strategies of the business
- Architecture Roadmap that defines the initiatives required to migrate from the current state into the future state. By taking an enterprise-wide perspective across business services, business processes, information, applications, and technology, an EA ensures the enterprise goals and objectives are addressed in a holistic way across all IT projects. To be successful, an Enterprise Architecture needs to be woven into the enterprise's culture, not treated as a closed-scope project. The value of an EA is greatly enhanced when it is organically embedded into the lifecycle of the organization, including capital planning, project management, asset management, resource allocation, and strategy formulation [22].

Enterprise Architecture is a journey, not a project. It evolves over time and needs to maintain the flexibility required to adjust to changing market conditions, strategy shifts, and new innovations in technology. EA frameworks have emerged to manage the increasingly complexity of innovation and change. Enterprise Architecture is as much about ongoing communications among business and IT leadership as it is about technology innovations and architectural choices. Enterprise Architecture facilitates business and IT communication with common language, process, and structure [23].



Figure 1. Enterprise Architecture Framework Components

Therefore there are different types of Enterprise Architecture Framework that are comparatively applied at any business organizations. So we try to compare in order to apply in our project area.[24].

2.3.Oracle Enterprise Architecture Frameworks

According to Beckner, S.G. creating an Enterprise Architecture from scratch can be a daunting task, so EA frameworks were created to simplify the process and guide an architect through all areas of architecture development. An Enterprise Architecture framework provides a collection of best practices, standards, tools, processes, and templates to assist in the creation of the Enterprise Architecture and architectures of various scopes. Enterprise Architecture frameworks typically include: common vocabulary, models, and taxonomy, processes, principles, strategies and tools, reference architectures and models Prescriptive guidance (EA processes, architecture content, implementation roadmap, governance), Catalog of architecture deliverables and artifacts, Enterprise Architecture Content Meta model, Recommended set of products and configurations [25].

Utilizing an Enterprise Architecture framework streamlines the process for creating and maintaining architectures at all levels (e.g. enterprise architectures, functional business segment architectures, cross-cutting technology domain architectures, and solution architectures) and enables an organization to leverage the value of architecture best practices. A number of EA frameworks exist in the industry with the goal of addressing the basic challenge of assessing, aligning, and organizing business objectives with technical requirements and strategies. Examples include the Zachman Enterprise Framework, The Open Group Architecture Framework (TOGAF), OMB Federal Enterprise Architecture (FEA), and The Gartner Methodology (formerly the Meta Framework). Each framework possesses different strengths and weaknesses, which makes it difficult to find any one existing framework that is ideal for all situations [26].

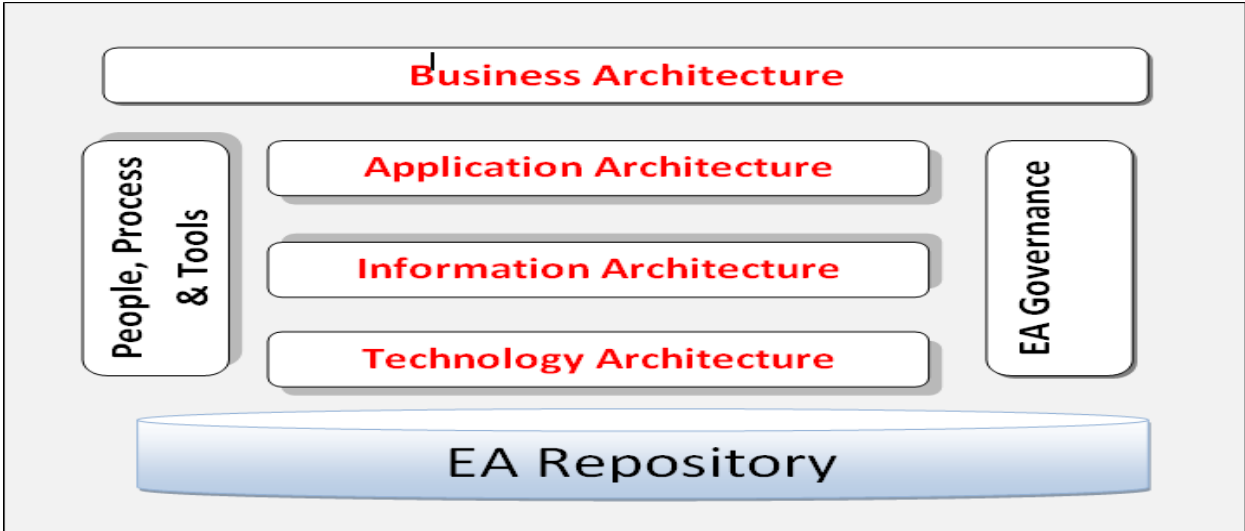


Figure 2. Oracle Enterprise Architecture Framework Components

To create these Enterprise Architecture components, Oracle has created a streamlined process to facilitate their development. The Oracle Architecture Development Process (OADP) defines a practical approach for working with customers collaboratively to align their enterprise and solution architectures to their business strategies and goals [27].

2.4. 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. It 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 [28].

The FEAF enables U.S federal agencies to share information and design common process between other agencies. It also emphasizes on functional role and enterprise architecture team member’s responsibilities. 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 [29].

There are four primary outcomes that are enabled by the common approach to federal EA:

- Service Delivery
- Functional Integration
- Resource Optimization
- Authoritative Reference

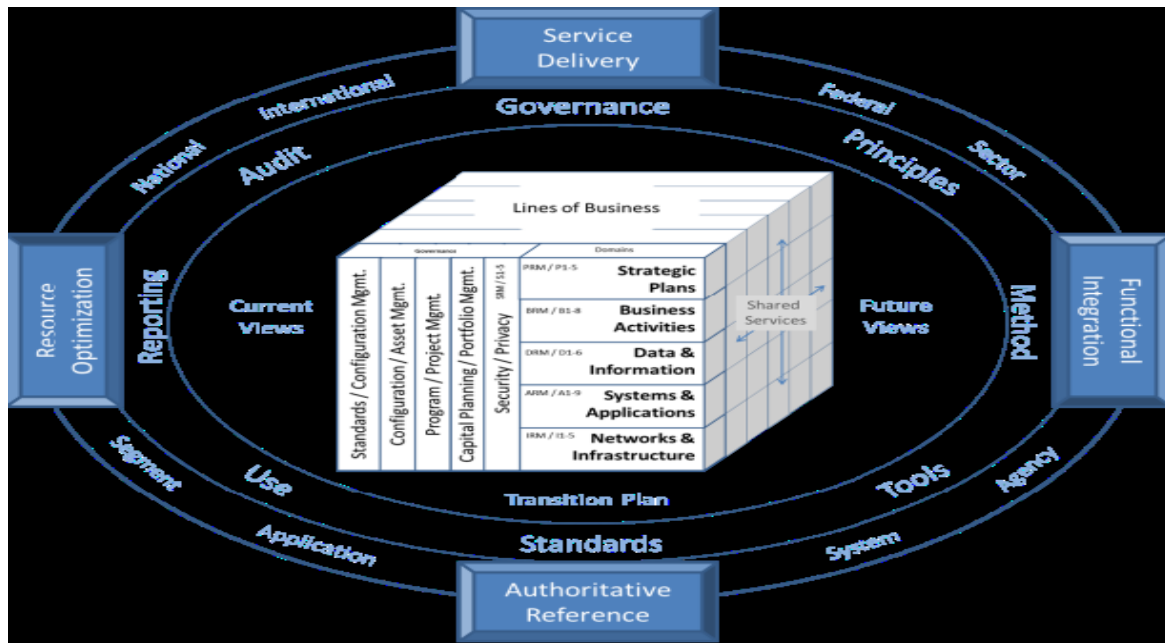


Figure 3. The Common Approach to Federal EA

While there are many positive outcomes that EA contributes to, these four outcomes are “primary” in that they represent areas of direct, positive impact that architectures can make within and between agencies and with customers and partners external to government. EA is uniquely positioned as the management best practice which can provide a consistent view across all program and service areas to support planning and decision-making. EA standards also promote mission success by serving as an authoritative reference, and by promoting functional integration and resource optimization with both internal and external service partners [30].

2.5. 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 [31].

The IEAF has four components namely physical, contextual, conceptual and logical. In each component it explains different domains like business, information, and information service and technology infrastructure [32].

Table.1.The following chart depicts how the three Enterprise Architecture Frameworks compare.

Criteria	Zachman	FEA	Gartner
Taxonomy Completeness	4	2	1
Process Completeness	1	2	3
Reference Model Guidance	1	4	1
Practice Guidance	1	2	4
Maturity Guidance	1	3	2
Business Focus	1	1	4
Governance Guidance	1	3	3
Partitioning Guidance	1	4	3
Prescriptive Catalog	1	4	2
Vender Neutrality	2	3	1
Information Availability	2	2	1
Time to Value	1	1	4
Total	17	31	29

Rating Scale:- 1. Very Poor 2. Inadequate 3. Acceptable 4. Very Good

Source:- Comparison of the top enterprise Architecture Methodologies by Roger Sessions CTO of Object Watch.

2.6.Enterprise Architecture for Hospital 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 [33].

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. 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 [34].

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 [35].

EA can provide a healthcare delivery system, health information exchange, 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(36). The comparative analysis among the different enterprise architecture shows that FEA enterprise framework has better features than other frameworks to develop the health information system for Mettu Karl Hospital.

CHAPTER THREE

3 Methodology

In this project 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). FEAF was used to develop the hospital information system framework.

3.1. Research Design

An institution-based cross sectional study was conducted at Mettu Karl referral hospital from January to June 2017. Cross sectional study design was selected because the researcher can collect all the needed data at single point in time; it's cheaper and can be conducted with limited time period than longitudinal studies.

3.2.The study setting

The project was done in Mettu Karl hospital which provide hospital information system services. From Oromia hospitals Mettu Karl Hospitals was selected. This hospital was selected because the investigator is in the compound and it is easy to gather information about the hospital. Most of the interview, document review and observation were done in Mettu Karl Hospital, Because, more functions of hospital information system services are done in this hospital and it includes both outpatient and inpatient department. Mettu Karl Hospitals is also a referral hospital for other hospitals in the Zone.

3.3. Source Population

The source population was all healthcare professionals who are employees of Mettu Karl Hospital. There are a total of 174 healthcare professionals such as Specialists, Medical Doctor, doctorate of dental, Physiotherapist, Nurses, Health officers, Pharmacists, Sanitarians, midwifery's , Anesthetist, Laboratory technicians, health educators, mental health professionals, occupational health, emergency obstetrics officers and public health professionals.

3.4. study population

Different Populations were used for this project. Health professionals involved in care giving of patients were the study population to understand the patient information flow. Further the plan

and program officer was consulted to know how to acquire documented information about existing system . Documentary sources were used to assess patient health business functions and their strategies. It also used to know different stakeholders (ORHB, FMOH, and other NGOs) involved in patient care. setting and their concerns related to patient health.

3.5.Data collection

In this project different data collection methods were used to collect requirements from the hospital. The data collection focused on the topics of service of different department or case team of the hospital, and structure of hospital information system. In order to collect such data structured interviews, direct observation, written documents that were available in the hospital and from other literatures were used.

3.5.1. Interview

Interview is a more flexible data collection method than questionnaire if wisely used. It can generally be used to 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 questionnaire [37]. The interview process was important as it gives direct references from respondents about their patient treatment, managing patient information systems.

Interview was selected in this project because of its support to get rich and thick information about the phenomenon being investigated. The interview was also used to know the personal interaction with the hospital process. The structured interviews were done with nine respondents including the medical director, physician, HMIS focal person, other health professionals and plan and program officer. Most of the interviews were conducted face to face in office at Mettu Karl hospital with the above mentioned respondents.

3.5.2. Observation

Observation was used to gather information which could not be collected by other data collection methods. Respondents may not be willing to express some sensitive information about their organization such as deterioration of services quality because of fear of their supervisors. It is also good to gather information about user interaction on the task and flow of information among

different units of the organization..Observation was used in this project to confirm that the data obtained from interview matches with the reality; to understand the flow of activities in different case teams, to compare services given by different case teams the hospital. Moreover observation was used to assess information used and shared among health professionals during health information collection, processing and dissemination. The observation was conducted in registration, OPDs, Emergency OPD, Dental Clinic, Ophthalmology Clinic, TB Clinic, Laboratory, ART, Obs and Gyn Wards, NICU, Ped ICU, Adult ICU, Pharmacy, Radiology, Operation Room, Medical Ward and Surgical Wards. During observation the investigator recognized different types of practice that was done in the hospital regarding reporting systems and disease classification categories.

3.5.3. Review of documents

Review of documents such as business processes reengineering (BPR) documents, annual plan, patient registration books, outpatient and inpatient disease report, different records, reports and tally sheet of patient documents of Metu Karl hospital and zonal document were done to know the service and care of patients so that the design of the framework could depend on these different documents. Different literatures were reviewed to understand the experience and practice of enterprise architecture in health care organizations in different countries.

3.6.Tools and Techniques

Identification and utilization of an appropriate tool and technique is critical to the success of hospital information system architecture framework design [38].

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 service of hospital information system. An open and independent modeling language for enterprise architecture. A notation for describing, analyzing and visualizing

relationships amongst business domains and common language. Archimate is selected in this project because it is easily available and easy to use [38].

- Microsoft Visio 2003 was used to draw system analysis and design part.

Microsoft made Visio 2013 for Windows available in two editions: Standard and Professional. The Standard and Professional editions share the same interface, but the Professional edition has additional templates for more advanced diagrams and layouts, as well as capabilities intended to make it easy for users to connect their diagrams to data sources and to display their data graphically. The Professional edition features three additional diagram types, as well as intelligent rules, validation, and sub process (diagram breakdown). Visio Professional is also offered as an additional component of an Office 365 subscription [39].

On 22 September 2015, Visio 2016 was released alongside MS 2016 A few new features have been added such as one-step connectivity with Excel data, information rights management (IRM) protection for Visio files, modernized shapes for office layout, detailed shapes for site plans, updated shapes for floor plans, modern shapes for home plans, IEEE compliant shapes for electrical diagrams, new range of starter diagrams, and new themes for the Visio interface [39].

Data Base Modeling in Visio revolves around a Database Model Diagram (DMD).

- UML Modeling tools such as use case, class diagram and sequence diagram to model the different views of the system

The U in UML stands for unified because the UML is a unification and standardization of earlier modeling notations of Booch, Rumbaugh, Jacobson, Mellor, Shlaer, Coad, and Wirf-Brock, among others. The UML most closely reflects the combined work of Rumbaugh, Jacobson, and Booch – sometimes called the three amigos. The UML has been accepted as a standard by the Object Management Group¹ (OMG) [40].

3.7. Data analysis & framework design

3.7.1. Data analysis

The data collected was analyzed within the hospital to identify similarities and compare differences on hospital 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 designing 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 customers. Sequence diagram shows the interaction of the tasks with the customers.

3.7.2. Framework development

Information systems are complex and because people heavily depend on them, they have to be established using the right enterprise architecture frameworks. 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 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 [41]. 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 FEAF was selected after making a comparison of different criteria that was formed by the investigator based on the literatures review in chapter two.

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

- Availability of tools– the framework provides different tools to support the design of the architecture.
- Standardization –ensure design and architectural standards are maintained
- Ease to use– the ability of the framework to readily and successfully perform by the user without the need of an advance explanation.
- A base for other framework design – the framework helps as an initiator to develop other frameworks.
- Understanding of the architecture – the framework makes use of standard terms, principles and guidelines for consistent application of the architecture.
- Techniques of use– the framework will provide different techniques for the design of the architecture.
- Depth and breadth – the ability of the framework to have detailed instructions to help the user to use the framework.
- Identification of stakeholders – the ability of the framework to identify different stakeholders that will have impact on the design of the architecture.

Table 2: Selection Criteria

Selection criteria	Zachman	FEAF	IEAF
Availability of tools	✓		✓
Standardization		✓	✓
Ease to use	✓	✓	✓
A base for other framework design	✓	✓	
understanding of the architecture		✓	
Techniques		✓	
Depth and breadth	✓	✓	
Identification of stakeholders	✓	✓	

Accordingly, because of Availability of tools, Standardization, Ease to use, ease to design, ease to understandability of the architecture, its techniques, depth and breadth as well as Identification of stakeholders FEA Enterprise Architecture Framework was used in this project work.

CHAPTER FOUR

4 Data Analysis, Design and Discussion of the Results

This chapter describes the findings from the data collected by observation, interview and document review.

Interview

The result of interview of key informants revealed that the hospital has a strategic plan to design hospital information system and to implement electronic medical record system in collaboration with Oromia Regional Health bureau and Tulane University. But the members of the management team including HMIS focal person testify that the hospital didn't plan to design any frame work that facilitates the flow of information among the departments.

The hospital will be benefited from this hospital information system framework in that the system will provide quality improvement and good patient management by improving the flow of information in a computerized way.

The HIS system framework also improves the clinical process in patient care and to keep the data up-to-date. The system also helps the hospital to make the communication between patient and different health care professionals (General Practitioners, specialists, care teams, nurses, pharmacy etc) easy.

On the other hand, the system helps the hospital to collaborate and share information on patient care through digital equipment(virtual health care).

Generally the results from the interview showed that currently the information flow between different departments is paper based and the hospital information is collected manually using HMIS tools from different departments there is lack of computerized HIS to analyze and process the data. The respondents also testify that there is some limitations regarding the HMIS reporting formats.

Observation

The investigator also tried to observe different departments and case teams while they were collecting patient data by filling the formats, tally sheets, and registers and the result showed that it lacks legibility and completeness of data.

Concerning the number of staffs in the HMIS unit only one HIT professional who is HMIS focal person, and one BSC Nurse was assigned there.

Availability of IT/communication equipment in the HMIS office revealed that there are two desk top computers, one hp printer , a fixed telephone , a WIFI internet and abroad band internet which is not functional during observation period. The HMIS team used software such as SMART care, EHMIS and HRIS.

4.1.Requirement analysis

Most of our respondents cited lack of interoperability/standards, lack of knowledge about system use and fear of positions to be replaced by technology.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 health professionals. This also confirmed by observation done by the researcher. 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 implementation of policy.

4.2. 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 [41]

The functional requirements are:

- Storing patient information for later reference
- Store information about treatment provided by patient name
- Appointment schedules
- Search for patient information

- Generate different type of reports for internal users as well as for external users like Ministry of health.

Business activities to be addressed

- ❖ Patient registration
- ❖ Laboratory investigation
- ❖ Admission
- ❖ discharge
- ❖ Diagnosis
- ❖ Treatment
- ❖ Medication order
- ❖ Referral
- ❖ Forensic cases
- ❖ Teaching of health professional
- ❖ Funding from different NGO's
- ❖ Planning, monitoring and evaluation

Patient registration

A patient comes to hospital and register to the system. After registering the patient will be screened by public health 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 activity performs the following activities

- Patient registration
- Screening
- Making payment or fee, if recommendation latter.

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

Laboratory investigation

After the patient get laboratory prescription, he/she takes to the laboratory. 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 sample container and to the patient's lab prescription form
- Collect sample
- Perform procedure
- Compare lab ID patients lab prescription form
- fill laboratory results
store in the laboratory results file
- Send copy to the physician or doctor

Treatment

Physician will decide the type of treatment that is appropriate for the Patient/ 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

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

Discharge

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

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

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

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.

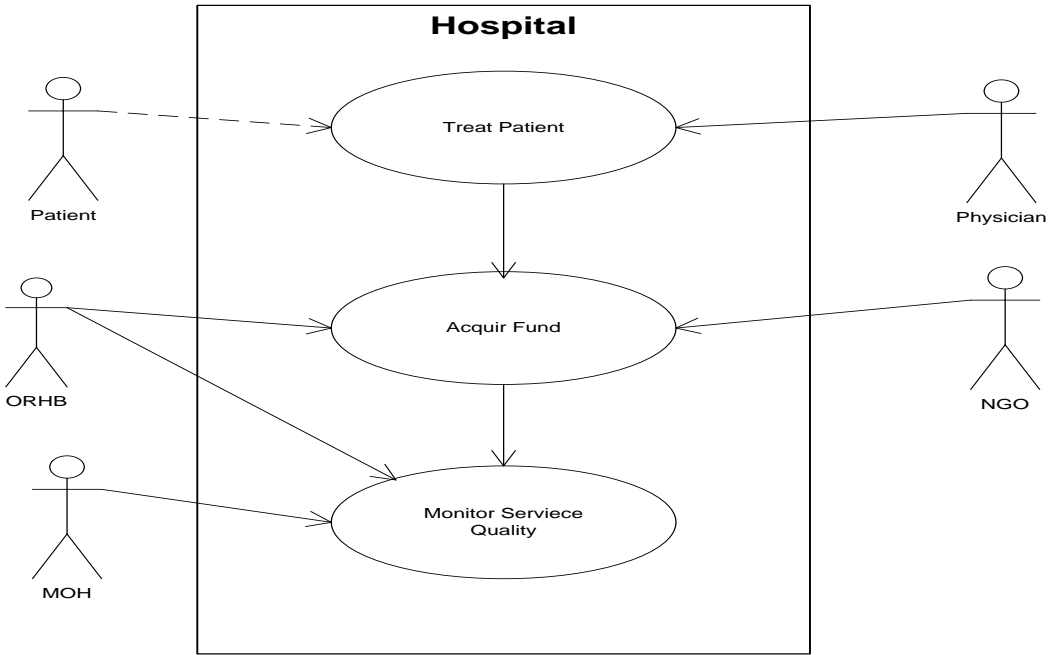


Fig. 4. High level System use case for Mettu Karl Hospital

4.3 Non-functional requirements

The Non-functional requirements describe usability requirements of the system but not directly related to the functional behavior of the system. Usually, these are constraints of the system to improve quality of service. Therefore the project presents an opportunity to deliver an integrated hospital information system service. I suggest the following high-level requirements for the solution:

4.3.1 Accessibility and Manageability

It must implement the methods to collect process and distribute patient's vital data, from central health service to the whole health service system accessibility and it must be manageable that to provide control over the myriad of computing devices connected to the environment.

4.3.2 Reliability and Optimization

It must be reliable that to guarantee system availability despite fluctuations of operational conditions and punctual issues and optimized for computing resources; for the application to run in inexpensive and low-profile computing devices.

4.3.3 Security and Privacy issues

Security and privacy issues in healthcare data are very sensitive. Therefore it must be secure; that the system must guarantee the integrity and confidentiality of medical data. The data transferred to a different department should be secure and users should have access to part of data they are supposed to use.

4.3.4 Scalability

It must be scalable, to support the deployment in large healthcare environments and the integration of different health service and the system allows easily extensible. It is simple to add services or integrate with other systems. Therefore, hospital information system allows other systems, to consume the common services. It expose functionalities such as getting list of messages and authentication as a web service so that they can use them as part of another system.

4.3.5 User Interface

The usability of a system is highly affected by the way its user interface is designed. In this case simplicity is a key characteristic of a user interface. To complement the low level of information Technology usage in the hospital, the system needs to have a simple and attractive interface. Making the system web based put any user familiar with internet at ease in using the system. Since it uses familiar links to work with different components of the system, it makes users comfortable in using it. Furthermore, any system needs to be available whenever it is required to make use of it. Hospital information system is expected to be available at any time when professionals need to use the system. It runs on any system capable of running web browsers. But the server should be a powerful computer which is capable of handling requests even during high traffic times. Hospital information system is designed to run on the existing network infrastructure.

4.4 System Model

System modeling is a tool used to understand the system. It is then used for an analysis and design of the system(36). Models are developed to represent the system view under consideration and to explain the behavior of various components of the system. Different components in the system are described using FEAF. These tools are used to model these components of the system so as to better understand it and its requirements. This part of the document present the model diagram of hospital information system using UML.

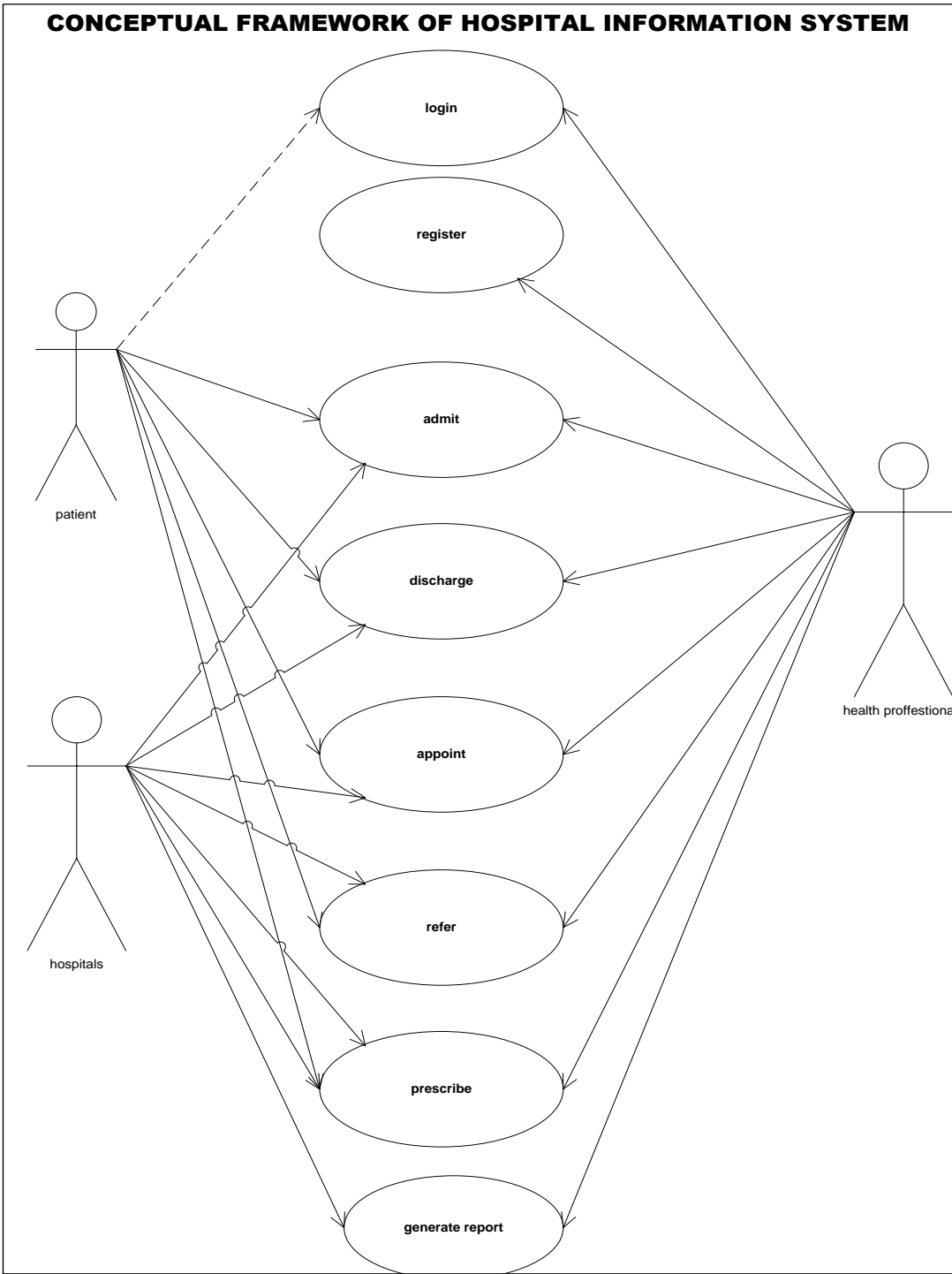


Fig.5. Patient Information System Use Case Diagram

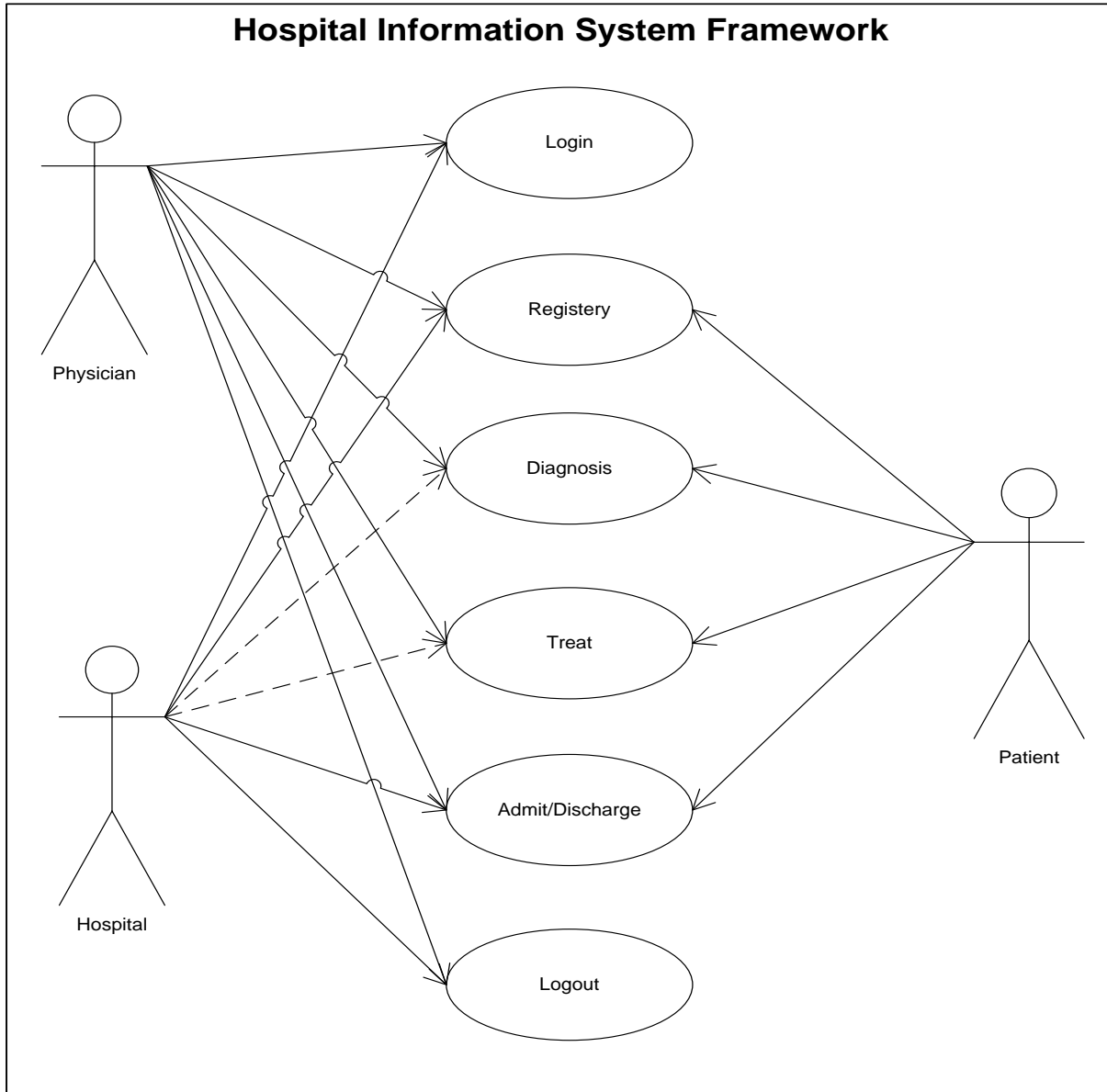


Fig.6 .User controlling Use Case Diagram

4.5. Use case descriptions

Currently Metu Karl 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).

Table 3: Log- In use case description

<p>1. Name: Login</p> <p>Identifier: Use Case 01</p> <p>Description: Allow registered users to log into the system so that s/he can use it.</p> <p>Precondition: Registered users must exist.</p> <p>Post condition: Users logged into the system.</p> <p>Basic course of action 1: Users enter username and password to the system.</p> <p>Basic course of action 2: System determines that the user is privileged.</p> <p>Basic course of action 3: System displays the message form and the use case ends.</p> <p>Alternative course of action 1: Invalid user name or password is entered.</p> <p>Alternative course of action 2: The system determines the user is not privileged.</p>

Table 4: Use case patient register

<p>Name : Register Patient</p> <p>Identifier: Use Case 01</p> <p>Description: This use case describes how to register a new patient for service enrollment in the system.</p> <p>Precondition: Patient is interested in getting a patient card and Registration clerk is interested in registering patient in to the system</p> <p>Post condition: Registration clerk is authenticated and Patient may have referral paper</p> <p>Alternative course of action:</p> <ol style="list-style-type: none">1. Patient arrives with referral paper2. Registration clerk clicks on register Patient menu.3. The system displays the registration Patient form.4. Registration clerk inputs Patient 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 Patient detail.
7. “Success message box” appears on the screen when the data added is correct.
8. The system automatically prints service ID card.

Table 5: Use Case description patient diagnosis and treatment

Name: Diagnosis and Treatment a patient

Identifier: Use Case 06

Description: This use case describes the process of adding a diagnosis, a diagnosis code and treatment for a patient and a patient is interested to get better treatment outcome.

Pre-condition : Physician is Identified and authorized and patient is registered and assigned to specific OPD.

Post Condition

1. The physician records current history of the patient 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 paln
6. The system confirms diagnosis, treatment plan and displays information.
7. Go to use case 8

Alternative course of action patient diagnosis information is recorded.

Table 6: Use case description for patient admission

Name : Admit Patient

Identifier: Use Case 03

Description: This use case describes assigning a Patient in specific ward and bed for inpatient treatment.

Pre-conditions: Patient is enrolled in the service

Post condition

1. Physician sends admission request form to liaison officer

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 Patient

Alternative course of action: if a Patient is in waiting list for admission
 Patient is assigned to specific ward.

Table 7: Use case description for patient discharge

Name : Discharge Patient from the service

Identifier: Use Case 04

Description: This use case describes the process of generating discharge information for admitted patients.

Pre-conditions: Patient admitted to have bed

Post condition:

1. Search for Patient from the system to discharge by patient id card number.
2. Select existing enrollment record from discharge user interface to discharge Patient.
3. Enter discharge date and reason.
4. The system automatically updates enrolment status to “discharged”.

Alternative course of action: 4a. If a Patient is dead

4a1. The system automatically updates enrolment status to “dead”

4b. If a Patient refuses treatment

4b1. The system automatically updates enrolment status to “refused treatment”

4c. If a Patient escape from the department

4c1. The system automatically updates enrolment status to “escaped”

4d. If a Patient is referred to other health facility

4d1. The system automatically update enrolment status to “referred”

Table 9 : Use case Description for appointment

<p>Name : Assign appointment for Patients</p> <p>Identifier: Use Case 05</p> <p>Description : This use case describes the steps how to create, confirm and print daily Patient appointments</p> <p>Pre-conditions: Patient get treatment in the hospital and requires follow up treatment</p> <p>Post condition:</p> <ol style="list-style-type: none">1. Physician opens appointment user interface to complete Patient information.2. Physician assigns an appointment date on appointment interface.3. The system adds an appointment date in Patient's profile.4. The system automatically saves the data, prints and issues an appointment card <p>Alternative course of action:</p>
--

Table 10: Use case description for patient referral

<p>Name : Patient referral</p> <p>Identifier: Use Case 07</p> <p>Description: This use case describes the process of adding Patient referral into the system.</p> <p>Pre-conditions: Patient is enrolled in a program and A referral request has been requested.</p> <p>Post condition:</p> <ol style="list-style-type: none">1. Physician checks patient history from diagnosis user interface2. Physician fills referral form in referral user interface.3. The system validates the enters referral form's data4. Referral paper is issued to the Patient <p>Alternative course of action: Referral information is written to other healthcare facility and Patient gets referral paper.</p>
--

Table 11: Use case description for prescribe treatment

<p>Name : Prescribe treatment</p> <p>Identifier: Use Case 08</p> <p>Description: This use case describes the process of generating prescription treatment form by filling the information needed.</p> <p>Pre-conditions: Physician is authenticated; Patient is enrolled in a program and diagnosed.</p> <p>post condition:</p> <ol style="list-style-type: none">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. <p>Alternative course of action: Patient gets prescription paper.</p>

Table 12: Use case description for generate report

<p>Name : Generate a report</p> <p>Identifier: Use Case 09</p> <p>Description: This use case describes the process of generating different types of reports depending on user need and All kind of data must be registered/ exist in the system to generate a report.</p> <p>Pre-conditions: System users are Identified and authorized and All kind of data must be registered/ exist in the system to generate a report.</p> <p>Post condition:</p> <ol style="list-style-type: none">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. <p>Alternative course of action: 1a. If the data is not available for report, the system shows a</p>

message to users like:

1a1. The required data is not available or incomplete

1a2. The user uses the report out of his/her privilege

4.6. Existing System Architecture

The Ethiopian health organizations systems are now coordinating health care service in their institutions. This coordinating will profoundly improve access to health care and quality of care given to the community (37).

Metu Karl hospital provides a full service to a patient. That includes outpatient and inpatient treatment, FP, ANC, Labor and Delivery services, admission, medical care, surgical care, laboratory service, pharmacy service, medical imaging service, dental care, psychiatry service, TB screening and treatment, ART service for HIV pts, and referral for cases needing further investigation and management.

The hospital is organized in different teams and it includes , OPD, Emergency OPD, Dental Clinic, Ophthalmology Clinic, TB Clinic, Laboratory, ART, Obs and Gyn Wards, NICU, Ped ICU, Adult ICU, Pharmacy, Radiology, Operation Room, Medical Ward, Surgical Wards and triage case team .

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

4.7. The Proposed HIS Framework

A coherent description of hospital information system framework provides understanding, enables communication among stakeholders and guides complex modification processes. To develop the hospital information system framework, the Metu Karl hospital service and activity was investigated in detail. The proposed framework was done based on FEAF Enterprise architectural framework.

4.7.1. Service and activity of Hospital information system

The service and activity describes what the new capability will meet the business goals and strategic objectives and address the customer concerns when implemented. The service provides a first-cut, high level description of the target architectures, covering the business, data, application, and technology domains. The activities are derived from the hospital service and the national health care strategies to align the development of the hospital information system framework.

Table 13: Organization and HIS framework service statement

Title	Business Statement
Regional health bureau : HIS service Statement	“To ensure the provision and implementation of a hospital service that addresses the health wellbeing of all Ethiopians through services that are affordable, accessible, and available and of good quality”.
Mettu Karl hospital service	“To Provide a comprehensive, qualified, standardized, and efficient health treatment and diagnosis service”

Business rules

Defining business rule normally lies outside the scope of the framework function. But, depending on how such rules are defined within the organization it may be possible for the set of architecture rule to restrict or cross-refer to a set of business rules.

Business principle 1

Title: Patient Care Service

Action

The information system will deliver the services to patients and their care givers in accordance with their “needs and choices”.

Description

This rule is coherent with the one established by the regional health bureau and FMOH. The first rule set by the Ministry in providing Service for the customers that will be based on the needs and choices of individuals and their caregivers. The information system architecture shall provide for systems that will allow all health professionals to facilitate the delivery of health services in the time, place, etc selected by the patient and his/her caregivers.

Impact

There are cases for which patients and their caregivers spend their money and time by physically appearing in the hospital.. Through the implementation of information systems that adhere to this rule, the patients can get some services (such as advisory services without paying their money.

Business principle 2

Title: Coordination and integration with other health care service

Action

The information system will bring the support needed by the patient.

Description

This rule is consistent with the health strategy when it says “care will be provided as close to home” and “community level treatment is an integral” to the system.

Impact

The impact of this rule is that the hospital can reach out to many patients throughout the local area.

Business principle 3

Title: Community Participation

Action

The information system will serve the community at large level.

Description

All stakeholders need to participate in the prevention of promotion and rehabilitation of health care problems as well as in the care of patients. Education is a significant component of the information system. It provides the necessary information to educate the community.

Impact

Harnessing the knowledge of all stakeholders will be possible for the collective resolution of health problems.

Business principle 4

Title: Quality Services

Action

The information system will facilitate for the provision of quality service for the whole communities. The medical practitioners as well as other care givers would get complete information on the patient problem.

Description

Quality service based on gathered information and scientific knowledge built in-house to house provision.

Implications

The implication of this rule is better clinical, educational, and administrative services to the stakeholders.

Title: Consistency and Sustainability

Action

The system will further provide for case base treatment of patients continuously and sustainably.

Description

The Ethiopian health strategy document states that efficient, culturally acceptable, and sustainable service shall be one of its guiding rules. In this regard, the information system will partly answer for this business requirement.

Impact

The adoption of this principle will mean many people will be reached throughout the width and breadth of the health service as the system will have localized.

4.7.2. Actors and their role

Actors are individuals, organizations or agencies that could influence or be influenced positively or negatively during the development of the hospital information system architecture framework. The actors involved in the hospital information system and their roles are the following.

Table 14. Name Patient (patient)

Actors	Roles
Patient	Clinical status privacy Confidentiality Treatment procedure Availability of quality service Medication information Safety of laboratory procedure Waiting time Reliability

Table 15. Name: Health Professional

Actors	Roles
Health professionals	<ul style="list-style-type: none"> • better management of patients and • Case based records • Availability of treatment guidelines • Referral routes • Available resources in different services • Outcomes of the result

Table 16. Name: Community participation

Actors	Roles
Community	<ul style="list-style-type: none"> • Appropriate Information for the whole community. • Outcome of family member's condition. • available Information for the community

	<ul style="list-style-type: none"> • Outcomes of the treatment • Cost related to any treatment/ procedures
--	--

Table 17. Name FMOH

Actors	Roles
FMOH	<ul style="list-style-type: none"> • Health service policy and plans • Monthly, quarterly and yearly reports on time • Professional and technical support • Resource available to deliver the service

Table 18. Name Regional Health Bureau

Actors	Roles
Regional Health Bureau	<ul style="list-style-type: none"> • Health service policy and plans implementation • Monthly, quarterly and yearly reports on time • Professional and technical support and supervision • Resource available to deliver the service

Table 19. Name NGO's and partners

Actors	Roles
NGO's and partners	<ul style="list-style-type: none"> • Financial Support • Professional and technical • Report on different perspectives support • Coordination of training programs for the staffs

Table 20. Name other stockholders

Actors	Roles
other stockholders	<ul style="list-style-type: none"> • Patient Statistical data • On time forensic cases report. • Training and teaching

Table 21. Activity

Actors	Roles
Specialist	<ul style="list-style-type: none">• Consultations• Diagnosis• Treatment
General practitioner	<ul style="list-style-type: none">• Diagnosis ,• Treatment
Public Health office	<ul style="list-style-type: none">• Diagnosis,• Treatment
Nurse	<ul style="list-style-type: none">• Patient care
Pharmacist	<ul style="list-style-type: none">• Drug dispensing
Laboratory technician/ technologist	<ul style="list-style-type: none">• Test and investigating clinical lab order
Psychologist	<ul style="list-style-type: none">• Provide consultative
HMIS	<ul style="list-style-type: none">• Daily, Weekly, quarterly and yearly reporting
Human resource	<ul style="list-style-type: none">• Assigning & controlling clinician/ administrative staff,
Finance	<ul style="list-style-type: none">• Control & allocate payment process
General service provider	<ul style="list-style-type: none">• Control, manage , allocate & maintain medical equipment's

4.7.3. Class Diagram

The class diagram represents the static view of the system. It shows entities or classes about which the system maintains information to provide services to end users. For example, one of the services of the system to external users is report. Report is generated by extracting and processing information stored about system entities. Classes were identified by investigating system use case, interview and organizational documents.

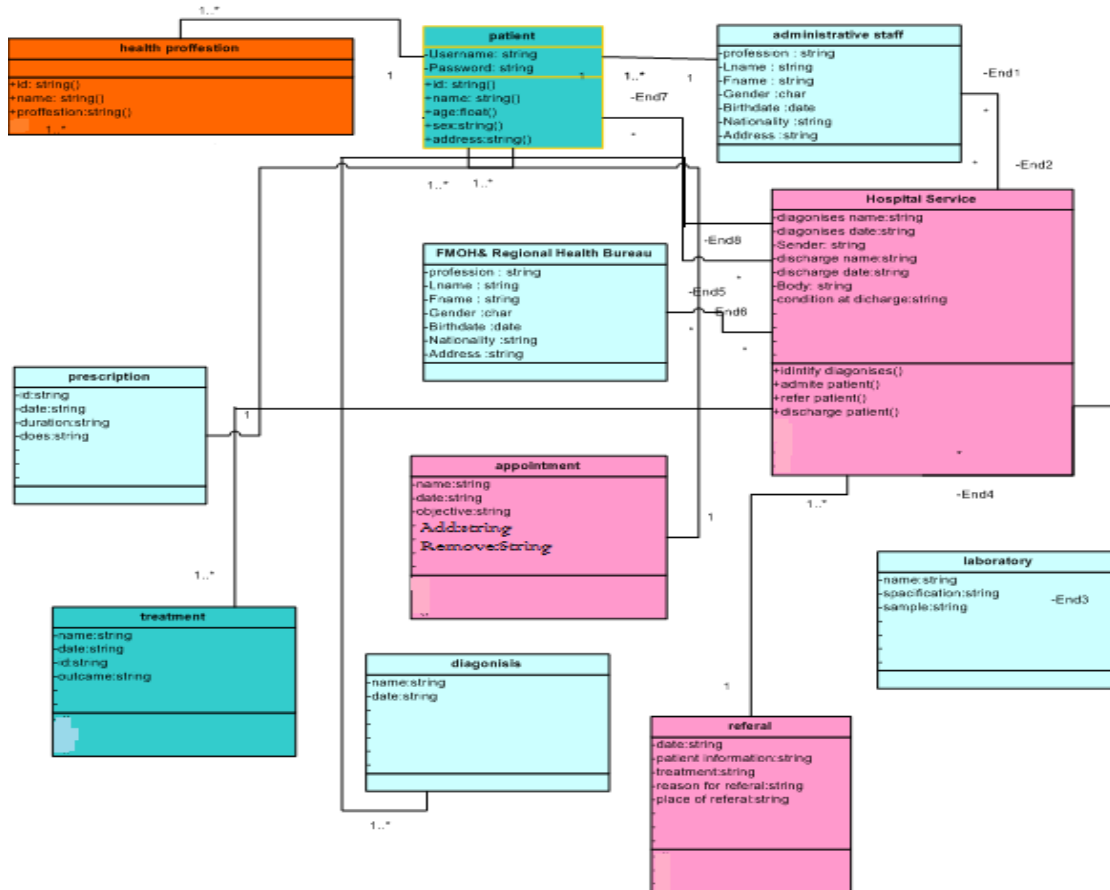


Fig. 7. Class diagram

4.7.4. Sequence diagram

Sequence diagram shows the dynamic view of the system. It provides an object-oriented procedural view that facilitates assignment of responsibility to a class and helps to finding out new methods and new classes. It shows object interactions arranged in time sequence. In particular, it shows the objects participating in an interaction and the sequence of messages exchanged between system objects. In this diagram, actors are users of any type of hospital information system service.

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 service 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.

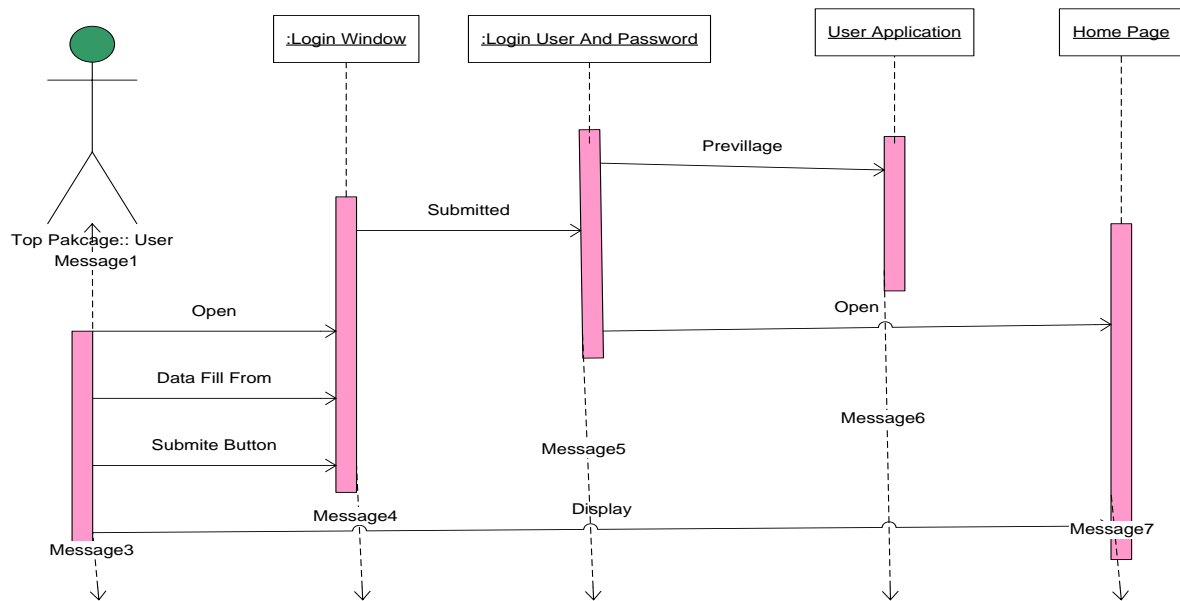


Fig 8. Login Sequence Diagram for hospital information system

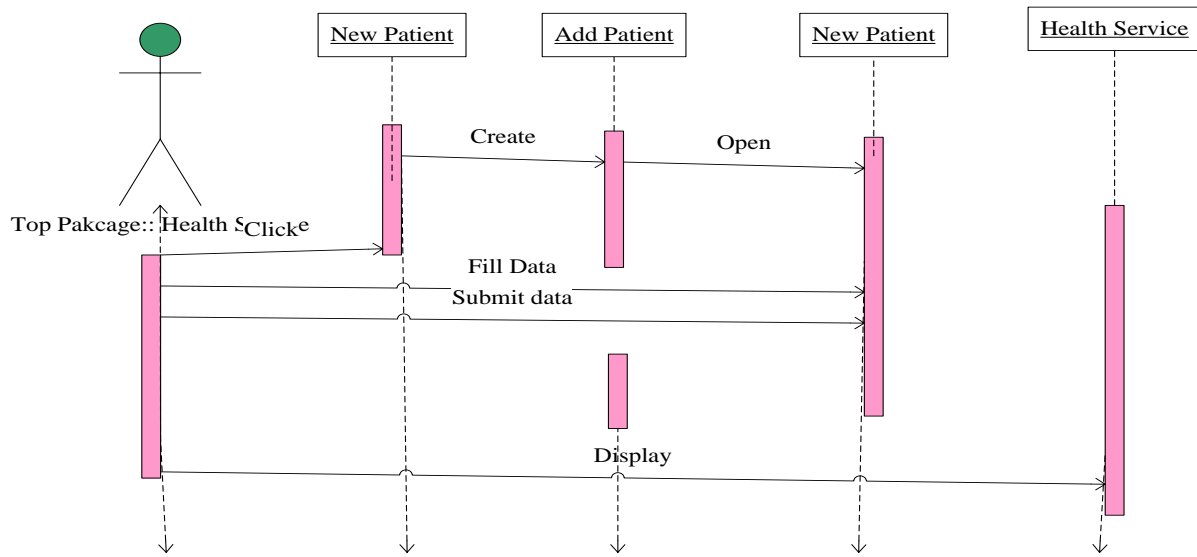


Fig 9. Sequence Diagram for Registration

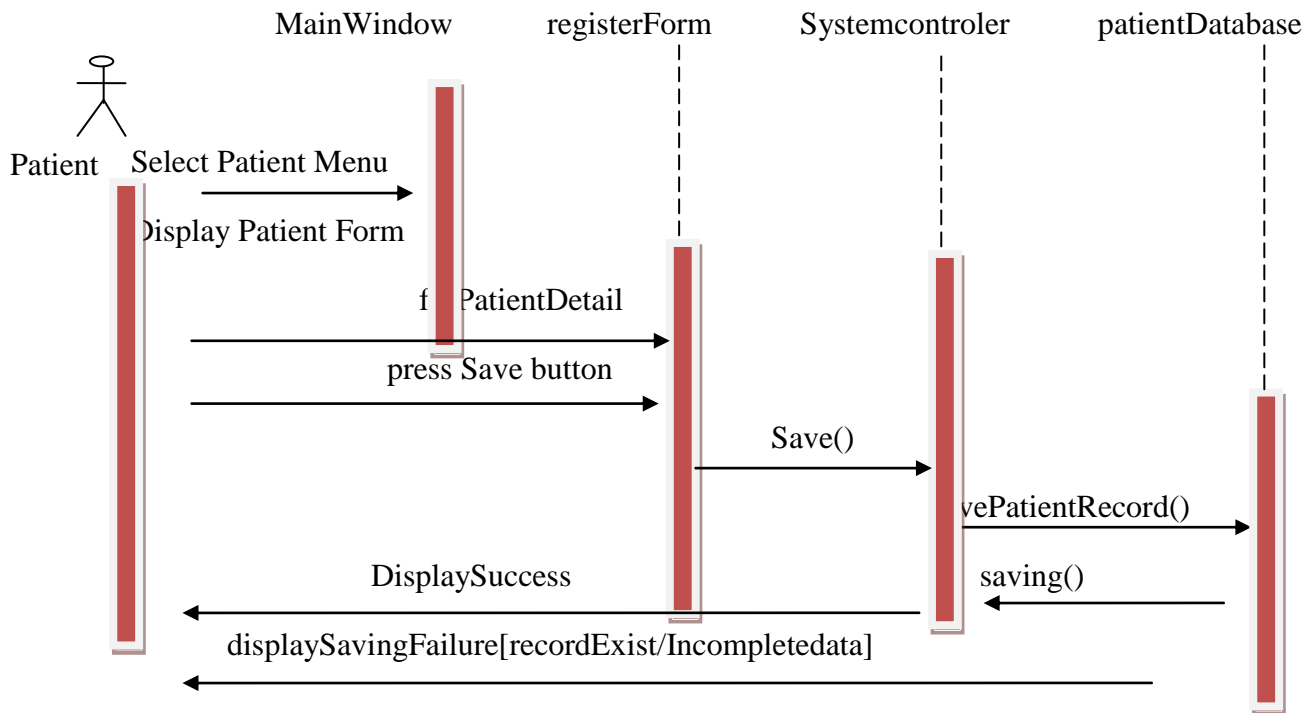


Figure 10: Sequence diagram for patient registration

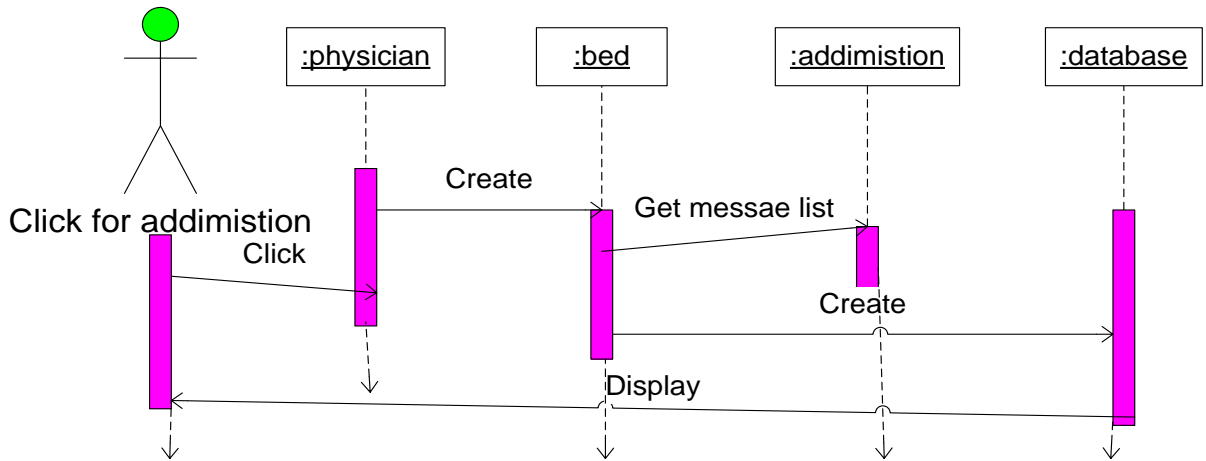


Figure 11: Sequence diagram for patient admission

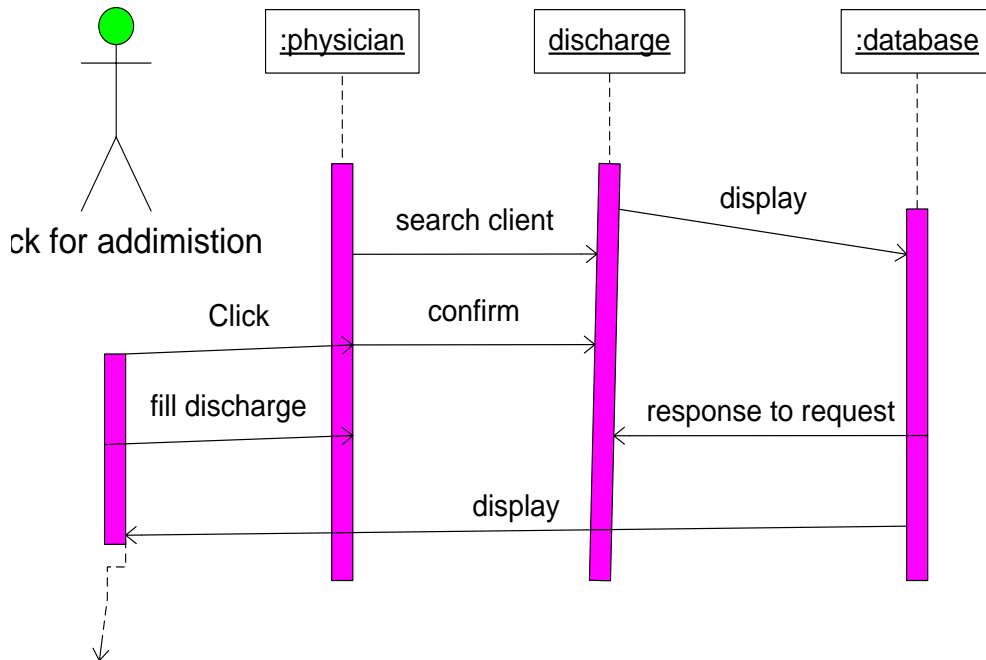


Figure12: Sequence diagram for patient discharge

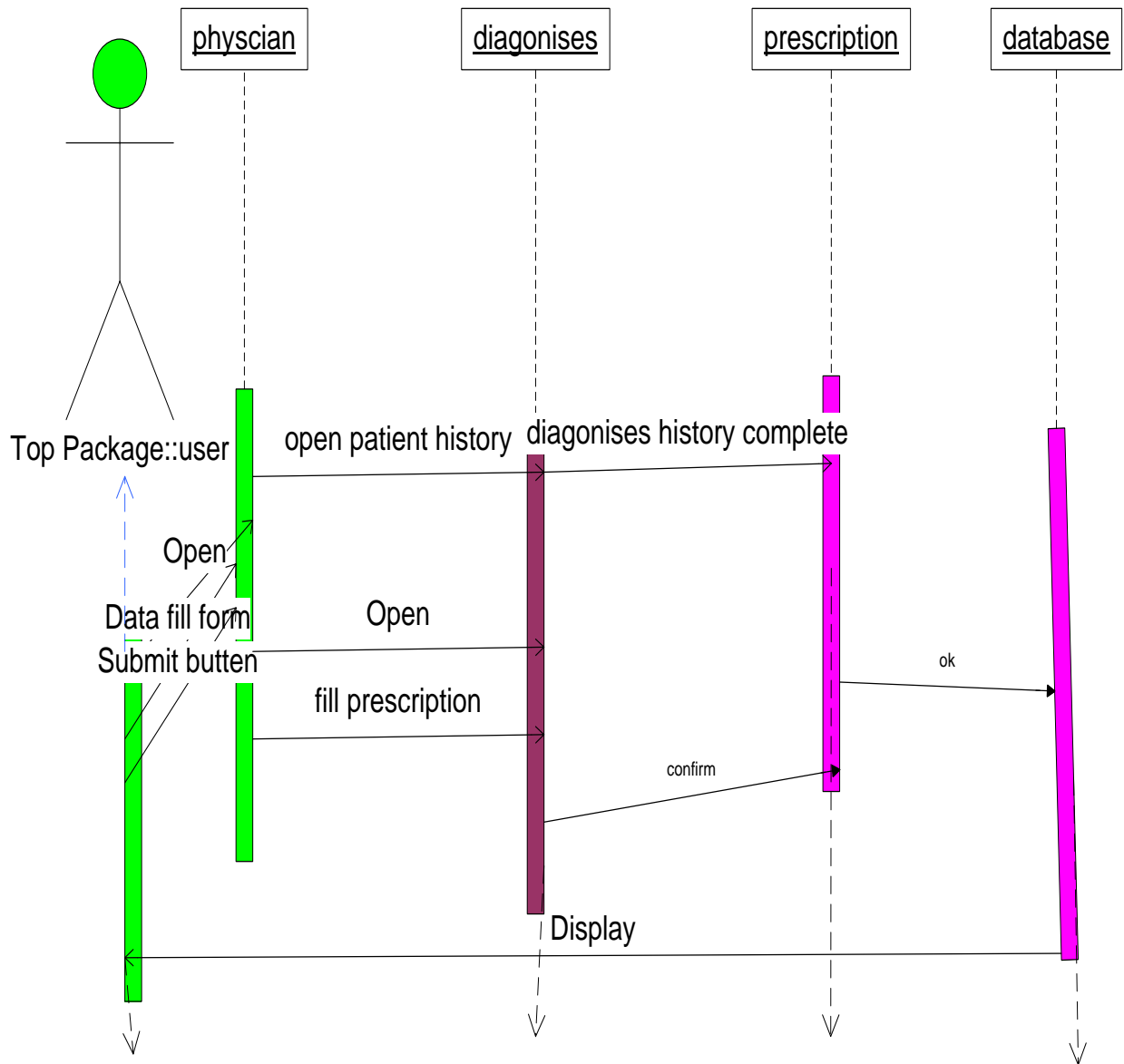


Figure 12: Sequence diagram for patient prescription

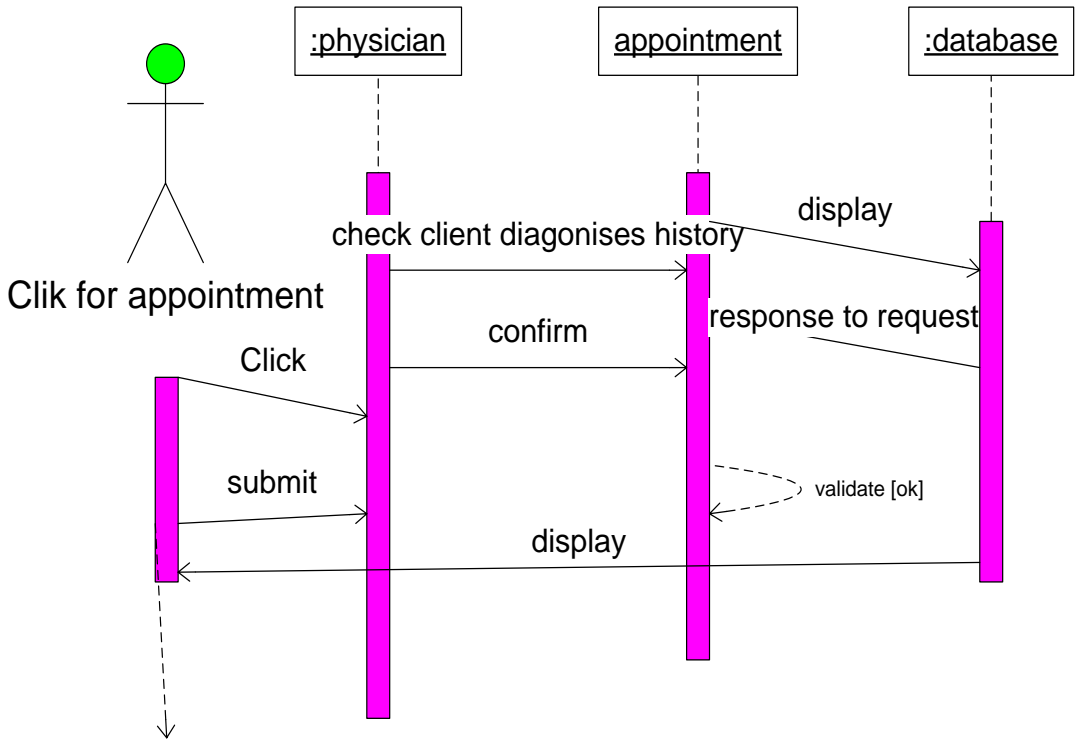


Figure 13: Sequence diagram for patient appointment

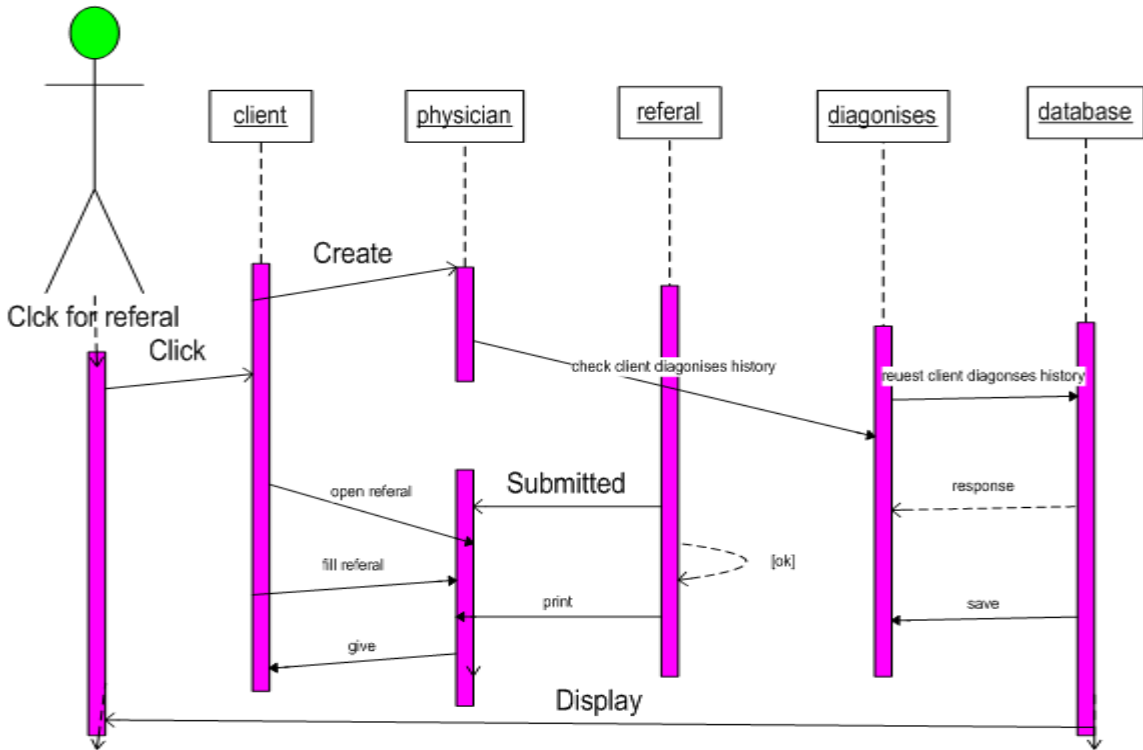


Figure 14: Sequence diagram for patient referral

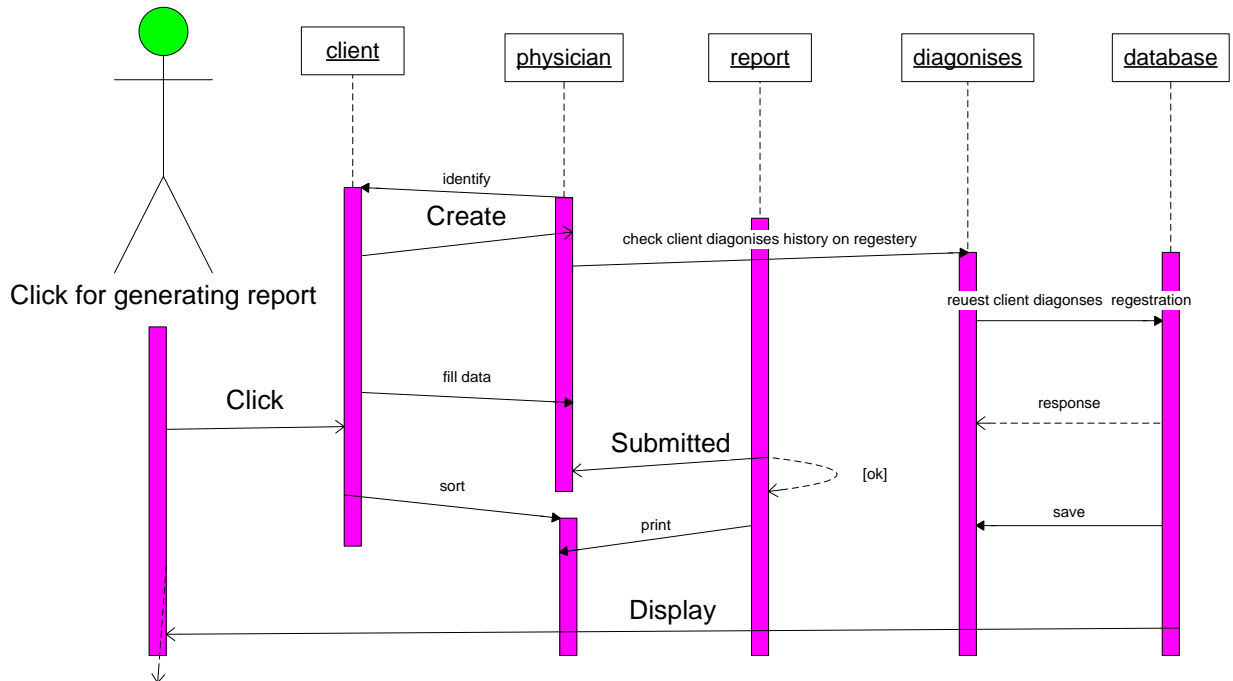


Figure 15: Sequence diagram for patient generating report

4.7.5. Data Base Design

Most functionality in hospital information system deals with data. Hence this section discusses the data that is stored persistently. Persistent data about users themselves required to be stored so that they can be authenticated and let them communicate each other. The database will be implemented using SQL database management system. The database entities and relationships are shown in the following diagram (See Fig. 15).

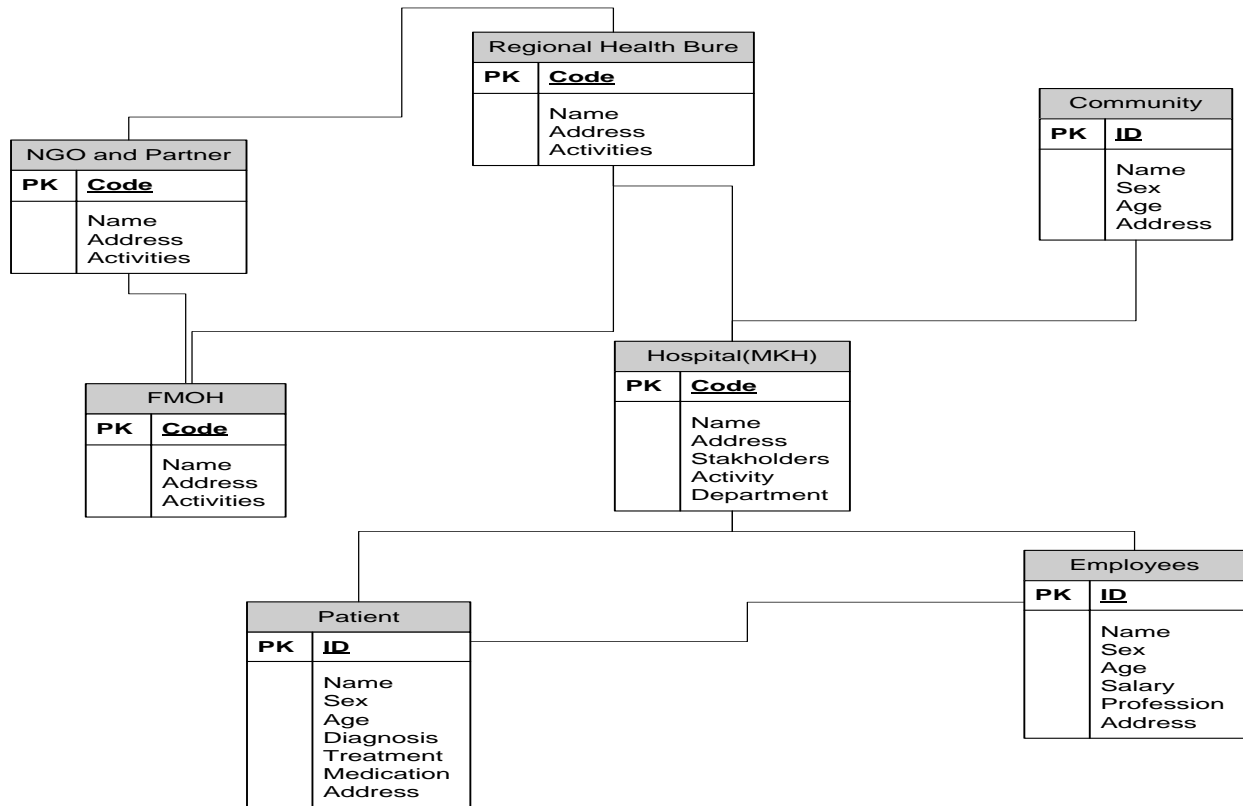


Figure 15. Data Base Design

Patient

Fields	Data type	Width	
Id	Varchar	10	Primary key
Name	Varchar	50	
Age	Number	3	
Sex	Varchar	1	
Diagnosis	Varchar	200	
Address	Varchar	20	
Medication	Varchar	30	

NGO

Fields	Data type	Width	
Code	Varchar	10	Primary key
Name	Varchar	50	
Address	Varchar	20	
Activities	Varchar	30	

FMOH

Fields	Data type	Width	
Code	Varchar	10	Primary key
Name	Varchar	50	
Address	Varchar	20	
Activities	Varchar	30	

Regional HB

Fields	Data type	Width	
Code	Varchar	10	Primary key
Name	Varchar	50	
Address	Varchar	20	
Activities	Varchar	30	

Employee

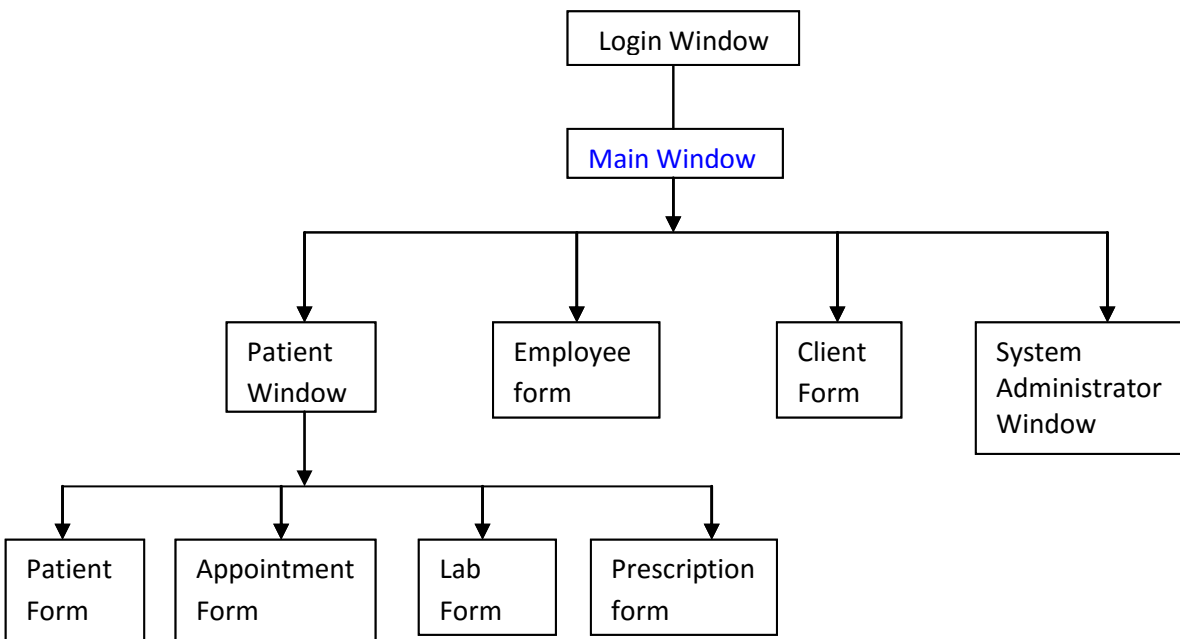
Fields	Data type	Width	
Id	Varchar	10	Primary key
Name	Varchar	50	
Age	Number	3	
Sex	Varchar	1	
Salary	Decimal		
Profession	Varchar	20	
Address	Varchar	30	

Hospital(MKH)

Fields	Data type	Width	
Code	Varchar	10	Primary key
Name	Varchar	50	
Stake Holders	Varchar	50	
Address	Varchar	20	
Department	Varchar	30	

4.7.6. User Interface

The user interface shows the interaction of the system with external entities. Users enter input into and receive output from the system through the user interface. Design of good user interface increases system usability and system success. The user interface design shows the main system functionality.



4.7.7. Prototyping

When the system is started, it displays the login form so that users should authenticate. Unless users are authenticated, they cannot use the system. The login form, which is shown in figure 16, requests users to enter their username and password as well as department.



Figure 16 : Home page of Mettu Karl Hospital information system

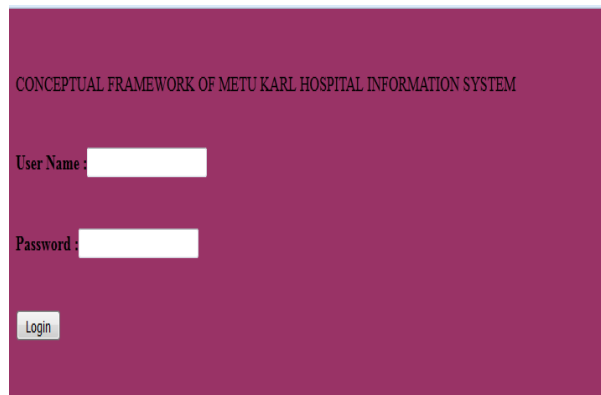


Figure 17: login forms Mettu Karl Hospital information system

The image shows a web form titled "New Patient registration" on a dark red background. The form contains the following fields and buttons:

- MRN**: A single-line text input field.
- Name**: A multi-line text input field.
- Sex**: A single-line text input field.
- Age**: A single-line text input field.
- Diagnosis**: A multi-line text input field.
- Address**: A multi-line text input field.
- SUBMIT**: A rectangular button.
- CLEAR**: A rectangular button.

Figure 18: new patient registration form of Mettu Karl Hospital information system

4.5. System Evaluation (User Acceptance Testing)

Acceptance is defined as the willingness within a user group to employ information technology to the tasks it is designed to support [42]. One of the factors to the user's resistance to change is highly related to the user's acceptance of IT application in their organization [43]. In order to enhance the acceptance level of Electronic Health Records, proper strategies and guidelines by the hospital and the Ministry are needed. A research conducted by S. A. Hussaini found that the acceptance level of THIS system in IT-based hospital in Malaysia is still moderately accepted.

Perceived usefulness is the factor that indicates the degree to which the individual believes that the use of information system would increase his/her job performance. Perceived ease of use is the other factor, which is used to indicate how difficult the person believes that the proposed system would be to use. Perceived ease of use is 'the extent to which a person believes that using the system will be free of effort [44].

User acceptance testing is the final stage of testing before system begins to be implemented by the user. The potential users evaluate the system to reveal the errors and omissions of system requirements that were defined in early stage developing the system. A total of 10 interview questions were given out in Mettu Karl Hospital to evaluate all the functions available in the system. The results of interview questionnaires revealed valuable information that enabled to evaluate the functional and nonfunctional requirements for the system.

The user acceptance evaluation of the proposed system framework revealed that the user interface of the system is good and attractive. And all of the respondents testify that the proposed system framework helps the professionals to quickly retrieve the data.

The result of the interviews also showed that the proposed system helps the professionals to save time to access essential patient information.

As most of the respondents revealed in their interview the system will improve the hospital information management problem.

On the other hand some respondents including HMIS focal person and CEO of the hospital indicated that the system should incorporate some additional features such as registration of new employee, user name and password, address and etc.

Generally the evaluation revealed that the proposed system will have high user acceptance because of its potential to solve the existing information management problems in the hospital.

CHAPTER FIVE

5. Conclusions and Recommendations

5.1. Conclusions

Information is a critical for provision of health services. The main objective of this project is to design hospital information system framework for Mettu Karl Hospital. It helps to provide quality patient care service, improved decision making and better monitoring capability. Hospital information system also introduces standard information management practices in the hospital and consequently improve communications with stakeholders.

For the development of hospital health service information system framework, the researcher assessed different enterprise information system framework and selected one best framework to develop Mettu Karl Hospital information system framework. The researcher used interview, observation and document review data collection methods to identify existing information management problems and new requirements to develop the proposed information system framework.

The major problems identified in the current system are:

- Lack of commonly accepted standard in data storage and exchange among different units of the hospital.
- Duplication of patient data in different units of the hospital
- Different reporting formats
- Poor data quality
- Inadequate knowledge/understanding on health data management
- Access to data and information is time consuming because of the manual system.

This proposed hospital health information system framework will serve as blue print to develop Mettu Karl Hospital information system. It also identified the necessary entities and their relationship that are used as a plan to develop the hospital database. The system was also evaluated by user acceptance evaluation method. The evaluation revealed that the proposed system will have high user acceptance because of its potential to solve the existing information management problems in the hospital.

5.2. Recommendations

- ❖ The Hospital should implement the proposed information system framework to utilize information as a resource to improve the hospital service to its patients.
- ❖ Patient care and quality should be maintained by providing available, accessible, and consistent patient information.
- ❖ The FMOH should support hospitals to develop their capacities to manage their internal information resources and develop the overall national health information system.
- ❖ The proposed hospital information system framework will provide an opportunity to share/ exchange standardized patient information between different hospitals.
- ❖ Facilitates integration and reuse of new systems that will be designed to support hospital service.
- ❖ Current data quality should be improved.
- ❖ Support decision making functions of the hospital by using the available information.

This research projects proposed the hospital information system framework for Mettu Karl Hospital. Other researchers can implement the proposed information system for other hospital and evaluate the validity and usefulness of the proposed information system framework.

References

1. Julia Adler. Milstein and D. W. Bates. 2010. Paperless healthcare: Progress and challenges of an IT-enabled healthcare system. *Business Horizons*. Vol.53. No.2.
2. Heeks, R. 2005. 'Health information systems- past, present, future'. *International Journal of Medical Informatics*,
3. Paul K. 2011, Determinants of Use of Health Information in Nathenje Health Area of Lilongwe District. A Dissertation for the Requirements of the Master of Public Health Degree.
4. WHO, CSA, HMNOct, 2007, Assessment of the Ethiopian National Health Information System, Final report by Federal Ministry of Health in Collaboration with CSA, WHO and HMN, Adama.
5. Elizabeth B, Kari A, Laura A. R, Emily J. C, Josh P, Rex W, Yigeremu A. 2008, Hospital Quality Improvement in Ethiopia: A partnership– Mentoring Model. *International Journal for Quality in Health Care*; Volume 20, p 392– 399.
6. Hilina D., 2014 developing an Enterprise Framework for Mental Health Information System in Addis Ababa, master's thesis, Addis Ababa University.
7. Meseret A. 2009, Assessment of Health Management Information System at public hospital in Addis Ababa, Master thesis, Addis Ababa University.
8. Winter, A., Brigl, B. and Wendt, T. 2003. 'Modeling hospital information systems (part 1): the revised three-layer graph-based meta model 3LGM2'. *Methods of Information in Medicine*, pp.544-551.
9. Heeks, R. 2005b. 'Health information systems: failure, success and improvisation'. *International Journal of Medical Informatics*, [In press].
10. Jaspers, M.W.M., Ammenwerth, E., Ter Burg, W.J.P.P., Kaiser, F. And Haux, R. 2004. 'An international course on strategic information management for medical informatics students: International perspectives and evaluation'. *International Journal of Medical Informatics*, pp.807-815.
11. Pereira CM, Sousa P, editors. A method to define an Enterprise Architecture using the Zachman Framework. *Proceedings of the 2004 ACM symposium on Applied computing*; 2004: ACM
12. Gona R, Smith E. Enterprise Transformation through Aspects and Levels: Zachman Bayesian Approach. *Procedia Computer Science*. 2011; 6:82-7
13. Kalogeropoulos, D.A., Carson, E.R. and Collinson P.O. 2003. 'Towards knowledge-based systems in clinical practice: Development of an integrated clinical information and knowledge management support system'. *Computer Methods and Programs in Biomedicine*, pp.65-80.)
14. Lee, T. 2004. 'Evaluation of computerized nursing care plan: Instrument development'. *Journal of Professional Nursing*, pp.230-238.

15. Wyatt, J.C. And Wyatt, S.M. 2003. 'When and how to evaluate health information systems'. *International Journal of Medical Informatics*, 69(2-3), pp.251-259.)
16. Staccini, P., Joubert, M., Quaranta, J. And Fieschi, M. 2005. Mapping care processes within a hospital: from theory to a web-based proposal merging enterprise modeling and ISO normative principles. *International Journal of Medical Informatics*, pp.335-344.
17. Wu, J. And Wang, Y. 2005. 'Measuring ERP success: The key-users' viewpoint of the ERP to produce a viable IS in the organization'. *Computers in Human Behavior*,
18. Brigl, B., Ammenwerth, E., Dujat, C., Gräber, S., Große, A., Häber, A., Jostes, C. and Winter, A. 2005. 'Preparing strategic information management plans for hospitals: a practical guideline SIM plans for hospitals: a guideline'. *International Journal of Medical Informatics*, pp.51-65.
19. Chang, Z., Mei, S., Gu, Z., Gu, J., Xia, L., Liang, S. And Lin, J. 2003. 'Realization of integration and working procedure on digital hospital information system'. *Computer Standards & Interfaces*, pp.529-537
20. Ciccicarese, P., Caffi, E., Quaglini, S. And Stefanelli, M. 2005. 'Architectures and tools for innovative health information systems: the guide project', *International Journal of Medical Informatics*, pp.553-562
21. Maybloom, B. And Champion, Z. 2003. 'Development and implementation of a multicentre information system for pediatric and infant critical care'. *Intensive and Critical Care Nursing*, pp.326-341.
22. Mike P, John F. Enterprise Architecture (EA) and the Health Metrics Network (HMN) Framework: A Federated Approach for Interoperability. Centers for Disease Control and Prevention Atlanta, Georgia.
23. Yu E, Strohmaier M, Deng X, editors. Exploring intentional modeling and analysis for enterprise architecture. Enterprise Distributed Object Computing Conference Workshops, 2006 EDOCW'06 10th IEEE International; 2006: IEEE.
24. Stansfield S, Orobato N, Lubinski D, Uggowitz S, Mwanyika H. The Case for a National Health Information System Architecture; a Missing Link to Guiding National Development and Implementation. Making the eHealth Connection, Bellagio. 2008.
25. Johnson, K.B., Ravich, W.J. and Cowan J.A. 2004. 'Brainstorming about next-generation computer-based documentation: an AMIA clinical working group survey'. *International Journal of Medical Informatics*, pp.665-674.
26. Feied, CF., Handler, JA., Smith, MS., Gillam, M., Kanhouwa, M., Rothenhaus, MS., Conover, K. And Shannon, T. 2004. 'Clinical information systems: instant ubiquitous clinical data for error reduction and improved clinical outcomes'. *Academic Emergency Medicine*, pp.1161-1169.
27. Version T. 9, The Open Group Architecture Framework (TOGAF). The Open Group. 2009.
28. Katehakis, D.G., Kostomanolakis, S., Tsiknakis, M. and Orphanoudakis, S.C. 2001. 'An open, component-based information infrastructure to support integrated regional healthcare networks'. *Medinfo*, pp.18-22
29. Schekkerman J. How to survive in the jungle of enterprise architecture frameworks: Creating or choosing an enterprise architecture framework: Trafford Publishing; 2004.

30. A practical guide to federal enterprise architecture. United states of America: 2001
31. Takeda, H., Matsumura, Y., Kuwata, S., Nakano, H., Sakamoto, N. and Yamamoto, R. 2000. 'Architecture for networked electronic patient record systems'. *International Journal of Medical Informatics*, pp.161-167
32. Bose, R. 2003. 'Knowledge management-enabled health care management systems: capabilities, infrastructure, and decision-support'. *Expert Systems with Applications*, pp.59-71.
33. Van Merode, GG, Groothuis, S. And Hasman, A. 2004. 'Enterprise resource planning for hospitals', *International Journal of Medical Informatics*, pp.493-501
34. Guptill, J. 2005. 'Knowledge management in health care'. *Journal of Health Care Finance*, pp.10-14.
35. Lu, Y., Xiao, Y., Sears, A. and Jacko, J. 2005. 'A review and a framework of handheld computer adoption in healthcare'. *International Journal of Medical Informatics*, pp. 409-422.
36. Taylor, PP. 2005. 'Use of handheld devices in critical care'. *Critical Care Nursing Clinics of NRuland, CM*. 2004. 'Improving patient safety through informatics tools for shared decision making and risk communication'. *International Journal of Medical Informatics*, 73(7-8), pp.551-557.North America, pp. 45-50.
37. A practical guide to federal enterprise architecture. United states of America: 2001
38. Anderson, JG. 2004. Information technology for detecting medication errors and adverse drug events. *Expert Opinion on Drug Safety*, pp.449-455.
39. <http://www.opengroup.org/archimate>
40. A comparison visio standard and visio professional Microsoft , 2016
41. Laurie Williams, 2004. "An introduction to the Unified Modeling Language.
42. Rothschild, J. 2004. 'Computerized physician order entry in the critical care and general inpatient setting: a narrative review. *Journal of Critical Care*, pp. 271-278.
43. S. A. Hussaini, "Selayang Hospital First in Total Hospital Information System," 2002.
44. H. Mohd and S. M. Syed Mohamed, "Technical Report on The Acceptance for EMR Systems in THIS," 2005.
45. V. Venkatesh, M. Morris, G. Davis, and F. Davis, "Users acceptance of Information Technology: Toward a unified view," *MIS Quarterly*, vol. 27, no. 3, pp. 425-478, 2003.
46. Kaushal, R., Shojania, K.G. And Bates, D.W. 2003. 'Effects of computerized physician order entry and clinical decision support systems on medication safety: A systematic review'. *Archives of Internal Medicine*, 163, pp. 1409-1416.
47. Kuperman, G.J. and Gibson, R.F. 2003. 'Computer physician order entry: benefits, costs, and issues'. *Annals of Internal Medicine*, 139, pp. 31-39.
48. Blobel, B. And Holena, M. 1998. 'CORBA security services for health information systems', *International Journal of Medical Informatics*, 52, pp.29-37.
49. Monteiro, E. 2003), 'integrating health information systems: a critical appraisal'. *Methods of Information in Medicine*, pp.428-432.

50. Anonymous, Best Practices in SCRUM Project Management and XP Agile Software Development, accessed 2/15/06 from <http://www.controlchaos.com/download/Primavera%20White%20Paper.pdf>
51. Firat Kart, Gengxin Miao, L. E. Moser, P. M. Melliar-Smith, A Distributed e-Healthcare System Based on the Service Oriented Architecture, IEEE International Conference on Services Computing, 2007.
52. J. C. Lin, "Applying Telecommunication Technology to Health- Care Delivery: The Current Status and Challenges of Telemedicine", IEEE Engineering in Medicine and Biology, July/August, 1999.
53. Federal Enterprise Architecture Framework, Version 1, September 1999. www.itpolicy.gsa.gov/mke/archplus/fedarch1.pdf
54. Federal Chief Information Officer (CIO) Council, Federal Enterprise Architecture Framework (FEAF). Version 1.1, September 1999.
55. Boar, B. H. Constructing Blueprints for Enterprise IT Architectures. Wiley Computer Press. New York, NY, 1999.
56. C. Larman. Agile and Iterative Development: A Manager's Guide. Addison-Wesley, Reading, MA, 2003.
57. Cook, M. A., Building Enterprise Information Architectures: Reengineering Information Systems.
58. National Institute of Science and Technology (NIST) Federal Information Processing Standard
59. NIST Special Publication 800-12: An Introduction to Computer Security: The NIST Handbook.
60. NIST Special Publication 800-37: Guide for Applying the Risk Management Framework to Federal Information Systems.
61. NIST Special Publication 800-53: Recommended Security Controls for Federal Information Systems and Organizations.
62. OMB Memorandum M-06-02: Improving Public Access to and Dissemination of Government Information and Using the Federal Enterprise Architecture Data Reference Model, December 2005.
63. Prentice Hall. Upper Saddle River, NJ, 1996. Department of the Treasury, Treasury Information Systems Architecture Framework (TISAF), Office of the Deputy Assistant Secretary for Information Systems and Chief Information Officer, 3 January 1997.
64. Publication 199: Standards for Security Categorization of Federal Information and Information Systems.
65. R. Battin, R. Crocker, J. Kreidler, and K. Subramanian. Leveraging resources in global software development. IEEE Software, pages 70–77, March/April 2001.
66. Sowa, J. F., & J. A. Zachman, Extending and Formalizing the Framework for Information Systems Architecture. IBM Publication G321-5488. IBM Journal, Vol. 31(3). 1992.

67. Waman S Jawadekar, Software Engineering: Principles and Practice, Tata McGraw-Hill, New Delhi, 2004.
68. Zachman, J. A. A Framework for Information Systems Architecture. IBM Systems Journal. Vol. 26(3). 1987.
69. Zachman, J. A. The Framework for Enterprise Architecture: Background, Description and Utility. 1996.
70. Chiotaki Nikomacheia, 2005, Evaluation of Hospital Information Systems, MSc Thesis Submitted in partial fulfillment of the degree of Master of Science, University of Greenwich,
71. A. Dillon and M. Morris, "User acceptance of information technology: Theories and models," Annual Review of Information Science and Technology, vol. 31, (Medford, NJ: Information Today), 1996.

Annex 1

ADDIS ABABA UNIVERSITY

SCHOOL OF INFORMATION SCIENCE AND SCHOOL OF PUBLIC HEALTH

MASTERS OF SCIENCE IN HEALTH INFORMATICS PROGRAMME

Formal interview for designing a conceptual framework of hospital information system at Mettu Karl Hospital, Oromia Regional State, Ilu Ababor zone south west Ethiopia.

Subject: - Information sheet

The objective of the Project is to design a conceptuel Framework of Hospital information system for solving patient related problem. This health facility is chosen to participate in the study. In each facility, all individuals who are Works were needs providing Health activities (Health professionals) are selected. And you are selected just because of your position. The study is conducted for the partial fulfillment of Master program in Health Informatics; it is believed to contribute much for the understanding of the current patient treatment pattern and to identify the factors contributing to the existing situations. This in turn is hoped to give insight as how to improve patient related problem. You will be asked for the interview that will help in investigating the issues. Your co operation is very helpful. Your name will not be mention on the interview and all the information you will provide will be kept confidential and strict. You will be facing no harm by participating and you are also not obliged to answer any question you don't wish to answer. To provide an interview 25-30 minutes will be required. If you wish to comment feel free to use the contact address.

Consent Form: Considering the information you get from the general information sheet, we would be thankful if you spend some time with us solving questions related to the issues. Are you comfortable to participate in this study?

- If yes, continue to next page

Contact address

Name: Buzuneh Buli

Tel: 0911 E-mail: bizunehbuli@gmail.com

A. Part one: Background Information

1. Address: Town _____ Keble _____ H. No _____
2. Position of the respondent in the Hospital
Manager Health professional officers
If others specify _____
3. Year of service
Less than 1 year between 1 and 5 years between 5 to 10 years
10 and more than 10 years
4. Qualification
BSC nurses Diploma nurses Health officers Medical Doctors
Others degree diploma and certificate _____

B. Part Two: General Interview Guide Line

1. Have you a strategic plan for hospital information system design?
A. Yes B. No
2. Is Hospital has an Opinions to design possible enterprise architecture frame work?
A. Yes B. No
3. What can benefit from this system application?
 - A. It provides Quality Improvement and patient Management.
 - B. Improving Clinical Processes and Data can be kept up-to-date.
 - C. easy communication of patient data between different healthcare professionals (GPs, specialists, care team, pharmacy)
 - D. collaborate and share information on patients through digital equipment (Virtual healthcare teams)
 - E. Core Data function-based systems that support the key processes
 - F. all
4. How hospital information system is implemented at Metu Karl hospital?
5. How hospital information system data was collected from different departments?
6. Is there any problem regarding to hospital health data collection, analysis and process?
7. Is there any limitations regarding to reporting formats?

Thank you for your devoting during the interview!

Observation Checklist

Department/Room/ Case Team _____

Format/sheet/registers used _____

Skill/Competence/experience/of the staff (by observing filled formats tally sheets, and Registers, their legibility and Completeness of data

Room

Status _____

No of staff in HMIS

unit _____

Availability IT / Communication equipment (pc computer, Printer, telephone internet, Network, etc) _____

Availability HMIS office _____

Backup system _____

Software used for data capturing, Reporting _____

Interview Questions (User Acceptance Evaluation Checklist)

- 1.How do you see the user interface?
- 2.Does the system help you to quickly retrieve the data?
- 3.Does it help you to save time to access information?
- 4.Do you think that the system will improve the hospital information management problem?
- 5.What additional features do you want to be included?

Declaration

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

Signature

Date

The Project has been submitted for examination with my approval as university advisor.

Name and Signature of Advisors

Name	Signature	Date
1. Dr Ababi Zergaw	_____	_____
2. Dr. Temtim Asefa	_____	_____