



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

**Design and Development of a Web-Based Liaison Services System
for Yekatit 12 Hospital Medical College**

By

ATKILT MICHAEL

**A Research Project 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**

June, 2017

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M.SC IN HEALTH INFORMATICS

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Approved by
Addis Ababa University

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Dedication

This work is dedicated to my beloved mother Kidan Geday.

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Sincere appreciation to my project advisors Dr. Wondewosen Mulugeta and Professor Jemale Hiadar for their time, intellectual input, constructive criticism and suggestions offered while undertaking the project. Their Guidance and intellectual advices were my inspirations, without their help it would have been impossible to finish the whole project and I really want to thank you.

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Above all I would like to thank God for leading me all the way, as my light, my lead and my provider without him, I would never make it.

ABSTRACT

Background:- Web-based liaison service System presents a multi potential benefits for health system especially for those in developing countries. The system will replace paper based liaison service system that have limitation on referral papers which were not complete, unreadable and difficult to understand a referral case where the patient referred. But also it improves poor paper based referral feedback mechanism system and its arrival on time. In addition to this the new system can strength bed and ambulance management system as well as able to control a large number of patient requests for service which was in capability to handle.

Objective:- This project aimed to develop a Web-based liaison service System for Yekatit 12 hospital medical college.

Methods: - In developing the liaison service system, we have used Object Oriented Systems Analysis and Design methodology. UML tools were used for analysis, design phases and programming tool like CSS and PHP were embedded with HTML and MySQL database language. Integration of development modules and testing was implemented to bring the functionality of system and also used prototype and usability tests method.

Result: - The newly web-based liaison service System for Yekatit 12 Medical College was developed so that end users of the system could manage and transfer patient referral data, bed and ambulance management on online. But also two way communication between the health institutions and hospitals would be easily possible. Using standard liaison service have their own benefits in the way to decrease the time needed admit the patient. But also made possible the redirection of patient to alternative facility based on the information provided in advance to service delivery. Report generating mechanism become an integral part of the system has a function of generating report based on the information need of the user. This makes the retrieval of the information from the database easy, customized and appropriate.

Conclusion: - Web based liaison service empower hospitals to take more responsibility for their people health and quality of life, and they lead to better cost-efficiency in the health sector. The use of the system allows a mutually beneficial collaboration and involvement of patients and medical professionals in the prevention and treatment of diseases. Overall, the system can be used to ensure the top-quality health care of citizens.

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LIST OF ACRONYMS

EHR – Electronic Health Record
EMR – Electronic Medical Record
E-Referral – Electronic Referral
FMOH -Federal Ministry of Health
HMIS- Health Management Information System
IP –Internet Protocol
IT – Information Technology
KPI- Key performance indicators
MySQL – My Structured Query Language
NGO – Non Governmental Organization
OO – Object Oriented
OOA – Object Oriented Analysis
OOD – Object Oriented Design
OOA/D – Object Oriented Analysis and Design
OOP – Object Oriented Programming
OOSD – Object Oriented System Development
PHP- Hypertext Processer
SDLC- System Development Life Cycle
SQL – Structured Query Language
SSL – Secure Shield Line
UC – Use Case
UI – User Interface
UML – Unified Modeling Language
USA – United State of America
WWW - World Wide Web

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CHAPTER ONE

1. INTRODUCTION

1.1 Background

The Ethiopian public health care system is structured around the concept of a “health network model” that uses a three-tiered health care delivery level which are primary, secondary and tertiary(1). To insure the harmonization of this health network, a functional and well-coordinated referral system has to be practiced. Such coordination is very important in order to assist in making cost-effective use of hospital’s service delivery with primary health care(2). For proper implementation of referral, bed and ambulance management systems, readiness of all level of health institutions, reorganizing and implementing on efficient use of hospital beds as well as insuring high turnover of beds to facilitate accommodating of both emergency and elective patients service delivery(3).

Liaison service is needed for health care effective communication, sustainable and smooth flow of patients that need to be activated by liaison officers by providing special training. According to the Ethiopian Ministry of Health a referral manual for liaison officer’s liaison means communication between two or more groups, or co-operation or working together and a Liaison officer means a person who helps organizations or groups to work together and provide information to each other. Liaison Officer is thus a person that runs the liaison services and serve as a bridge between two or more organizations and the public to communicate and coordinate their activities.

After receiving the patient, liaison officer in turn will communicate with the relevant case team within the facility and secure plan for the continuity of care service and bed availability. If decision is made to accept the patient, the liaison officer will provide feedback to the health facility. The liaison and referral service should be available for 24 hours a day, 7 days a week(4). Based on the capacity or patient load of the facility, a hospital can set the number of liaison officers.

Establishing and maintaining an effective referral system, improve the beds utilization and institute proper discharge and admission criteria, a liaison office service is instrumental thus incorporated in the Ethiopian health service concept.

Federal Ministry of Health has prioritized the provision of quality emergency and critical care medicine in the national health care system. To this end, the procurement and distribution of ambulances, other emergency and critical care equipment, that are launched by Addis Ababa emergency team coordinators such as: publication of the national ambulance guideline and

development of referral manual. Through strengthening emergency medical services, it is expected to reduce morbidity and mortality rate(5).

Facility liaison service and the various roles and responsibilities of a liaison officer mainly update the elective admission waiting list, assign an admission date to patients based on the urgency of the clinical need as date indicated by the physician in the patient notes, secure a bed for the patient, maintain good communications with inpatient case teams and the wards, ensure that the patient received proper directions to the ward, in collaboration with ward staff play a leading role for discharges, ensure regular bed census study is carried out and reported. This used to update and manage the bed utilization. But also coordinate the overall referral activities.

Web-based applications provide the power of desktop and server applications with the flexibility and accessibility of the web. Using web browsers, users can securely access applications from anywhere to access the organization through intranet or extranet. The particular issue strives to explore the advanced web-based information systems and database applications in healthcare. So a web based system to support liaison officer are undergoing major reorganizations and adjustments to meet the increasing demands of improving healthcare access and quality, as well as lowering costs.

As the use of Information Technology (IT) to process medical data increases, much of the critical and necessary information to meet these challenges is being stored in digital format. Therefore Web-enabled information technologies can provide the means for greater access and more effective integration of healthcare information system from disparate computer applications and other information resources(6).

1.2. Statement of the Problem

The main provider of public health services in the country is the Federal Ministry of Health of Ethiopia. FMOH has established effective networked health care system as one of its main objectives to improve the quality and the efficiency of health care services delivery. The ministry being sensible for the need of guidance in establishing referral networks and, liaison service. it had released the National Guideline for Implementation of a Patient Referral System in May 2010 which was followed by the development and realization of Health Facility Directory (1).

So this guideline mainly targets by the role of liaison officers, health services providers, facility managers and other stakeholders who need fast communication to improve liaison services in particularly and referral network in general.

WHO Expert Committee on the Role of Hospitals at the First Referral Level identified the key problems within the referral system are over- loading of hospitals with inappropriate self- referrals, poorly-judged referrals, barriers of distance, transport, payment, lack of confidence in health care at the health post/center levels, leading to by-passing of those levels and inadequate flow of information to and from the hospital (11). Although the analysis of referral information use is a common practice in the rest of the world, in Ethiopia it is hardly possible to find studies conducted on referral information use, the communication gaps occurred between the sending and receiving organizations and completeness and legibility of the referral letters at any health facility level even though the country is revising and improving the referral system.

Electronic information systems maintain quality, speed and accurateness of the data, and also it make the potential of the report more flexible and efficient. On the contrary, in paper-based systems the data is collected and compiled manually at each site where the data is collected, a process that hinders managers and decision makers at higher levels of the hierarchy to view the disaggregated data coming from lower levels of the system. Besides this, accessibility of data in the paper based system is time consuming, potentially unreliable and inefficient when the number of records becomes very large(7).

According to Eyerusalem The referral information system in Addis Ababa was manly paper based, static that was the fixed catchment area based and do not consider the timely situations like physician's availability, bed availability and service availability, moreover it was inconsistence and time taking.

Based on the observation at Yekatit 12 Hospital Medical College liaison service system, it shows that 16 health centers, hospitals and private institution have network with the hospital. through observation on operational time shows that, on average 10 of the referral forms sent to the hospitals were not complete and 4 additional was unreadable, almost 8 out of 10 feedbacks was not send to the referred health institutions and out of 10, 6 patients have compline about bed managements But since the referral forms to the hospital from other institution were not complete and unreadable which cause difficulties to understand the referral case. In addition to this, a large number of patient requests service referred may not be handled by the hospital. Even there is no enough communication between hospitals and health centers to solve information gaps appeared during the process.

Generally the following are the main gaps observed at Yekatit 12 Hospital Medical College liaison and referral system:-

- Hospital beds management, admission and discharge is not well integrated with health centers and other health institution. And also it is done through desktop Microsoft applications.
- Paper-based hospital bed management, admission and discharge is usually incomplete and time taking to access and process.
- Beds management and patient's allocation based on the catchments areas defined but there is no mechanism plan that redirect patient to alternative health facility when varied number of patient referred in from different hospitals that brings load in the hospital.
- Poor paper based referral feedback mechanisms that was with missing and incomplete information. Therefore, having a Web-based liaison and referral service system to maintain an effective liaison network with pertinent institutions and public to achieve the best utilizations of resource is important, manage the hospital beds and transport appropriately, manage appointments, admission and discharges. The system will also help to disseminate information and monitoring feedback to ensure continuous improvement, increase awareness creation, proper use of the service and perform emergency liaison duties during mass casualties such as, flooding, fire, industrial accidents(8).

In addition to this, this system may be used to introduce a well-organized patient data management, timely sharing referral data, flexibility of patient allocation and fast communication among healthcare service providers.

1.3. Objective

1.3.1. General objective

The general objective of this project is to design and development a web based liaison service system prototype for Yekatit 12 Hospital Medical College.

1.3.2. Specific objectives

To achieve the general objective, the following specific objectives are set.

- ❖ To assess the existing liaison service system requirements;
- ❖ To design a web based system to support liaison system;
- ❖ To develop system prototype;
- ❖ To evaluate the prototype;

1.4 Scope and Limitation

This study is limited to design and developed prototype liaison services system for Yekatit 12 Hospital Medical College hospitals because of time constraint. The main focus of the study is to design and develop a system which can handle and transfer patient medication data of referral service unit starting from the time where the patient is referred from health institution to the patient get diagnosis at hospitals including bed and ambulance service management.

1.5. Significance

A good web based liaison service and referral system increases the efficiency of the health system by maximizing the appropriate use of health care facilities. It strengthen the peripheral health facilities and improves the decision-making capacity of professionals at the lower level of the referral network. It also creates opportunities for balanced distribution of funds, services and professionals based on patient flow while at the same time improving the effectiveness of the health system. In addition, a good referral system helps to promote cooperation among primary, secondary and tertiary levels of care.

The new web based system have significant positive impact on liaison and referral service, such as:- To disseminate information and monitoring feedback, monitor proper utilization of ambulances as per the guideline, to develop mechanism to involve private health facilities in the referral system, coordinate the overall referral activities within the health facility, record and report the referral activities to facility management and Compile, analyze and interpret data to improve the referral service and insure that referred patient has received service from a receiving health facility.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Historical Overview of Liaison Service System

The primary task of a “liaison officer” which, in military terms, may be traced at least as far back as the legendary Marathon Run of 490 BC, has been to personally relay messages between headquarters and the frontline (and vice versa).

In the sphere of international organizations, the establishment of liaison offices between one agency and another has a similar mission: to provide a mutually agreed upon, regular and permanent channel to facilitate communication. For the purposes of the present report, a liaison office is defined as an office established by one entity (organization, fund or program) of the United Nations system at the headquarters location of another, to ensure the former’s representation and coordination on issues and activities of common interest.

According to United nation 1940s and 1950s: - To gain an insight into and better recognize the diverse roles of liaison offices in the United Nations system and to propose criteria and measures to maximize their effectiveness. Using modern communication technologies, such as teleconferencing improve information sharing between the liaison offices and all other relevant units of the parent organization to sharpen their negotiating and advocacy functions, as well as within each liaison office to foster cohesion(9).

2.2 Liaison Service System in health

Much work has already launched within the hospital and primary care settings to improve the patient journey. However, many opportunities still exist to maximize the impact of the work to date through more systematic and strategic management of outpatient services.

The current challenge for the health sector is to ensure more extensive and harmonized implementation of evidence-based best practice and tested management improvement solutions across the hospital. In the short term, this would reduce outpatient waiting times through better referral and discharge management, enhance service quality through standardization and ultimately improve the patient journey across the continuum of care(10).

For successful referral, there must be first and foremost geographical access to referral care facilities. Provided referral services are accessible, referral staff must be trained to provide quality care, services must be affordable, and essential drugs, supplies, and equipment must be available.

The most complex aspect of referral care is often the caretaker's acceptance of and compliance with a referral recommendation. This is often determined by a variety of factors, including the perceived need of a referral (disease severity), caretaker/community experience with and impressions of the referral facility (quality), and cost (time and resources)(11).

The development of effective patient liaison and referral systems is one of the important public health issues in developing countries. Primary health care will not work unless there is effective hospital support to deal with referred patients, and to refer patients who do not require hospital attention back to one of the other primary health care services in World Health Organization (12).

Liaison services in health provide commissioners with a means to address this in the acute hospital setting. Liaison services can significantly reduce the burden on both primary and secondary health care.

Liaison officer who is aware of issues and who engages in continuous dialogue and exchange of information with hospital and health centers can play a valuable facilitating role, with both the governmental and nongovernmental hospitals. In addressing problems and responsible for monitoring lessons learned, best practices and serving as a focal point for knowledge preservation and retrieval, provides great value for a more effective quality of service.

Also better communication with key stakeholders, in line with government policies and approaches, increases the relevance and effectiveness of the program. Key stakeholders include governmental and nongovernmental health facilities responsible for planning units, multilateral and bilateral development partners, including NGOs (13).

These trials were not of sufficient size to detect a moderate reduction in admission rates. There were reasons to believe that community nursing visits close liaison with hospital services might be helpful for older patients with Chronic lung disease discharged from the hospital in Hong Kong, in that the readmission rates of older medical patients there were generally higher than those reported in Western countries, and major problems in communication about medication and follow-up arrangement, lack of community support, and increase in functional disabilities had been reported.

Therefore, a randomized, controlled trial of an intensive community nursing program was performed with emphasis on continuity of care and close liaison with hospital services, targeted toward high-risk patients with Chronic lung disease who had just been discharged from a hospital. The hypothesis was that the program could prevent readmission, reduce hospital utilization, and improve functional and psycho social status using timely medical and nursing interventions (14).

Liaison mental health services have been operating in the United Kingdom since the 1980s. The vast majority of published information about UK services is descriptive. There is evidence from Accident and Emergency (A&E) department staff and liaison nurses that offering this type of service improves quality of care. Recent data from Australian emergency departments indicate that implementation of liaison services reduces waiting time and decreases the number of patients leaving without treatment acknowledged the anecdotal worth of liaison mental health services in the UK and recommended that further research be conducted. This qualitative evaluation was conducted as part of a wider study which evaluated several aspects of a UK liaison mental health service. For a detailed review of the research literature on the structure process and outcome of liaison mental health services.

The opinions of service users concerning their care are useful on three counts: for evaluation, as an outcome variable and as an indicator for change or improvement. Three types of service user involvement/consultation: user involvement in treatment and care; user involvement in service development, monitoring and evaluation; and public (non-user) involvement. Argued that quality and satisfaction with a service may not be the same from the perspective of the professional offering the liaison service and the user receiving the service.

The study shown in Australia, The length of wait lists to access specialist clinics in the public system is problematic for Queensland Health, general practitioners and patients. To address this issue at the Townsville Hospital, the GP Liaison Officer, GPs and hospital staff including specialists, collaborated to develop a process to review patients waiting longer than two years. GPs frequently send referrals to public hospital specialist clinics. Once received, referrals are triaged to category A, B or C depending on clinical criteria resulting in appointment timeframes of 30, 90 or 365 days for each category, respectively. However, hospitals often fail to meet these targets, creating a long wait. Overwhelming negative feedback from hospital staff regarding referral content prompted the GP Liaison Officer to conduct an internal audit on consecutive new orthopedic referrals over a three month timeframe and found only 25% contained complete and appropriate information to adequately triage. Findings from an audit of existing referrals showed many referrals contained clinical

information that was up to eight years old. Information regarding the duration of referral validity is limited, but it is suggested in the Australian Medicare Benefits Schedule to be 12 months. Poor quality referrals present a dual risk management issue. If high risk patients are ranked low on the triage scale, negative outcomes may result before the appointment date. Conversely, if low risk patients are seen urgently, it may inappropriately delay high risk patients. One solution is to improve the adequacy of the information contained in the referral to enhance appropriate triaging. Therefore, developed a referral template containing a minimum data set for each of the specialties. The minimum data set was used to update clinical information for the long wait process and to ensure all appropriate investigations had been performed(15).

India Consultation – Liaison Psychiatric service aims to provide cost-effective, comprehensive mental health care services to inpatients and outpatients across practice settings the consultation liaison psychiatrist focuses mainly on the corroboration of the patient's history and clarifies relevant questions and writes a patient consultation report for future reference and follow-up. Following evaluation of the patient, the consultation–liaison psychiatrist offers psycho-tropic and non-psycho-tropic therapies, and May also hospitalize or refer the patient for psychiatric outpatient follow-up. The consultation–liaison psychiatric service embraces both the medical consultant model (single discipline) approach and the complex, community mental health team (multidisciplinary) approach.(16)

2.3 Overview of Web-Based Application

"WWW" or "Web" (World Wide Web) is one of the source of information over the internet. It is growing at extraordinary rate. Distributing data and information over the web is cost effective and fast, and gives Internet users easy access to databases from any locations. For this reason, web based system this days use databases for providing timely information to user. It is believed that the integration of the web and database technology will bring many opportunities for creating advanced information management applications.

As the technology becomes an important thing today, thus the internet has become a new paradigm in computer world. In the next time frame, mostly part of computerization process will be based on the internet technology and so does the application .Because of this phenomenon the web-based application becomes the optimal alternative.

In order to develop an application that used a web-based type of implementation, numbers of development tools are available .A few to be list out are HTML, SPS and Java. All of these tools are chosen depends on the system need and also requirement of clients.

Web-based application does improve the performance of application .The competencies of web-based application are able to support the access of international software market .Web based providing the opportunity to save time and money .It also improve the way of user interaction with system.

2.3.1 Advantages of Web-Based System

There are a lot of advantages that can be list out for the system that used a web based concept. Among the advantages are as below:

- User friendly the interfaces are ease to use, just point and click. It utilize familiar browser, buttons, drop down and text entry elements. There is no need for user to learn new application or menu system. So it does save cost and time and Information/Data are updated, the biggest benefits in a web-based application in today fast-paced environment where all are frequently change is the data that are always updated.All users will automatically have the latest version of information they need.
- The other advantage of web-based system is shorter implementation time because many web browsers are already up and running and available around the clock so the implementation time is reduced .User just needs to login and begin using the system, entering data, etc. This is important to the person who works in hospitals, where everything needs to be done fast and efficient.
- In addition deployment of Web-based application brings benefit with simple procedure. This is because control of the web-based application is centralized at the web server. Hence, the support to user also can be much simpler because users are accessing the same version of the application.

Because of all the advantages that have been emphasizing, Web based liaison service system, which refers to Yekatit Hospital where the case studies have been done, has requested to make the System as a web-based application type of system(17).

2.4 Electronic Based Health Liaison Service System in Hospitals

eHealth is defined as the use of information, computers and telecommunications (ICT) to meet the needs of individuals and improve the health of citizens. It covers the electronic information recorded and shared between individuals and healthcare providers, communication between individuals and/or

healthcare professionals, and organization-to-organization transmission and sharing of information. eHealth is also the overarching term that encompasses other disciplines such as Telehealth and Telecare, Telemedicine, Digital Health, Mobile Health and Health Informatics. The term eHealth has been retained for the purposes of this document. However, it is important to note that the strategic direction in towards the provision of integrated health and social care, and this will be reflected in the future development of eHealth. Associated with this will be a shift in focus from the internal needs of towards joint requirements with local government and third sector partners, and, in particular, two-way electronic communication and information sharing with citizens and patients(18).

The Information & Referral community analysis framework suggests that one fruitful way to compare and contrast various Information & Referral efforts in terms of the communities of interest and communities of place that they serve. If a non-profit does not develop a clear vision of the communities of interest they will serve and determine how they can gather and maintain accurate and relevant information for many widely scattered communities of place, they will probably face significant challenges in establishing their web enabled Information & Referral service(19).

The healthcare model currently applied in most countries nowadays is centered on highly specialized people, located in large hospitals, and it focuses on treatment of acute cases. However, this healthcare model is becoming inadequate, due to the increasing healthcare costs of a growing population of elderly people, the rapid increase of chronic diseases, the growing demand for new treatments and the relative decrease in the number of health professionals compared with the population increase.

Access to healthcare varies across countries, groups, and individuals, largely influenced by social and economic conditions as well as the health policies in place. Countries and jurisdictions have different policies and plans in relation to the personal and population-based health care goals within their societies. Healthcare systems are organizations established to meet the health needs of target population. Their exact configuration varies between national and subnational entities. In some countries and jurisdictions, health care planning is distributed among market participants, whereas in others, planning occurs more centrally among governments or other coordinating bodies. In all cases, according to the World Health Organization (WHO), a well-functioning health care system requires a robust financing mechanism; a well-trained and adequately-paid workforce; reliable information on which to base decisions and policies; and well maintained health facilities and logistics to deliver quality medicines and technologies (20).

Each hospital should establish a referral service coordinator that lists facility to from which patients can be referred or received and service available at each facility (the referral network). The contact details of each facility in the referral network should be documented. The criteria for receiving and referring patients to each facility should be also documented and agreed between all facilities participating in the network. Standardized referral and feedback formats should be used by all facility participating in the network. Providing feedback to the referral sources is an important factor in sustaining referrals to the secondary providers. Providing feedback in a time manner and in a format that is most likely to be useful to primary referral sources is critical (21).

Information technology utilization is vital to improve patient referral system from primary care to tertiary care. Another study on Computer-Based Outpatient Clinical Referral System, Clinical Systems. Research and Development Partners Healthcare System, Boston, U.S.A explored if the new computer-based referral initiation process (i.e., replacing the paper forms) requires any additional time on the part of the Primary Care Physicians (PCPs), by comparing the time required to complete the referral initiation process using the current manual, paper-based system with that of the new computer-based application. The investigator observed two managed care referral coordinators in a primary care practice, whose job is to help patients obtain referrals from their PCP. The referral coordinators were timed from the moment they began filling out the paper form until the form was complete (i.e., ready for clinician signature). In the computer-based time study, the system automatically timed four primary care physicians from the moment they began to enter data (i.e., patient name) until they had entered their electronic signature indicating completion of the referral initiation process(8).

The investigator counted the total number of data items (e.g., referring physician's name, maximum number of visits, valid dates, etc.) recorded on both the paper-based and computer based referral forms that were completed. In an attempt to reduce the Hawthorne effect, they also counted the total number of data items recorded on 50 randomly selected, previously completed, paper-based referral forms. They conclude that based on a convenience sample, the time to complete the required paperwork to initiate a referral decreased using a computer based process. The main reasons for computerizing the approach are to facilitate better quality medical care, better communication between physicians, and decision support when and where appropriate. This new approach holds great potential for improving the overall process and accuracy of clinical referral systems (9).

Old age psychiatrists are accustomed to working with patients who present with both physical and psychiatric symptoms. Frequently, these symptoms are attributed to particular physical disorders or to psychiatric illnesses such as anxiety disorders. On occasions, however, the cause of the physical symptoms may be unclear, although psychological factors may be etiologically relevant.

Understandably, psychiatrists and physicians are often reluctant to attribute unexplained physical symptoms to psychiatric disorder in a population in whom physical illness is so prevalent and atypical presentations so common. Nonetheless, it is evident that the process of somatization (physical symptoms occurring in the absence of relevant physical disorder which have a presumed psychological basis) does occur in older patients.

Liaison psychiatry outpatient clinic in a general hospital. The nature and duration of the psychiatric disorders seen are reported, together with rates of current physical comorbidity, associated functional impairment and putative precipitants of illness. Finally, we consider the usefulness of a diagnosis of somatoform disorder when applied to older adults (20).

2.5 A Web-Based Electronic Referral System

One of the major problems in health is the complexities of waiting and queuing systems. Which is result in healthcare a complex long waiting chain of events. These include referral, outpatient activity, decisions to admit, offers of admission, elective admission, treatment and discharge. This process in its entirety makes up a patient's pathway through the healthcare system.

The second simple change is to improve referral and diagnostic pathways. Evidence suggests that referral between primary and secondary care and access arrangements for diagnostic tests often create bottlenecks in the system. Referral pathways must be defined with clear protocols and implemented in practice with the following key characteristics. Within these broad strategies successful organizations employed a host of additional measures including tight bed management, maximizing day case activity, ensuring full utilization of theatres and effective discharge planning. These were supported by an understanding of the nature of their waiting lists to provide greater control over the flows and movements of patients into, around and out of hospital. This need for visible management and control has become a strong driver for centralized waiting list management and standardized booking and access guidelines (22).

The study shown in Ireland, Ireland has the lowest number of consultant neurologists per capita in Europe. This results in long waiting lists, overbooked clinics, unnecessary emergency department

presentations and patient frustration. In 2006, the neurology department in St. Vincenta University Hospital and the National Health link project, launched an internet referral system, to alleviate the administrative burden on staff, reduce unnecessary visits for patients, shorten waiting lists and improve patient care. 710 electronic referrals from GPs between December 2006 and January 2011 were analyzed. The average time taken to for a consultant to reply to a GP referral was 19hours 8minutes. When asked their opinion as to the suspected a etiology 33.7% (239/710) of GPs selected the option unknown, followed by epilepsy 12.1% (86/710), migraine 12% (85/710), and multiple sclerosis 7.6% (54/710). Significantly, 19% (127/662) of referrals did not require a neurology outpatient appointment and the GP was given advice. The results highlight the benefits of using an electronic communication system with primary care; allowing prompt response to GP enquires, early initiation of treatment and reducing the number of patients attending hospital clinics(23).

Outpatient Clinical Referral System Clinical Systems Research and Development Partners Healthcare System. Boston, U.S.A investigators have confirmed factors such as: inappropriate documentation of referrals, lack of standard structure of referral letters, delay in feed-back from hospitals and inadequate resource and facilities in health centers are major factors that affected the functionality of the referral. The WHO Expert Committee on the Role of Hospitals at the First Level identified key problems within the referral system. These were overloading of the hospital with inappropriate self-referrals, or poorly judged referrals, barriers of distance, transport, or payment, lack of confidence in health care at the health post/ center levels, and inadequate flow of information to and from the hospital(24).

In South Korea The Web-based information sharing service implemented at patient referral center in Asian Medical Center, a tertiary care teaching hospital located in Seoul, Korea serviced 11,587 patients in 1998. During hospitalization, each referring physician is given access code to check status of the referred patient. When the patient is discharged or transferred back to the referring institute, discharge summary and other adequate information are provided through simple file transfer.

In general, Web-based referral management system and referral network improve information flow and communication so each party involved in patient referral has the information they need and when they need it(25).

The launch of the electronic-first referral system generated great excitement at the clinics in Zambia because clinic staff was now being informed of their patients 'outcomes after pregnancy complications: whether they survived, whether they delivered their babies, what sex the babies were, and other outcomes. This ability for two-way communication about patients between the clinics and Hospitals was, in fact, a great incentive for clinic staff to fill out the information when they referred a patient. The patient referral system, which was the first step towards the full Zambia Electronic Perinatal Record System (ZEPRS), was developed with high levels of Lusaka user input and involvement of local technical staff.

Not all patient referrals were entered within an immediate (emergency) status; staff seemed not to abuse the notion of priority patients. Having this acknowledgment and disposition data filled out for hospitals had been a key motivator for clinic staff to use the referral application(26).

A study conducted in Manchester eye hospital to assess general practitioner (GP) referrals which analyzed 500 consecutive referral letters content, should the referral letters are extremely variable in terms of presentation, information provided and the need for priority. Among them 500 referral letters, 81.8% had recorded the diagnosis, 10.8% had information about the duration of symptoms and 6% had information about treatment given(27).

The favor result s of the Web-based appointment system on subsequent Emergency department utilization likely are an underestimation of its potential in different systems and over a longer period of time. One reason is financial(25).

Weaving the seamless web of care: an analysis of parents' perceptions of their needs following discharge of their child from hospital Changes in children's nursing services in the United Kingdom in recent years have focused on the need for adequate and efficient services to be provided in the interests of the child. Early discharge is now the norm and children are often sent home in an earlier recovery stage than adults with comparable conditions. Whilst the contributions of pediatrics community nursing services have gone some way to providing specialist nursing care for children and their families in their own homes, the majority of children are discharged home without such support being available. This may place an overwhelming responsibility of caring for a recovering child onto parents. Research reported in this paper was to identify any gaps in nursing services for acutely sick children and their families following discharge, and to suggest ways to improve

integration and communication between hospital and primary care to facilitate a 'seamless web of care' for families (28).

In USA the study show that web based referrals represent an opportunity to use health information technology (health IT) to improve access to subspecialty care. Health IT can improve the safety and efficiency of health care. The potential for improvements apply not only to resource-rich settings, but also to safety-net health systems, which the Institute of Medicine characterizes as those that offer care to patients regardless of their ability to pay for services, a substantial share of their patients are uninsured, Medicaid, or other vulnerable patients. While safety-net health systems' diversity of reimbursement sources may allow for greater innovation in primary care-subspecialist relationships than traditional fee for-service models, safety nets vary in uptake of health IT. In addition to a lack of IT resources, health systems may encounter barriers because of concerns about the effects on workload, work roles, or workflow.

Two hundred ninety-eight PCPs (81.0%) from 24 clinics participated. Over half (55.4%) worked at hospital-based clinics, 27.9% at county-funded community clinics, and 17.1% at non-county-funded community clinics. Most (71.9%) reported that electronic referrals had improved overall clinical care. those who spent ≥ 6 min submitting an electronic referral were significantly less likely than other participants to report that electronic referrals had improved clinical care (29).

2.6 Hospital Liaison Service System in Ethiopia

Ethiopian Hospital Reform Implementation Guideline and the BPR document dwell on referral issues significantly. This document is intended to describe the overall health system organization ,rationale for referral system ,the national referral system and the roles and responsibilities of health institutions found at various levels of the hierarchy of the health system, facility liaison service and the various roles and responsibilities of a liaison officer operating at facility level. The document mainly targets liaison officers, health services providers, facility managers and other stake holders who need guidance for creating or improving liaison services in particular and that of the referral network in general.

An effective referral system ensures a close relationship between all levels of the health system and helps to ensure people receive the best possible care closest to home in timely manner. It also assists in making cost-effective use of hospitals and primary health care services. Support to health centers and outreach services by experienced staff from the hospital or district health office helps build

capacity and enhance access to better quality of care. Moreover, it reduces patient overcrowding at secondary and tertiary level facilities.

Generally, a liaison service aims at:

- Establishing and maintaining an effective liaison network with pertinent institutions and the public to achieve the best utilizations of resources
- Disseminating information and monitoring feedback- to ensure continuous improvement
- Organizing awareness creation programs- to ensure proper use of the service or the system
- Perform emergency liaison duties during mass casualties such as, flooding, fire, industrial accidents, etc a Liaison Officer is thus a person that runs the liaison services and liaises between two or more organizations and the public to communicate and coordinate their activities.

2.7 The National Referral System

The 2010 Ethiopian Guideline for Implementation of a Patient Referral System describes referral as a process by which a health worker transfers the responsibility of care temporarily or permanently to another health professional or social worker or to the community in response to its inability or limitation to provide the necessary care.

As the guideline describes referral is a two way process and ensures that a continuum of care is maintained to patients or clients. It is done from the community to the primary care health service and to hospitals and within hospitals and vice versa. It also involves not only direct patient care but also support services such as transport and communication. The national referral network is composed of referral networks that are organized based on geographically defined catchment areas. A catchment level of referral network links primary hospitals to health centers that in turn are linked to health posts. The next level of referral network connects primary hospitals with general hospitals that are found in a specifically defined geographic area. The highest level of network connects general hospitals to specialized hospitals.

Referral network Management is done following the hierarchies of the network structure. Each catchment should have its structured meeting schedule for reviewing catchment performance on patient referral and accordingly design ways on how to rectify challenges and replicate good practices(1).

2.8 Emergency Medical Service/EMS/

EMS is a service providing out-of hospital acute care and transport to definitive care, to patients with illnesses and injuries which the patient believes constitutes a medical emergency.

It is a complete system capable of responding to the medical and surgical emergencies of a community with prompt and adequate emergency care. The most common and recognized EMS type is an ambulance pre hospital care.

FMOH has prioritized the provision of quality emergency and critical care medicine in the national health care system. To this end, procurement and distribution of ambulances and other emergency and critical care equipment, launching of Addis Ababa emergency coordinators team, publication of the national ambulance guideline, development of referral manual, initiating post graduate study in emergency medicine have been done. Through strengthening emergency medical services,, it is expected that morbidity and mortality from obstetric, medical and trauma case will reduce significantly(5).

Web Referral Information Management System in Addis Ababa by Akale Regassa conclude, Improving the existing referral system using Web-based Referral Information Management system plays an important role in enhancing the quality of referral service provision in Ethiopia. It has a great impact in reducing morbidity and mortality rate by providing on time referral service which can be achieved through effective communication, coordination, sharing of patient medication data using Web-based system(3).

CHAPTER THREE

3. METHODOLOGY

3.1. Study Area and Period

Yekatit 12 Hospital is found in, Addis Ababa, which is the capital city of Ethiopia. The hospital was established in 1915 E.c by missionaries in 20 hectares of land and handover to local government by the year. The institution was upgraded to referral hospital in 2004 E.C and currently serves more than 2 million people by 1130 employees. This study was conducted from December 1, 2016 to May, 2017.

3.2. Study Design

This study employs Object Oriented (OO) system development methodology to design Web-based System to Support Liaison services system for the health facility. It is an appropriate method to develop the system hence there are different objects interacting within the system like patient, liaison officer, physician, health institutions and their service operation like referral, appointment, update bed, implementation or intervention and evaluation, report. This is because the focus of object oriented system development is on interacting Objects in the real-world (13).

Object Oriented (OO) system analysis and design is a way to develop information system by building self-contained modules (Objects) that can be more easily replace, modify and reuse; that is why the investigator use this method to integrate the patient data that could produce from the health facility during service delivery to users (14).

3.3. Data Source

The source population was all healthcare professionals who are employees of Yekatit 12 Hospital medical college. There are a total of 664 healthcare professionals such as Specialists, Medical Doctor, Doctors of dental medicine, Physiotherapist, Nurses, Health officers, Pharmacists, Sanitarians, Midwives', Anesthetist, Laboratory technicians, Radiographers but among them 69 of them send for education to upgrade themselves therefore, totally 595 health professionals are working in the hospital.

3.4. Sample Size

Study population of 18 experts were interviewed for the study (n=18). Taking the existing situation, the health workers were purposively selected for the study. For this specific research project the referral unit liaison service staff including physicians, health officers, nurses and technical staffs who involves in tasks related to referral service were considered. From the different sampling techniques available purposive sampling of experts was employed(30). The method is important to gather the required information for designing of the system.

3.5. Inclusion and Exclusion Criteria

The inclusion criterion for the project was staffs who are currently working in the selected hospital (Liaison officer, nurses, HMIS officer and medical director) and exclusion criteria those who are not available in the time of data collection due to different reason like annual leave, training and maternity leave.

3.6. Method of Data Collection

Use of qualitative data provided detail insight that enabled investigation of the depth of contents to be developed. For this research project questionnaire were adapted from related works or articles (31),(32),(33) ,(34) and some modification was done in line with the objectives of the research project. The questionnaire was prepared in English language. This research project used primary data and collected through interviews, observation, and document analysis. The data was collected by the principal investigator.

3.6.1. Interview

The face to face interview was conducted with 18 health professionals who are working in liaison service and referral system. The responses of the respondent was recorded and short notes was taken. These interviews have their own importance to gain information about the existing liaison service system that serve as an input for web based design of liaison service system.

3.6.2. Observation and Document Analysis

Systematic observation and document analysis have their own importance and create a chance to observe what is actually being implemented regarding liaisons service. During observation and document analysis the business process of manual (paper) based record system of liaison office is assessed. All registration book form, assessment form, referral form, beds management form,

implementation form, evaluation form, report form, referral guide line, ambulance guideline and other formats were examined as initial requirement for system design.

3.7. Data Quality Assurance

For data assurance data collection instrument was shaped in order to answer the need of information from study unit before the actual data collection. Data collections was conducted by principal investigator. Finally collect data was checked for its completeness before taking and analyzed.

3.8. Data Processing and Analysis

The collect data through interview, observation and document review was summarized in relation with the ideas found in different phases of liaison service system. This aggregation was done based on the Federal Ministry of national reference System Network Development Liaison Officer manual guideline. Analysis-level classes, or simply analysis classes, are used to capture important concepts in the problem domain. By identifying them first, we can proceed towards the design more systematically. Noun/verb analyses is commonly used to identify them. Analysis classes should only contain key attributes and high level responsibilities.

3.9. System Development Phases

In this web based system design, Object Oriented used as a methodology followed by the system design put in consideration the principle of object oriented analysis and design phases. Object oriented methodology with incremental and iterative designing cycles was used as the methodology to design the system.

Object oriented analysis OOA emphasizes an investigation of the problem and requirements, rather than a solution. It concerns with determining the system requirements and identifying classes and their relationships that make up an application. This phase also called requirement analysis. The classes identified in this phase represented using the domain model or conceptual model class and also their attributes and relationship are express. Therefore the investigator develop the domain model in this phase using one of UML artifacts (class diagram).

Finally the response for interview was summarized and used in requirement document. Then it was described using essential use case modeling that helps the researcher to understand the existing system very well, helps to identify difficulties for current system detailed and helps identify gaps to

be filled by the new design system. This requirement serves as an input for the next stage of system development.

The study uses object oriented Design OOD to define objects and how they collaborate to fulfill the requirements independent of implementation. During object oriented design phase of the system in this study emphasizes on designing web based system objects, classes with their attributes, methods, and interfaces using UML artifacts class diagram. Then designing entity objects in the system database with their attributes and association between entity objects and designing/prototyping user interface for the system where a user in the health facility interacts. More over the design prototype user interface was evaluated based on heuristic evaluation method and also used prototype and usability tests.

3.9.1. Analysis and Design Technique

In this design of a web based system to support referral network the following technique was used.

- Context diagram
- Business diagram
- Use case diagram
- Design class diagram
- Sequence diagram
- System Architecture and for diagram Unified Modeling Language (UML modeling), is used to modeling the components of the system

3.9.2. Analysis and Design Tools

In this design of a web based system to support liaison service Visio 2013 and UML was used as tools. Front end: HTML enable the construction of easy and intuitive user interface for accessing the database and any browser to display in html document.

Middle ware: PHP enables links of the text enter in the created graphic user interface to be sent to the database.

Back end: My SQL it's easy to use, inexpensive database language it can run on a variety of operating system such as window, Linux, and others. It is secure and technical support is widely available on the internet but most of all it supports large databases.

3.10 System Testing

System testing is the process of analyzing a software item to detect the differences between existing and required conditions and to evaluate the features of the software item. System testing is an activity that should be done throughout the whole development process. With heuristic evaluation, someone looks at the user interface by using list of rules or guidelines to identify potential problems. This method is appropriate because analyzing the application's usability with usability heuristics during the development phase is a low-cost and easily implementable way to improve usability(40).

3.10. Ethical Consideration

Ethical clearance was obtained from Addis Ababa University School of Public Health to conduct this project. Beside this, official letter was written to Yekatit 12 Hospital from school of information science to assess the requirement. All participants were provided with an information sheet to inform them about the objective of the research, let them know what data would be collected, how it will be used and disseminated.

3.11. Dissemination of Results

The final project reported and disseminated to Addis Ababa University and Yekatit 12 Hospital medical college.

3.12. Operational Definition

Liaison officer: is a person who helps organizations or groups to work together and provide information to each other.

Liaison: A person that liaises/connects between two or more service providers

Request referral facility: is the facility that starts the referral process and they prepare an outward referral to communicate the client condition and status.

Receiving facility: is the facility that accepts the referred case, and at the end of their involvement, they prepare a back referral/fed back on the lower part of the forms to let the initiating facility know what has been done (see sample tool 1). This completes the referral loop between the 2 facilities.

Referral network: is a patient flow system among geographically localized health service and health related service providing facilities upon referral of a patient.

Referral in: Are those cases, which are accepted by the receiving facility

Referral outs: Are those cases referred to other facilities by the initiating facilities.

CHAPTER FOUR

RESULT AND DISCUSSION

4. ANALYSIS AND DESIGN OF THE SYSTEM

4.1 Analysis

4.1.1 Introduction

The existing liaison and referral system must be improved to satisfy the need of clients. For this reason analyzing the existing system will lead to identify all problems of the existing system, the functional and non-functional requirements used to design the new system.

Collection and analysis of the requirement is one of the basic and essential steps in the software development life cycle. Investigations of the existing system in use by various means to provide the basic and necessary inputs to design the new system. This chapter discusses the existing system, the functional and non-functional requirements used to design the new system. But also deals System design and models used in the proposed system such as: business process diagram, contextual framework diagram, use cases diagram, class diagram, sequence diagram and system architecture are presented (35).

4.1.2 The Existing System and findings of the Current Organizational System

Currently all methods and activities, in Yekatit 12 Medical College Hospital used liaison and referral service system has been carried out manually. So, this careful analysis shows that because of the complexities of the manual system and incomplete feedback system has difficulties to store and retrieve information which result inconsistency it take extra time.

4.1.2.1 Data and Process

In order to establishing and maintaining an effective referral system, to improve the bed utilization, discharge and admission criteria, a liaison office service is an instrument and incorporated in the Ethiopian health care service delivery system .

Liaison and referral service system currently in the Yekatit 12 Hospital Medical College is done using manual, paper based and telephone for patient appointment and follow-up. Currently the liaisons officers uses different formats some of these are; Microsoft excel applications for registration Referral system, Hospital beds management, admission and discharge format. But it is

not integrated with health centers and other hospitals which is usually incomplete and time taking to access and process.

In addition beds management and Patients allocation are defined based on the catchment areas. But there is no mechanism to plan redirect patient to alternative health facility when varied number patient referred in different hospitals that brings load in the hospitals.

Paper based feedback mechanism is used to accept the referred case, to prepare referral feedback patient information format in health facilities and kept manually on chart forms. Generally the problems exist in the data and its processes in the organization are:-

The data recorded based on paper liaison and referral service system which is incomplete, fragmented and hard to read. And also sometimes it is hard to find, shareable, updated, accurate and fast retrieval information that is potentially available anywhere at any time. So there is Lack of standard data storage and communication to maintain a data and information analyses easily for; medical audit, research and quality assurance, epidemiological monitoring, bed occupancy rate and Support for continuing medical education.

4.1.2.2. Report/ Communication

The exist liaison service system expected to report daily, weekly, monthly and annually HMIS and KPI reports. The information and data used for report is collected using reviewing previously formats and registrations. There is no system or supporting mechanism for data analysis in the existing system. Liaison officer need data for decision making about the need of immediate treatment for both emergency and elective patients, for effective utilization of health care services resources and ensure better quality health care provision system.

Even if the exist liaison service system exposed this problems but has a responsibility to document its activities including referrals, admission and discharge patients process in order to:

- Monitor referral volume so that, it allows the facility to plan better and better
- Manage the hospital beds appropriately
- Facilitate transport for admitted and referred patients
- Manage appointments for elective patients
- Follow discharge timely
- Monitor and evaluate the performance of referral system at hospital and health center level.

- Improve the quality of referral service continuously.
- Strengthen the accountability of the referral health care system.
- Conduct researches.

The liaison officer should analyze and report information related to referred, admitted and discharged patients based on the schedule regularly (monthly, quarterly, biannually and annually) to the hospital management team.

In the existing system patient information flow among the professionals using manual registration books and Reports are prepared daily, weekly and monthly. This patient information is submitted to the hospital HMIS officer and management team using paper based manually recorded documents.

4.1.2.3. Document

As Ethiopian Reform Implementation Guideline explain properly bed management information for every admitted patient in wards and their EDD (expected date of discharge) should be documented. But also for all appointed patients; appointment date, the responsible department and physician and the patient's address should be documented properly.

Liaisons service should document in and out referral registration. For referred in patients document registration system should also be placed at Triage, Emergency department in addition to liaison office. Every responsible departments listed above have the responsibility to register every referral case on the registration form. The liaison officer has the responsibility to follow the documentation and aggregation of all referred in patients and include them on monthly report.

4.1.2.4. People

All liaison officer in the hospital can access patient records in the existing system. The one who record the information of the patient is responsible for error. All health professional are responsible to make daily weekly and monthly report as required. At a time 2-3 health professional present and working 24 hours by using rotation 8 hours interval system. As information got through observation and interview they have the basic computer skill. But Problems on Liaison Service process reviewed and handled by the liaison officer coordinator.

4.1.2.5. Management (Procedure)

In the existing system, the processes of Liaison and referral system is used to increase the quality of health care services through improving the information recording procedures such as; Coordinate the overall referral activities, Record and report the referral activities to the hospital management, Compile, analyze and interpret data to improve the referral service, Use the part in the quality assurance programs of the referral system through participating in regular review meeting within and outside the hospital, Monitoring and evaluation of Performances and Ensure feedback mechanisms that has to be sent other health facility.

4.1.2.6. Software

In the existing Yekatit 12 Hospital Medical College liaison and referral system there is one desktop computer to use Microsoft Excel software to register referral cases. The hospital do not have network system for sharing data and information with other institution.

During interview of the medical director of the hospital it is notes that there is plan to improve the current manual system by purchase the necessary equipment's and to provide training on computer usage for the staffs.

4.1.2.7. Hardware

The existing computer hardware available in the liaison service is only one that is not enough for recording, processing and communication of information for fast and quality of care for the customer.

4.2 Major function of the existing system

In the existing liaison service system in Yekatit 12 Hospital Medical College uses manual (paper based) patient record system. These records are in line with the HMIS and KPI data collection and reporting tools designed for the hospital. The daily routine service in the hospital has to be recorded manually using different paper formats and registers. The major activities or business process of the current system are:-

➤ Request Referrals

Purpose: - The purpose of this function is to request referral to get services in the hospital.

Input: - When a patient requires referrals should send at minimum the following information:

Patient name, phone number and medical record number, summary of the clinical history and reason for admission, case team to which patient should be admitted like surgical case team, internal medicine case team and urgency of admission (set criteria related to: pathology of the disease, socio-economic status of the patient, and distance of the patient's residence).

Process: - The liaison officer should book the admission date and give an appointment card to the Patient and patient number, and take contact information of patient and/or care giver or the patient should report to the liaison officer and from there he/she will be assisted to make any necessary payment or registration and will be directed to the relevant inpatient case team/ward. **Output:** - Patient is registered at medical record unit

Output: - Patient admitted or appointed to get services in the hospital.

➤ Admission Patients

Purpose: - The liaison officer should facilitate for the patient in order to admit.

In put:- As a minimum the following information has to be delivered: Patient name and medical record number, summary of the clinical history and reason for emergency admission, case team to which patient should be admitted like surgical case team, internal medicine case team and expected date of discharge.

Process: The liaison officer should inform the case team leader of the receiving ward that the patient should be transferred to that ward and any necessary administrative tasks carried out with the assistance of runner

Output: - admit patient

➤ **Bed Management**

Purpose: -To have hospital bed information.

In put: - At any time the liaison should and have the following information: Free beds in the health facility, number of bed that are due to be evacuated, likely discharges planned during admission, number of beds Occupied in the facility, number of patients transfer ins and outs and number of ‘reserved beds for elective admissions that day

Process: - Each day, every 8 hours the liaison officer should asses the number of unoccupied beds, number of patients in the emergency unit or department waiting to be transferred to inpatient wards, and number of patients in the ICU to be transferred to the ward.

Output: - To make maximum use of hospital beds, ensuring high bed occupancy, high patient turnover and minimum waiting times for elective admission.

➤ **Discharge**

Purpose: - Discharge summary for the patient should make the decision for discharge.

In put: - discharge summary containing medical history should be given to the patient and a second should save in the Medical Record data base

Process: - Resources such as a discharge coordinator should be available to ensure delays are minimized and extensive patient and family involvement in decision-making processes. Analysis of trends and data should be undertaken by the Liaison Officer and communicated to hospital senior management.

Output: - The patient should leave the hospital.

➤ **Feedback**

Purpose: - used to send the basic and necessary data about patient stay time at the hospital.

In put: - As a minimum the following information has to be delivered: Patient name and medical record number, summary of the clinical history total stay days, total payment and reason for discharge.

Process: - If a patient was referred from another facility, after discharge the patient physician/liaison officer should also complete the feedback section..

Output: - The patient data is retrieved successfully and treatment result is registered.

➤ **Ambulance Management**

Purpose: - To manage means of transport and control ambulance activity

Input: - The following information has to be registers: Starting time, kilo meter, Arrived time, kilometer and number of passengers.

Process: - This user interface is used to register ambulance management which is usually important to control means of transport and the activity of the referral system.

Output: Ambulance management report

➤ **Generate Report**

Purpose: - To compile report from different liaison service from different registration books and bad tally sheets.

Input: - Registration logbooks and bad tally sheets.

Process: - HMIS officer Collect report of each department and generate as aggregated report.

Output: The outputs are either daily, weekly, monthly, quarterly biannually nine month or annual report.

4.3. Functional Requirements

The requirements phase is the first major step towards the solution of a data processing problem. During this phase, the user's requirements with respect to the future system are carefully identified and documented. this phase the most challenging and difficult aspect of requirements is to get a complete description of the problem to be solved(36).

Information from interviews supplements other information about the system from documentation and observations describing business processes or existing systems, This web based liaison service system is designed is a way that enables the stakeholders to collect, analyze, disseminate and utilize information at all levels of referral networks(37).

The functional requirement of the system is concerned with the functionality that the system should provide to users. This system is designed to enable users to collect and gathered data and information. It can also provide a means for health Professionals to request assistance and get information on how to give a care service to the patient. The functional requirements are listed as follows.

Table 1: Functional system requirements for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Req ID	Description of the requirement
RQ-1	The system should allow the user to log in according to the assigned right.
RQ-2	The system should allow to update patient record
RQ-3	The system should show notification to remind feedback
RQ-4	The system should allow search into the database by Name, card number or mobile no
RQ-5	The system should allow to update patient beds information
RQ-6	The system should allow ambulance management any medicines to be taken away, and patient transport arrangements confirmed
RQ-7	The system should allow to enter emergency admissions processes and able to register patient personal information, address and identification number or medical record number. .

RQ-8	The system should allow to register Elective Admission Process and able to register patient personal information, address and identification number or medical record number
RQ-9	The system should record then send through web referral format and register referral in
RQ-10	The system should show the update beds information in each case time.
RQ-11	The system should allow record ambulance order and management
RQ-12	The system should allow to register schedule and appointment information for admission
RQ-13	The system should allow to record discharge summary information
RQ-14	The system should enable generation of report based on daily, weekly, monthly and annual basis
RQ-14	The system should allow the administrator to maintain user account

Remark RQ = Requirement id, UC= User Case

4.4 Non-functional Requirements

The non-functional requirements describe that are not directly concerned with the specific services delivered by the system to its users. User visible aspects of the system that are not designated to the functional behavior of the system. Non-functional requirements, such as performance, security, or availability, usually specify or constrain characteristics of the system as a whole. System properties such as reliability, response time, and store occupancy failing to meet a non-functional requirement can mean that the whole system is unusable.

They span on a number of issues from user interface to security issues and the constraints of the system to improve quality of service. In a nutshell the basic non-functional requirements can be viewed as follows:

4.4.1 Availability

Since the system is web based liaison and referral service should be available 24 hours a day, 7 days a week, and 365days a year. Based on the capacity/patient load of the facility, a hospital can set the number of liaison officers.

If the case load is low, the facility can orient some of the emergency department staffs on referral coordination and may use this staffs on duty hours.

Since the hospital give services for 24 hours, the system should be available 24 hours/day or 7 days a week, and there should be 24 hours/day of electricity and back up source such as generator for the system to work without interruption.

4.4.2 Scalability

Is the capability of a system, network, or process to handle a growing amount of work, or its potential to be enlarged in order to accommodate that growth? For example, in liaison service it can refer to the capability of a system to increase its total output under an increased load when resources (typically hardware) are added.

The liaison service system project define the specific requirements for scalability on those dimensions that are deemed important. It is a highly significant issue in electronics systems, databases, routers, and networking. A system whose performance improves after adding hardware, proportionally to the capacity added.

4.4.3 Performance

This fully configurable software solution allows for custom workflows that easily adapt to the needs of this ever-growing market.

Healthcare Professionals work in an environment where there can be a significant amount of stress and the time to perform certain tasks can be limited. At the same time, the system must provide accurate, consistent and reliable data to the system users. User interface screens shall respond with speed so as to ensure fast data entry to the system. The system shall have flexible and convenient provision for data import/export with other application.

4.4.4 User interface

By giving on job training for user minimize the time needed for users to adapt to use the system. There will be interfaces and menus for each function provided by the system to easily navigate from one point to the other. Users are communicating with the system through the application interface which is easy to use by the health workers.

4.4.5 Security

Since the liaison service system is going to handle patient personal information which is confidential, it should be protected from unauthorized users and intruders. No one can log into the system without a registered user name and corresponding password. Moreover the system will use encryption techniques to avoid the tapping of the data while in transfer. This will prevent the system from being accessed by observers [18].

4.5 Modeling

4.5.1 Liaison Service System (To be)

The current challenge for the health sector is to ensure more extensive and harmonized implementation of evidence-based best practice and tested management improvement solutions across the hospital(10).

One of the one health sector transformation plan is effective information use is critical across a range of activities in the health system. It is difficult to promote and maintain quality of primary, secondary and tertiary health care without the availability and effective utilization medical information. The decisions and organizational behaviors of service rendering facilities is also influenced by the amount of data they can gather and the capacity to translate it to meaningful information, which in turn is used for decision-making. From an equivalently imperative viewpoint, public access for essential information on health and health system is also important in terms of improving quality of care(38).

The introduction of the new proposed system designed and developed for liaison and referral service system in Yekatit 12 Hospital Medical College. This helps to facilitate and improve the services of the system. It contains registrar form of referral request, admission, discharge and emergency triage for patients that help to analyze and interpret data easily. On the other hand, the new system used to strength the peripheral health facilities and improves the decision-making capacity of professionals at the lower level of the referral network, and this cause to a reduce outpatient waiting times through better referral and discharge management system that enhance service quality through standardization and improve the patient stay time at the hospital ultimately.

The new system also used to update information about admission and discharge and show number of free beds in each case teams that is important to give appropriate and fair schedule for bed waiting time and answer good governance issues.

Moreover the proposed system used to ensure the appropriate pathway in hospitals through handover activity easily such as: discharge patients, identifying and addressing service gaps and better integration of services especially at the interface between primary and acute care. And also the system have ambulance management functionality system in the case of lack of transport.

Web based referral system can have invaluable benefits for service providers. Such as improving patient follow-up care through creating coordination between health organizations accurately and timely, but also the referral system contains available patient information enhanced medical decisions, avoid duplication tests, secure referral information, and improve speed of communication and ensuring a faster response rate.

The proposed model includes establishing collaborative activity through creating feedback mechanism. This provides evidences whether the delivered service was managed or should indicate there was follow up section.

In Addition to this as the idea got during interview and observation one of the main problem exist in the current liaison service system is feedback mechanism. So the new system show notification to remind the health professionals to complete the feedback information that should have to be filled after the physician register discharges completely.

Using the original referral request, documenting the status of service delivery and other pertinent information and returning the form to the site of referral initiation is one method of feedback communication

Objects oriented method used for analysis and design of the new system. It is easy, reusable and helps to reduce errors and proper documentation as well as generate report. This OO proposed system would have a great importance and will solve the problem of manual system. The liaison officer should analyze and report referral, admission and discharge patients regularly (monthly, quarterly, biannually and annually to the hospital Management Team).

Therefore, it ensure registration records correctly and improve the quality and overall activities in the hospital including lines of communication between them with particular attention given in hierarchy such as primary, secondary and tertiary care levels between organizations.

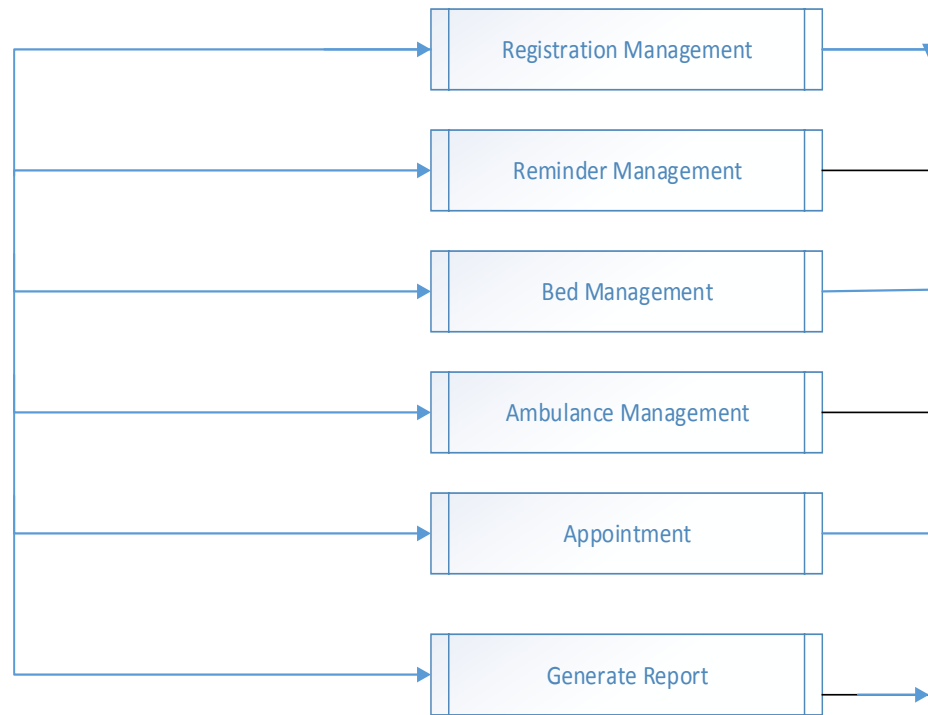


Figure 1: Business process modeling of the proposed system for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

4.5.2 Use Case Modeling

Use cases are an easy simple and good way of representing and explaining the system users/actors and the major use cases scenarios. This UML modeling provides interaction view, which is a more user- centric emphasis rather than focusing on the detailed functionalities of the system.

Software development is a social learning process. The process is a dialogue in which the knowledge that must become the software is brought together and embodied in the software. The process provides interaction between users and designers, between users and evolving tools, and between designers and evolving tools [technology]. It is an iterative process in which the evolving tool itself serves as the medium for communication, with each new round of the dialogue eliciting more useful knowledge from the people involved(39).

Use Case modeling is the most effective technique and simplest for modeling system requirements from a user's perspective.

Table 2: System actors and description for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Actor Name	Description of the requirement
Liaison officer	A person who helps For proper implementation of referral system, admission and discharge, update beds information, ambulance management, counted and allocate beds, send feedback, schedule patient admission and generate reports.
Physician	A Person who decide a patient to be inpatient department for treatment and also decide a patient to be refer and discharge.
HMIS & KPI Focal person	A person who generate report from liaison service system to different stakeholders in a given time.
System administration	A person who provides different security access credentials to the system
Health Institution	An organization (catchment health centers, clinic or hospitals) that send patient to the hospital.

The liaison service web based system has a total of 12 use cases these are

1. UC-01, Login
2. UC-02, Request referral
3. UC-03, View request referral
4. UC-04, Admission
5. UC-05, Beds management
6. UC-06, Schedule admissions appointment
7. UC-07, Managing ambulance
8. UC-08, Discharge
9. UC-09, Feedback
10. UC-10, Notification
11. UC-11, Generate reports
12. UC-12, Manage user

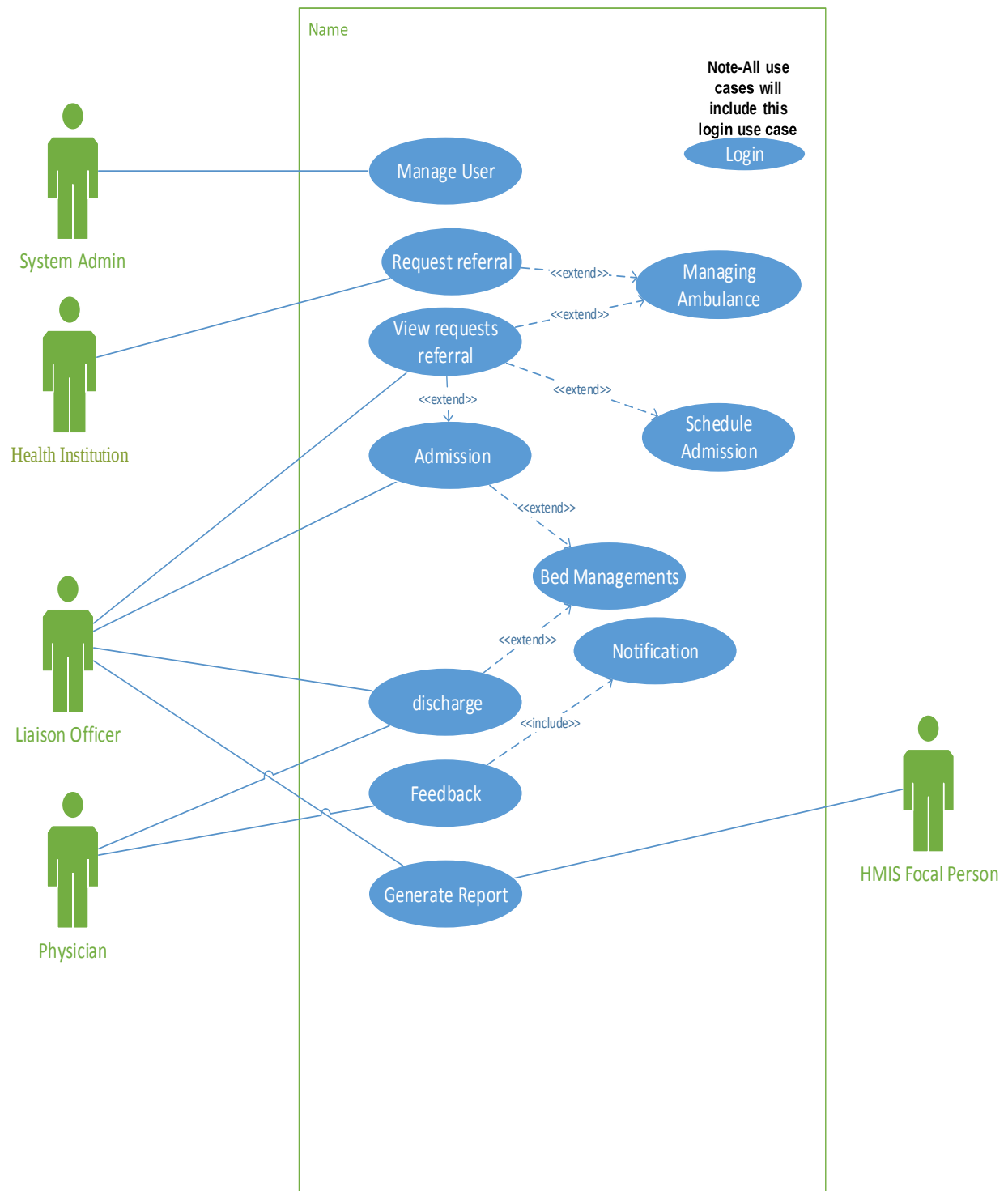


Figure 2: Use case model for web based liaison service system for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Table 3: Login use case for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Use Case ID	UC01
Use Case Name	Login
Use case Description	Used to login into the system to obtain the different functionalities of the system
Primary Actor(s)	Liaison officer / physician/ health institution / HMIS focal person
Trigger	The user open home page
Pre-condition	The user must have username and password
Post-condition	The user logs into the liaison service system
Basic Scenario	1. The system display home page and login screen main 2. The system displays 2. The user enters the username, password and select user type on login screen. 3. The system verifies account information and set access permission [3a]. 4. The user logged in to the system then system will display the main screen. 5. Use case ends
Alternative path	3a. If the username or password is not correct, invalid login message is displayed. 3a.1. The user is returned to login screen and re-enters user name and password.

Table 4: Request referral for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Use Case ID	UC02
Use Case Name	Request referral
Use case Description	When a patient needs an expert advice as determined by the attending health professional When technical examination is required that is not available at the referring facility When a technical intervention that is beyond the capabilities of the facility is required When patients require inpatient care that cannot be given at the referring facility When the referring facility couldn't more accept patients due to shortage of beds and unavailability of professionals write referral
Primary Actor(s)	Physician/ other health professional
Trigger	The patient should be decided by health profession to be refer
Pre-condition	The physician (user) must be logged into the system
Post-condition	The health institution should be prepare ambulance for the refer patient
Basic Scenario	The use case starts 1.The physician should decide the patient to be referred 2. The physician select request form from the main menu 3. The physician registers patient referral data and general medication information on referral request form. 4. The physician click send referral button. 5. The system save or stored the detailed current status patient referral information in to the patient database 6. The use case ends.
Alternative path	

Table 5: View request referral for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Use Case ID	UC03
Use Case Name	View request referral
Use case Description	The liaison officers receive message with referral patient form catchment health center, other health institutions or within the hospital to admit the patient
Primary Actor(s)	Liaison officers& physician
Trigger	Health institutions and health profession must send request through web referral form to the hospital
Pre-condition	1. The liaison officer & physician user must be logged into the system 2. Health institution should send request referral form and patient
Post-condition	1. the patient should be admitted or appointed 2. The patient data will be saved in to the database
Basic Scenario	1. The use case starts when the liaison officer checks the catchments area for referred patient. 2. Check the referred patient is from the right catchments area. [Alt 2.1] 3. The liaison office verifies the completeness of referral data from referral form. 4. If the referral forms data is complete and correct.[Alt 4.1] 5. The liaison officer registers the treatment route on referral form. 6. The liaison officer registers patient general information in register admission. 7. The system save or stored the detailed information in to the patient database 8. The use case ends.
Alternative path	2.1 The liaison officer returns the patient to referring facility. 4.1 The liaison officer returns referral form to referring facility

Table 6: Admission for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Use Case ID	UC 4
Use Case Name	Admission
Use case Description	For Emergency admissions length of stay should not be greater than 24 hours. Then transfer to ward has to be facilitated for proper inpatient admission if necessary. Based on admitting physician's recommendation liaison officer should coordinate beds for admission
Primary Actor(s)	Liaison officer other health profession
Trigger	The physician should decide to admit the patient
Pre-condition	A physician should be register
Post-condition	A bed immediately available in the relevant inpatient case team/ward.
Basic Scenario	1. The system displays menu user interface(admission register format) 2. The Liaison officer selects admission register format menu option 3. The system displays admission register format recording new form 4. The Liaison officer fill admission register format form with required history inform 5. The Liaison officer click send button the system 6. The system save or stored the detailed current status admission register format in to the patient database 7. Use case ends
Alternative path	

Table 7: bed management information for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Use Case ID	UC05
Use Case Name	Bed management information
Use case Description	Each department in the hospital need to inform the update beds information by reporting admission and discharge. The liaison officer receive admission and discharge report or counted free beds ever 8 hour.
Primary Actor(s)	liaison officer
Trigger	The user open beds management page
Pre-condition	Login to the web based liaison service system
Post-condition	The system display latest beds information
Basic Scenario	1. The system displays menu user interface (beds management home page) 2. The Liaison officer selects update beds from menu option 3. The system displays update beds recording new form 4. The system display number of free beds by calculating admission and discharge patient 4. The Liaison officer fill update beds form with required history inform 5. The Liaison officer click send button the system 6. The system save or stored the detailed current status beds information in to the patient database 7. Use case ends
Alternative path	

Table 8: Appointment for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Use Case ID	06
Use Case Name	Schedule admissions appointment
Use case Description	Non-emergency patient cases who are not receive service immediately in different reason should be give appointment.
Primary Actor(s)	Liaison officer
Trigger	The request referral form that send from health institution
Pre-condition	New referrals received and it is not emergency case
Post-condition	Patient's appointment is scheduled successfully.
Basic Scenario	The use case starts when the system displays main menu screen. 2. The user selects referral link on main menu screen. 3. The system displays referral list screen. 4. The user selects schedule appointment link on referral list screen. 5 The system displays schedule appointment form. 6. The user enters user data and schedule on appointment form. 7. The system adds scheduled data to the hospital database. 8. The use case ends.
Alternative path	

Table 9: Ambulance management for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Use Case ID	UC 7
Use Case Name	ambulance management
Use case Description	The liaison office should insure that the patient has a necessary transport to reach the receiving unit, making use of the facility vehicles/ambulance and professional attendance if it is essential.
Primary Actor(s)	Liaison officer
Trigger	The System should display means of transportation register form
Pre-condition	The liaison officer user must be logged into the system Ensure the ambulance service is in place for 24 hour and is equipped with the necessary medical supplies for critical emergency patients
Post-condition	1. the patient should have ambulance 2. The patient data will be saved in to the database
Basic Scenario	1. The use case starts when the system displays main menu screen. 2. The user selects ambulance management menu screen. 3. The system displays means of transport screen. 4. The user selects means of transport on referral list screen. 5 The system displays ambulance transport form. 6. The user enters user data. 7. The system adds data to the hospital database. 8. The use case ends.
Alternative path	

Table 10: Discharge for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Use Case ID	UC 8
Use Case Name	Discharge
Use case Description	Discharge summary for the patient should make the decision for discharge. A copy of the discharge summary containing medical history should be given to the patient and a second should save in the Medical Record data base.
Primary Actor(s)	Liaison officer
Trigger	The system user request to discharge register
Pre-condition	A physician who should complete a discharge summary
Post-condition	The patient should leave the hospital
Basic Scenario	1. The system displays menu user interface(discharge register format) 2. The liaison officer selects discharge register format menu option 3. The system displays discharge register format recording new form 4. The liaison officer fill discharge register format form with required history inform 5. The Liaison officer click send button of the system 6. The system save or stored the detailed current status discharge register format in to the patient database 7. Use case ends
Alternative path	

Table 11: Write feedback for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Use Case ID	UC 9
Use Case Name	Write feedback
Use case Description	If a patient was referred from another facility, after discharge the patient physician/liaison officer should also complete the feedback section.
Primary Actor(s)	physician/liaison officer
Trigger	The system user request to send feedback
Pre-condition	discharge summary report format
Post-condition	The patient data is retrieved successfully and treatment result is registered.
Basic Scenario	The use case starts when the system displays main menu screen. 2. The user selects feedback link on main menu screen. 3. The system displays feedback list screen. 4. The user selects add feedback link on referral list screen 5. The system displays feedback form. 6. The user enters treatment result on feedback form. 7. The system adds feedback data to the hospital database. 8. The use case ends.
Alternative path	

Table 12: Notification for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Use Case ID	UC10
Use Case Name	Notification
Use case Description	This use case describes the process of sending reminder text message To remind feedback
Primary Actor(s)	Physician
Trigger	1. Physician login into the system. 2.The Physician receives complete discharge information through the system database.
Pre-condition	The system should have control feedback service.
Post-condition	The system shows the message which the patients are discharge but have not send feedback.
Basic Scenario	The Physician finished discharge registration is in the system. The System display feedback notification. The Physician click on the notification then select feedback option display. The physician click notification The notification include (MRN, and Name of health institution) The system display feedback format The physician write feedback then save in to the system data base 7.Use case ends

Table 13: Generate report for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Use Case ID	UC-11
Use Case Name	Generate Report
Use case Description	This use case describes report generating information process The liaison officer should analyze and report referral and Admission and Discharge reports on regular bases (monthly, quarterly, biannually and annually to the hospital MT)
Primary Actor(s)	Liaison officer and HMIS focal person
Trigger	1. The system user request to generate report 2. The user login into the system
Pre-condition	1. All required data must be exists in the system data base to generate report. User has security access to the confidential data will be extracted with report 3. Data has been gathered
Post-condition	1. Requested report is produced The generated report information saved and stored in database server.
Basic Scenario	1. The report viewer opens the view report home page 2. The report viewer selects the generate report menu. 3. The system presents the list of available reports types. 4. The report viewer selects the report of his/her need 5. The system presents the description of that report 6. The report viewer confirms the report if it is what he/she needs 7. The system generates the selected report 8. The system displays the selected report on the users screen 9. The system saves the report onto the database 10. The report viewer click on print button to print the generated report 11. The use case ends
Alternative path	7 A The system displays the available options of report type 7 A.1 The report viewer select one or more sifting criteria from the options 7.A.1.1 if there is no data match with report viewers request 7.A.1.2 The system prompts no matching data found 8. A. if the user wants to have the report in different format 8.A.1The report viewer click on the export report button 8.A.2, Select the file type of the report

Table 14: User manager for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Use Case ID	UC 12
Use Case Name	User Manager
Use case Description	The use case describes how the system administrator Activates, inactivates and provides privilege to the users of the system
Primary Actor(s)	System administrator
Trigger	For the users to access the different services based on their provided privilege
Pre-condition	1. The System administrator must be logged into the system 2.The System administrator must be authenticated and authorized by its own assigned privilege and system administrator must be a registered user 4. The system administrator must be part a registered
Post-condition	Different user account information are managed
Basic Scenario	1 The System administrator opens the system administrator home page 2 The System administrator selects system administration page. 3 The System presents the different users of the system. 4 The system displays a new account creation form 5 The System administrator checks staffs have a user account from the list of Identification numbers 6 The System administrator fills the required forms 7 Click submit button to save the data 8 The system creates account that is the system provides privilege to use the system 9 The system validates and confirms the inserted data 10 The use case ends
Alternative path	6. A If the system administrator wants to update system user data B selects the identification number of the user C The system administrator changes the information of the user D The system administrator updates the needed data E) The system administrator clicks update F) The data will be saved onto the database 8. A If the system administrator wants to deactivate the user B Click on the identification number of that user C) The system displays the information of the user D) The system administrator clicks on the user Inactivate button E) The system will inactivate the user from the database F) The data will be saved onto the database 8. If the primary password mismatches with the confirmation password A The system notifies the passwords mismatch B The system lets the user to reinsert password 9. If the system administrator skip the necessary information A.1 The system prompts an error message on the blank space A.1.1 If the information is updated the system display “Updated” message A.1.2 If the information is not updated the system display “Not Updated” message

4.5.3 Class Diagram

Class diagrams depict the static structure of a system. A class diagram is a graph in which the nodes are objects (classes) and the edges are relationships between objects. By decorating the edges, many kinds of relationships can be modeled(40).

They can be used throughout the development life cycle, Class diagram carry different information depending on the phase of the development process and the level of detail being considered. Initially, class diagrams reflect the problem domain, which is familiar to end-users and as development progresses, class diagrams move towards the implementation domain, which is familiar to software engineers.

The contents of a class diagram will reflect this change in emphasis during the development process and Class diagrams capture the static structure of Object-Oriented systems, or how they are structured rather than how they behave(41).

Process, objects represent something in the real world, as an implementation is developed, In liaison service system usually define additional implementation objects that are used to provide the required system functionality. So this project focus on the modeling of real-world objects as part of the requirements or early software design processes. When showing the associations between classes, it is convenient to represent these classes in the simplest possible way. To define them in more detail, this project add information about their attributes (the characteristics of an object) and operations (the things that you can request from an object) (42). As the program runs, these objects interact with each other to implement the system functionality.

It can be used as to provide a general overview of the system objects and their interactions. An association is a link between classes that indicates that there is a relationship between these classes. Each class is drawn by using three part-rectangles with the class's name at the top, attributes in the middle, and methods (also called operations) at the bottom.

By identifying them first, we can proceed towards the design more systematically. Noun/verb analyses is commonly used to identify them. Analysis classes should only contain key attributes and high level responsibilities

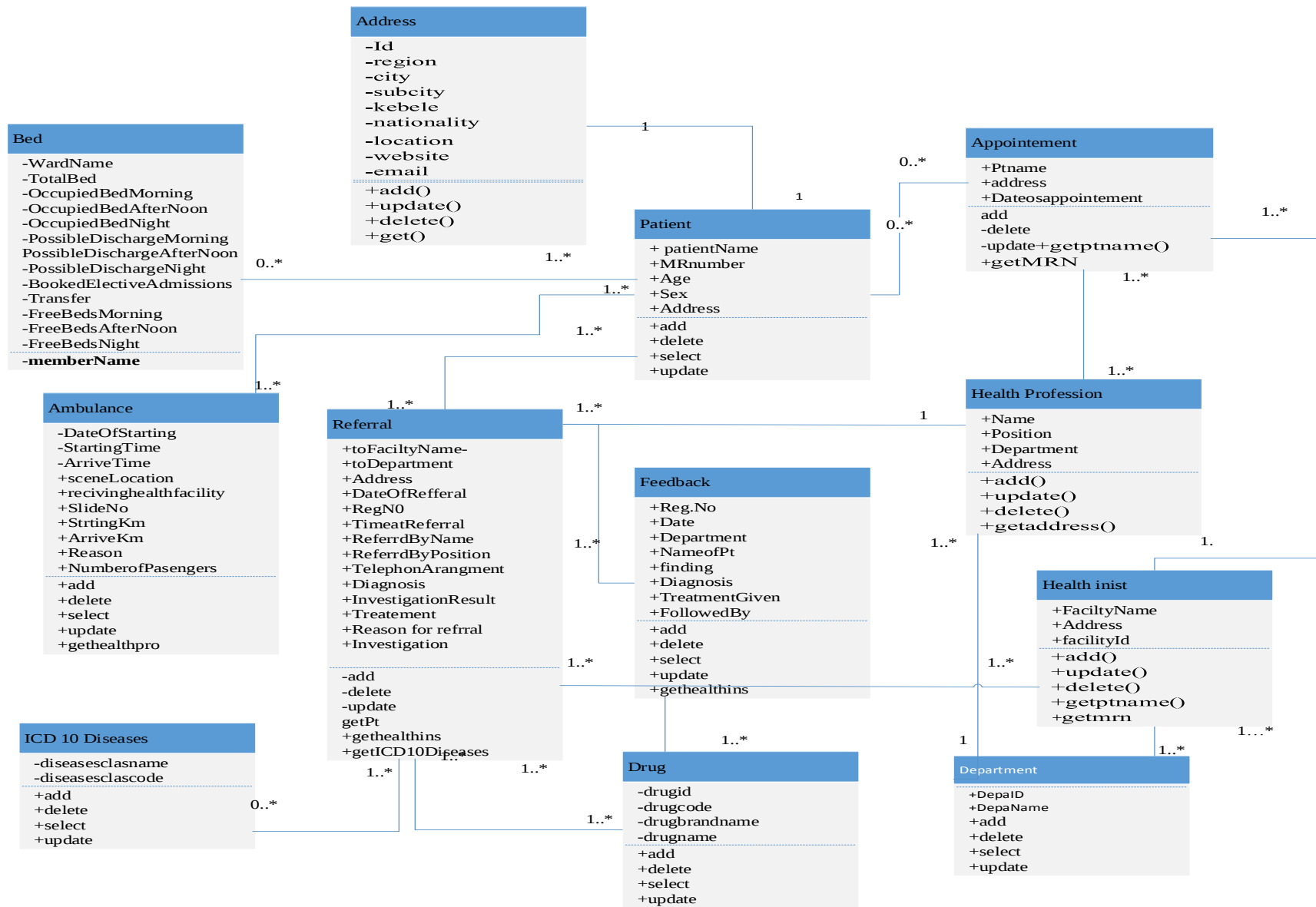


Figure 3: Class Diagram for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

4.5.4 Interface subsystem

In this research project of liaison service system a total of 10 basic interface subsystem are presented. Each interface have different purpose and integrated each other for the implementation of newly proposed liaison service system. The basic interface and their parts subsystems include:-

- **Home page interface** this user interface is include login which is important for responsible for providing the authentication and authorization of the users to the different functionalities that the system provides. And also include different information as well as contact menu. information
- **Referral request interface** this user interface enables the health institutions to send referral requests to the hospital online. The interface mainly include referral request form which have the necessary data as the standard of FMOH. .
- **View referral interface** enables the liaison officer to see all referral requests timely order which are send by health institutions. Due to this the liaison office decide the patient weather to have a bed or an appointment.
- **Admission interface** this user interface enables liaison officer to register the necessary data when the patient admitted to the hospital. For Emergency admissions length of stay should not be greater than 24 hours.
- **Appointment interface** this user interface enables liaison officer to give appointment for patient's non-emergency patient cases who are not receive service immediately in different reason should be give appointment.
- **View appointment interface** this user interface enables liaison officer to see the data and communicate with all patients who are in appointment to fix bed.
- **Discharge interface** this user interface enables physician to register discharge, which have patient discharge summary containing medical history and results.
- **Feedback interface** this user interface enables physician to write feedback, after discharge the patient physician should also complete the feedback section. And also the system display remind notification.
- **Bed management interface-** enables the different users of the system to see each department in the hospital update beds information by reporting admission and discharge.
- **Ambulance management interface-** enables the liaison officer to register the necessary ambulance management information during referral cases.

4.5.5 Sequence Diagram

Sequence diagrams in the UML are primarily used to model the interactions between the actors and the objects in a system and the interactions between the objects themselves. The UML has a rich syntax for sequence diagrams, which allows many different kinds of interaction to be modeled.

UML sequence diagrams model the flow of logic within the liaison service and referral system being developed in a visual manner, enabling both to document and validate the system logic, and are commonly used for both analysis and design purposes.

The objects and actors involved are listed along the top of the diagram, with a dotted line drawn vertically from these. Interactions between objects are indicated by annotated arrows. The rectangle on the dotted lines indicates the lifeline of the object concerned(43).

Two dimensions has sequence diagram: the vertical dimension represents time and the horizontal dimension represents the objects participating in the interaction. Time flows from top to bottom. Objects (or classifier roles, more generally) are shown as vertical lines (called lifelines) and messages as horizontal arrows extending from a sender object to a receiver object. Spacing is irrelevant, that is, only the order of messages matters, not the distance between them(44).

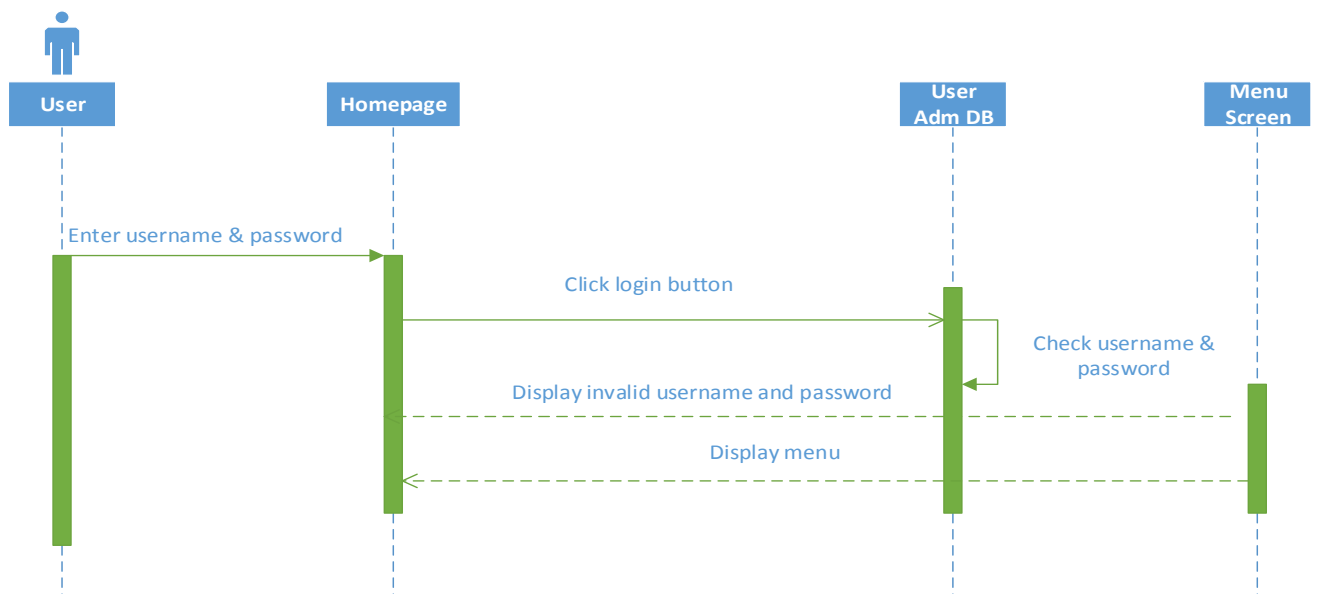


Figure 4 : Sequence diagram login for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

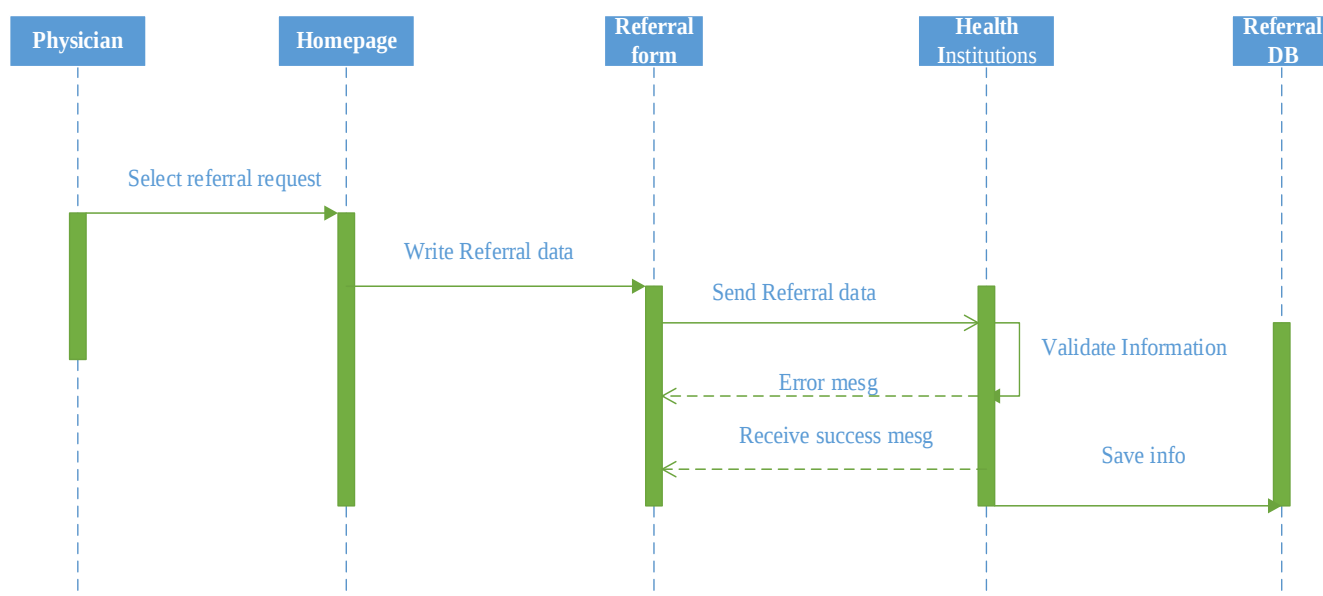


Figure 5: Sequence diagram referral request for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

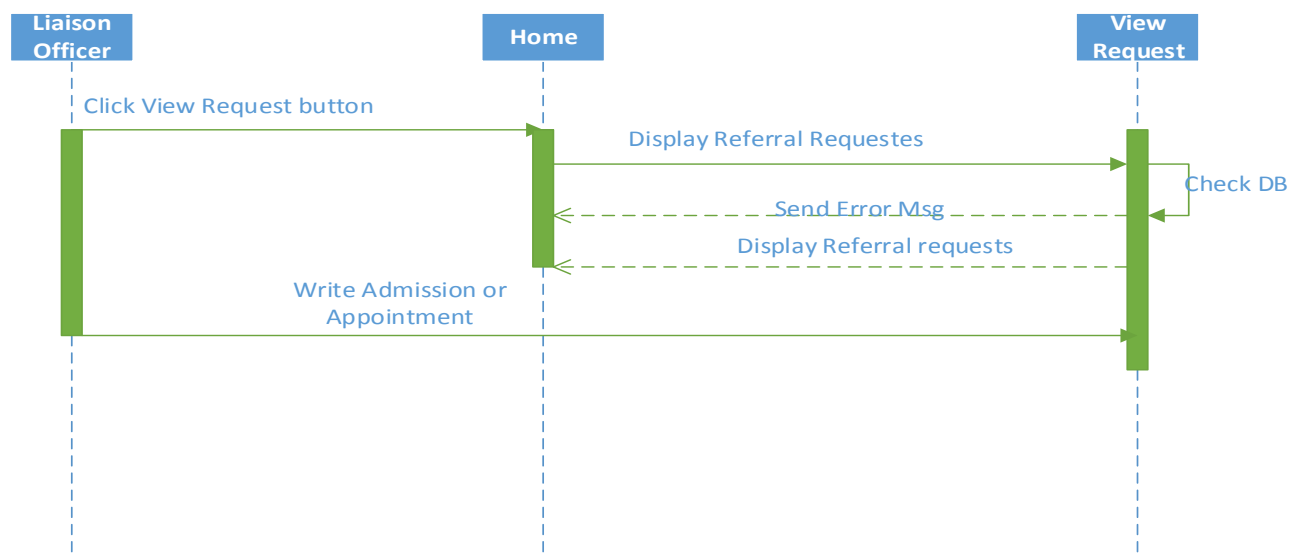


Figure 6: Sequence diagram view requests for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

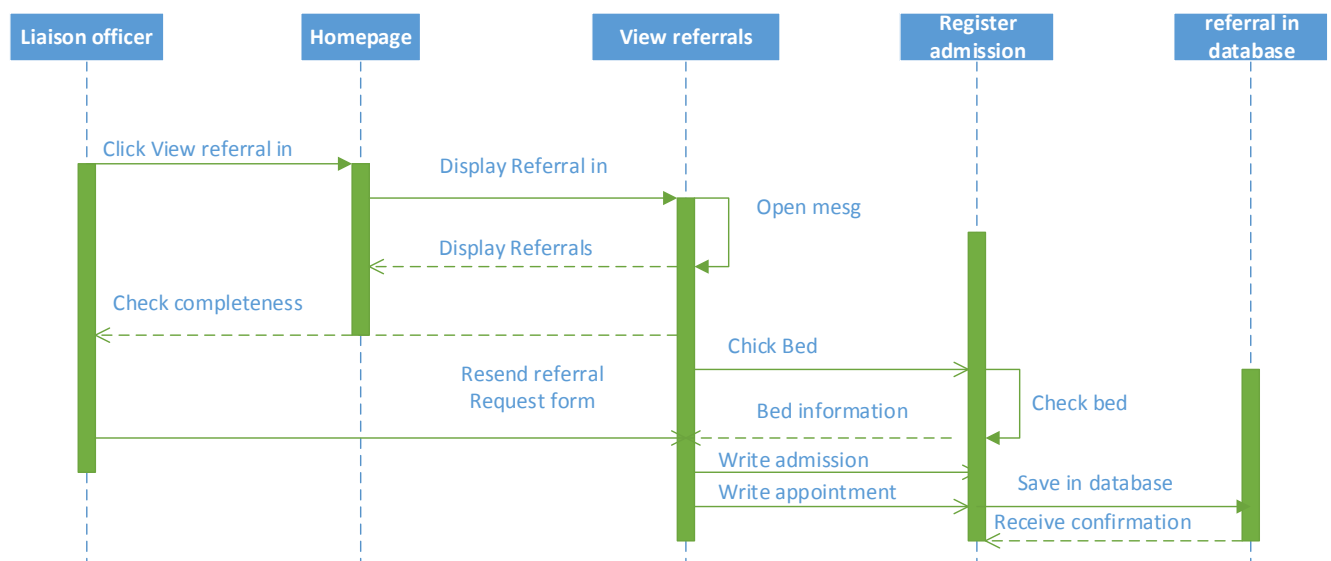


Figure 7: Sequence diagram admission for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

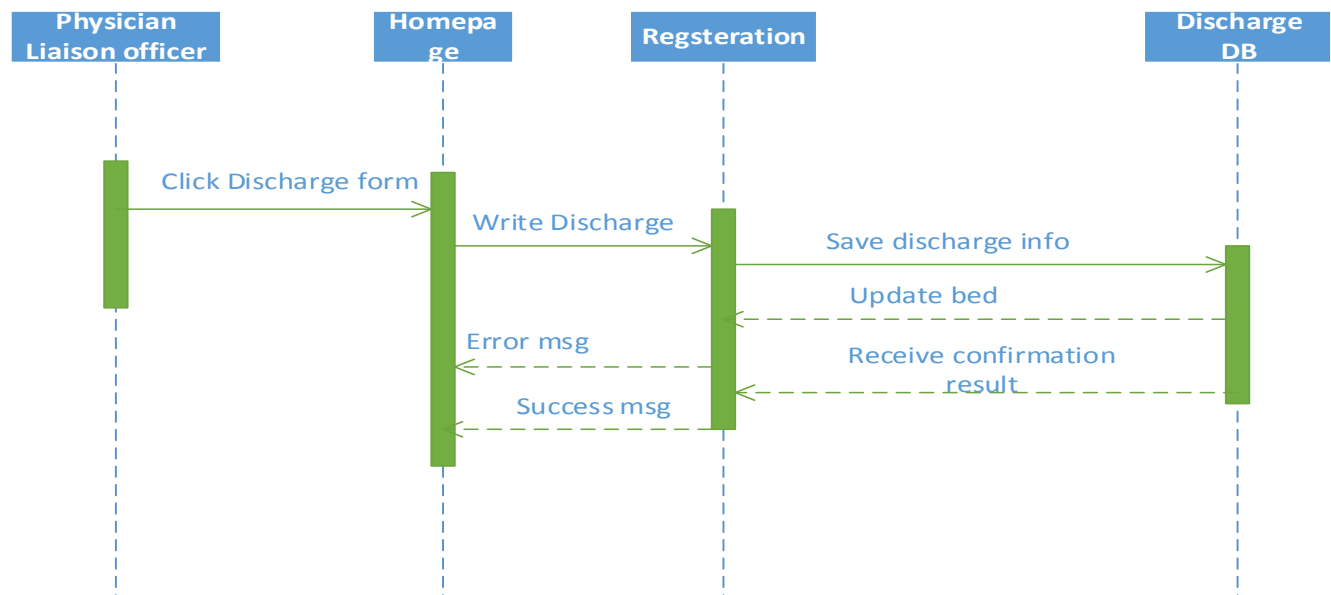


Figure 8: Sequence diagram discharge for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017

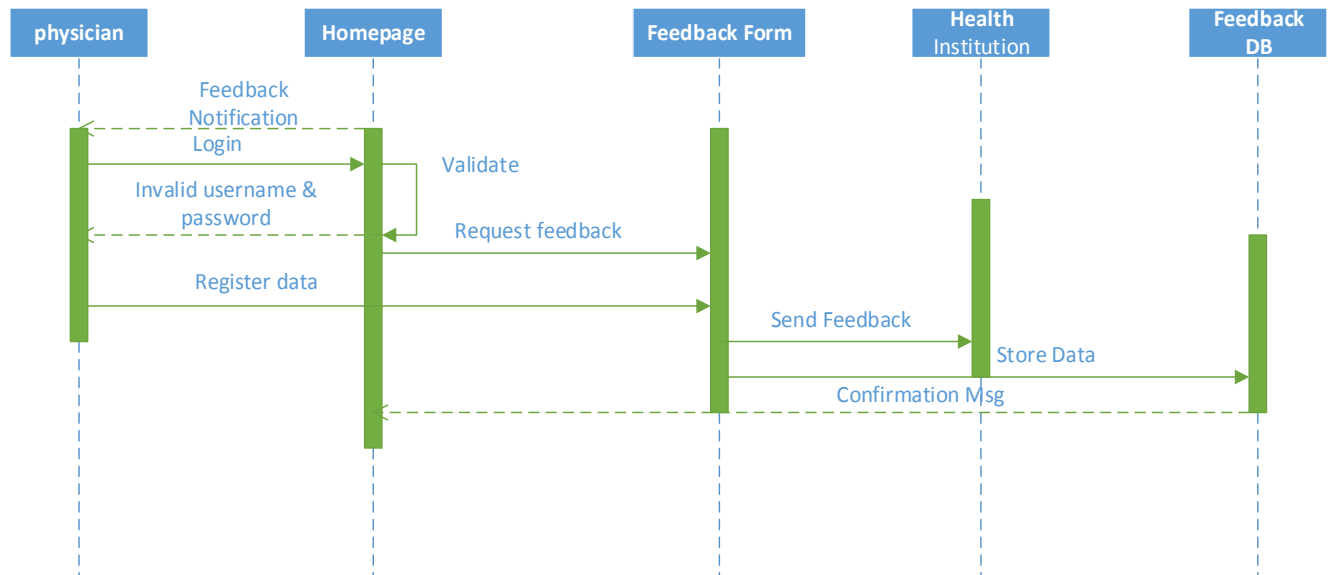


Figure 9: Sequence diagram feedback for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

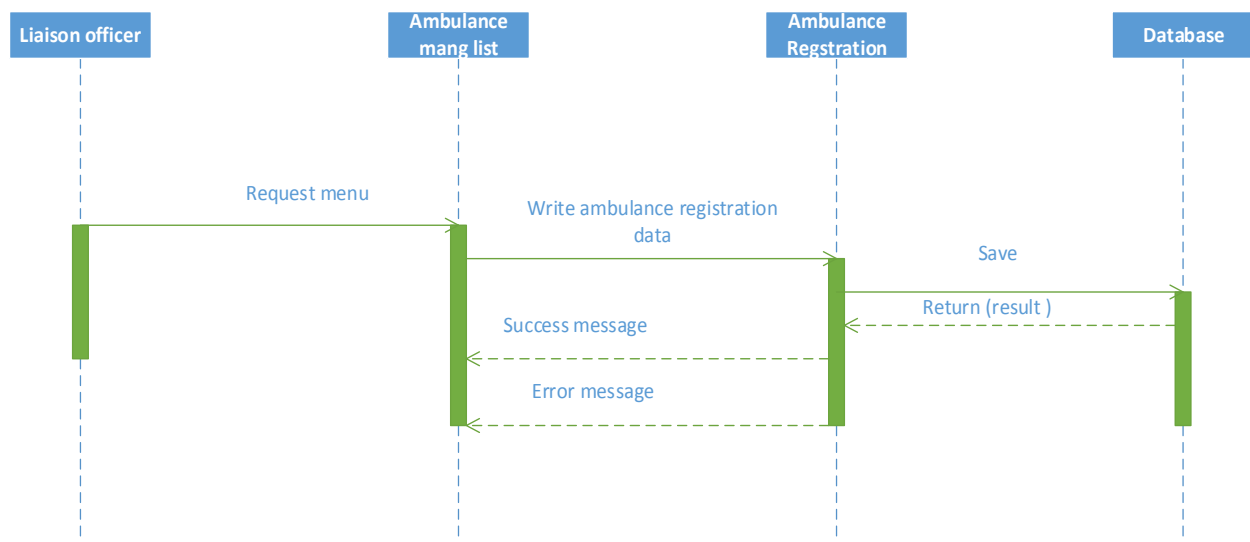


Figure 10: Sequence diagram ambulance management for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

4.6 The Proposed System Architecture

Liaison Service System Database Management Systems (DBMSs) are critical component of modern computing. DBMSs were among the earliest multi-user server systems to be developed, and thus pioneered many systems design techniques for scalability and reliability now in use in many other contexts. Liaison Service data are important sources of various critical information in a health care. Information that differ in content and size. They are accessed and saved onto the databases and data warehouses on a regular basis for the purpose of reveling different social and health matters. The accessibility of these secured information should differ based on the need and the authority of the personnel trying to access it (45).

The four tier system is chosen architecture for liaison system. The first layer runs on the client side, the second layer web server, the third layer process at the middle layer and the four will be the database system. The system will run using web technology.

This architecture provides greater application scalability, high flexibility, high efficiency, lower maintenance, and reusability of components. Since each tier runs on a separate machine, it improves systems performance. Its main function (independence of user interface, web server business rules and data storage/retrieval) only helps when migrating or extending to another script-language/data engine/platform. But this only happens very few times in an Application Lifetime.

The system has a dynamic nature thus the retrieval and entry of data can be performed whenever possible irrespective of time and geographic constraint. Each tier for the proposed system is designated to handle its own determined task.

4.6.1 The Proposed Front Tier (Web Browser)

HTTP are the most computers web browsers from various web protocols already built in. As these tier is the front end with which the users get access to the system through the web protocols they need a serious security controls. The different stakeholders in the system are assigned with different privilege to access functionalities of the system. This is made by varied credentials to each user according to the type of stakeholder group assigned.

The Liaison service system involves participants that need to access and retrieve various data from various locations and devices. The advantage of web applications can be used to make the availability of the services throughout the country. Besides the scalability of the web applications

on the front end, a number of users can be served at the same time from the same or different locations. This issue depends on the capacity of the server, speed of the internet and processing speed of the computer

4.6.2 The Web Server Tier

A web-application to all servers in the cluster when you deploy using the command-line or the browser. Web Services expose a service interface to which all inbound messages are sent. The definition of the set of messages that must be exchanged with a service, in order for the service to perform a specific business task, constitutes a contract. You can think of a service interface as a façade that exposes the business logic implemented in the service to potential consumers.

4.6.3 The Process Tier

In the middle tier placed that the business logic of the liaison service system. The servers hold all the application code and it is organized in four-tier architecture. The web application layer holds all the applications codes that make possible the communication between the database and the front end. In this layer most of the application logic and translates clients processing needs into database queries and brings databases responses with regard to the informational and data need of the user. It act as a bridge between the user and the database and functionalities' the user needs from the system. The applications supported by this middle-tier are data access and update to support liaison service system application which consists of the admission, discharge, bed management, and appointment service process system.

4.6.3 The Proposed the Back End Tier (Database layer)

The back-end tier is the database server where the patient information, care service information, system users' information will be stored. The database is a distributed database where a number of databases at different location collaborate to store and provide patient information. In this layer the different data that are collected via registration, request referral data, feedback data and different data are stored and used for retrieval.

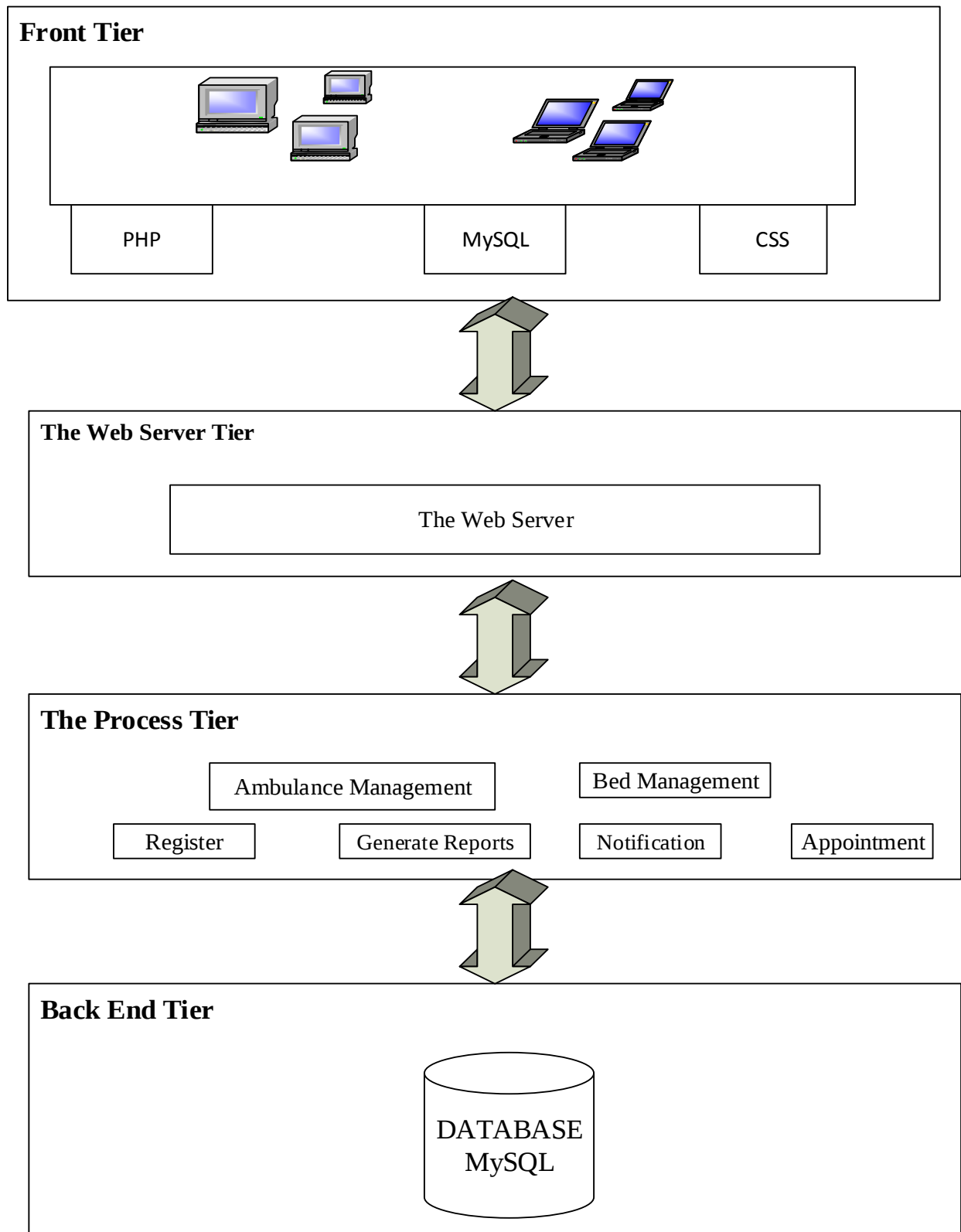


Figure 11: The proposed system architecture for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

4.7 User-interface Flow Diagrams

User interface-flow diagrams for liaison service are typically used for one of two purposes. First, are used to model the interactions that **users** have with your software, as defined in a single use case. For example, a liaison service use case can refer to several screens and provides insight into how they are used(46) .

UI flow diagrams are a diagram that depicts major UI elements and how users transition between them in designing system. It reflects the behavioral view of the single use case, a high-level overview of the UI for your application and also referred to as the architectural approach, because it enables me to understand the complete UI for a system. The liaison service system users can quickly gain an understanding of how the system is expected to work because interface-flow diagrams offer a high-level view of the interface of a system you can quickly gain an understanding of how the system is expected to work.

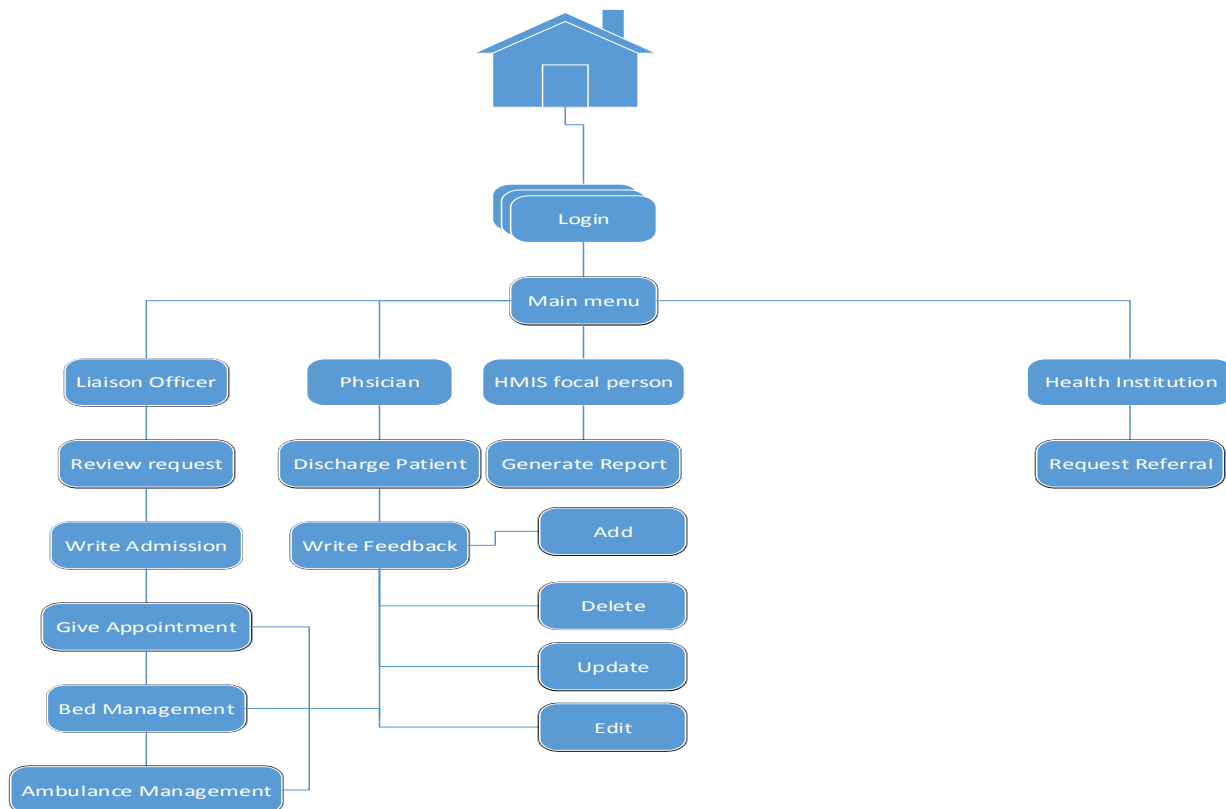


Figure 12: User interface diagram for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

4.8 User Interfaces of the Web based Liaison Service System

Prototyping is an iterative analysis technique in which users are actively involved in the mocking up of screens and reports. The purpose of a prototype is to show people the possible design(s) for the user interface of an application(47). The first liaison system user interface the actors of the system will obtain the home page prior to getting access to the different.

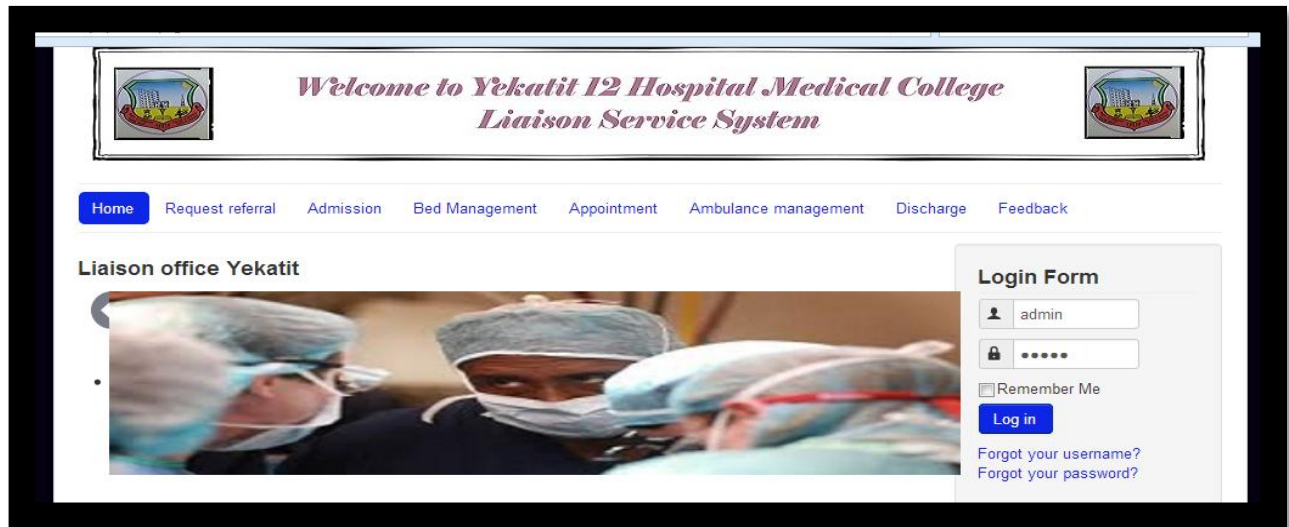


Figure 13: Home page for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.



Figure 14: Login for web based liaison service system at Yekatit 12 Hospital January to May 2017.

When the user enter user name and password need to clicks on the Login link to activate other services. This user interface is a gate way to the different functionalities of the system. Each user before logs into the system must have the appropriate password and user name and privilege assigned by the administrator of the system unless the system display wrong message.

Welcome to Yekatit 12 Hospital Liaison Service

Home **Request referral** Admission Bed Management Appointment Ambulance management Discharge Feedback

MRN:

Date:

From:

Name and Address:

Full Name:

woreda:

City: Sub City:

House Number: Country:

Dx:

Reason for Referral and Rx Given:

Book Yekatit

User Menu

Figure 15: Request referral for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

In this user interface a screen displayed after the user successfully logged in to the system when the users need to send referral requests. After completing the form the user must be click submit button in order to send the request to the hospital.

Welcome to Yekatit 12 Hospital Liaison Service

Home **Request referral** Admission Bed Management Appointment Ambulance management Discharge Feedback

request referral1

Entries: 3 Views: 147 Conversion Rate: 2.04%

Export to: CSV XML

Go Reset

#	Submitter's Username	MRN	Date:	From	Full Name	woreda	City	Sub City	House Number	Country	Dx
1		000003/09	2017-05-17	Kotebe	Abebe Alemu	Kotebe	Addis Ababa	Kotebe	90	Ethiopia	Pneumonia
2		000002/09	2017-05-07	Entoto 1	Erebetto Senbet	7	Addis Ababa	yeka	80	Ethiopia	Malaria with out lab
3		000001/09	2017-05-10	Janmeda	Sosena Kashun	6	Addis Ababa	Arada	89	Ethiopia	Malaria with out lab

Figure 16: View request user interface for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

This user interface is important for liaison officer to see patient View request in order to give beds or appointment in right order.

Welcome to Yekatit 12 Hospital Liaison Service

Home Request referral **Admission** Bed Management Appointment Ambulance management Discharge Feedback

MRN

Cash Sheet number

Ward Number

Select Admission Diagnosis:

- Select
- Malaria
- Cancer

Bed No

Payment

Submit **Reset**

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Figure 17: Admission user interface for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

Admission user interface is used an elective admission to make bed available for patient. As far as possible, planned admissions should not be cancelled. However depending on the priority it may be necessary to do so.

Welcome to Yekatit 12 Hospital Liaison Service

Home Request referral **Admission** Bed Management Appointment Ambulance management Discharge Feedback

Admission

Entries: 2 Views: 55 Conversion Rate: 3.64%

Export to:

#	Id	Submit Date	MRN	Cash Sheet number	Ward Number	Select Admission Diagnosis:	Bed No
1	100	2017-05-25 07:06:43	000098/09	0909	14	Malaria	22
2	99	2017-05-25 07:06:15	000031/09	0909	12	Malaria	10

Statistics

Select a Field:

Select a Date: From: To:

Figure 18: View admission user interface for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

This user interface is used to control and manage all the admission information.

Figure 19: Appointments user interface for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

This user interface is to give appropriate and fair schedule for bed waiting time. In this user interface the liaison officer is used the interface in the case of cold referral cases. After checking all necessary steps listed above and identifying appropriate facility the liaison officer should communicate with receiving facility liaison officer to pass the appointment information to the patient.

#	Id	MRN	Name	Phone	Department	Date of Appointment	Reason for Appointment
1	92	000002/09	Almaze Ayale	251 0911223344	pheda	2017-05-10	spec
2	91	000001/09	Selam Mamo	251 0911330344	surgery	2017-05-17	bed shortage

Figure 20: Admission user interface for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

This user interface is used an elective admission to make bed available for patient. As far as possible, planned admissions should not be cancelled. However depending on the priority it may be necessary to do so.

Figure 21: Ambulance management user interface for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

This user interface is used to register ambulance management which is usually important to control means of transport and the activity of the referral system.

#	Id	Submit Date	Submitter's Username	Submitter's Email Address	Date	Starting and Arrive Time	Slid No. Starting and Arrive Km	Receiving Health Facility	Reason	Number of Passengers
1	102	2017-05-25 07:17:45			2017-05-24	10 20 11 19	11.2 14	Yakob	referral	4
2	101	2017-05-25 07:16:36			2017-05-10	12 00 12 30	5 11.2	Yeka	Referral	2

Figure 22: View ambulance management user interface for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

This user interface is used to see ambulance management to generate appropriate information.

Figure 23: Discharge user interface for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

This user interface is a physician who should complete a discharge summary for the patient should make the decision for discharge. If a patient was referred from another facility the discharging physician should also complete the feedback section of the Referral Form.

#	Id	MRN	Condition on Discharge	Date of Discharge	Number of days admitted	Discharge by	Total Payment
1	98	000003/09	Improved	2017-05-17	10	Meron Tesma	298
2	97	000002/09	Improved	2017-05-17	12	Kasa Kembata	377
3	96	000001/09	Improved	2017-05-17	10	Jeksa Debesa	200

Figure 24: View ambulance management user interface for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

This user interface is used to see all discharge patients which is important information for patient stay time indicator.

Welcome to Yekatit 12 Hospital Liaison Service

Home Request referral Admission Bed Management Appointment Ambulance management Discharge **Feedback**

MRN:

Name: First Last

Followed by: First Last

Treatment given:

Dx:

Outcome:

Submit [Reset](#)

Book Yekatit





Figure 25: Feedback user interface for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

This user interface is used to send the basic and necessary data about patient stay time at the hospital. The system show notification to remind the health professionals to complete the feedback information that should have to be filled after the physician register discharges completely.

Welcome to Yekatit 12 Hospital Liaison Service

Home Request referral Admission Bed Management Appointment Ambulance management Discharge **Feedback**

Feed Backs

Entries: 3 Views: 97 Conversion Rate: 3.09%

Export to:

#	Id	Submit Date	Submitter's Username	MRN	Name:	Followed by:	Treatment given	Dx	Outcome
1	95	2017-05-25 06:50:46		000003/09	Abebe Alemu	Meron Tesma	option 1	option 1	Dead
2	94	2017-05-25 06:49:57		000002/09	Erebeto Senbeto	Kasa Kenbata	option 1	option 1	Referred
3	93	2017-05-25 06:40:18		000001/09	Sosena Kasahun	Jeksa Debsa	option 1	option 1	Improved

Figure 26: View feedback user interface for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

This user interface is used to see all information about the number of referrals who receive feedback.

4.9 User Interface Evaluation

Usability tests identify areas where people struggle with a product and help you make recommendations for improvement. The goal is to better understand how real users interact with your product and to improve the product based on the results. The primary purpose of a usability test is to improve a design.

In a typical usability test, real users try to accomplish typical goals, or tasks, with a product under controlled conditions. Researchers, stakeholders, and development team members watch, listen, collect data, and take notes(48).

Since usability testing employs real customers accomplishing real tasks, it can provide objective performance data, such as time on task, error-rate, and task success. There is also no substitute for watching users struggle with or have great success in completing a task when using a product. This observation helps designers and developers gain empathy with users, and help them think of alternative designs that better support tasks and workflow(49).

So that the newly liaison service system meet with stakeholders in Yekatit 12 Medical college different staff to evaluate prototype. Identify user goals and needs as well. With this information then develop scenarios and tasks for participants to perform that will help identify where the project can make improvements. The timeline for testing prototype will be ready for testing, when the time would like to discuss the results.

During evaluating the interface of a system the users should be representative of the typical user of that application and the number should be of optimal size for the anticipated evaluation results.

As shown in the table 15, the result of the user interface evaluation of liaison service system about 11 respondents was involved. The value of the responses are taken based on the Likert scale that is for the Functionality of the system Questionnaire response Strongly Agree=5, Agree=4, Neutral=3, Disagree=2, strongly Disagree=1(50).

When the value categorized in to disagree, neutral and agree most of the respondents that is 96.4% agreed that the system prototype has a good and clear informational and functional explanation regarding the major functionalities of the system.

Table 15: User interface evaluation of for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

No	Functionality Questionnaire					
	Rate your agreement with the following statements (Place a X in the appropriate column)	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	The system is easy to open and access the different options menus				2	9
2	The system is easy to choose from the different options in the system				1	10
3	The system is easy on using the different functionalities in the given privilege			1	1	9
4	The system display the required information in a format			1	2	8
5	The system saves entered data properly				1	10
6	The system Views saved data accurately				1	10
7	The System response time while saving searching is acceptable			1	1	9
8	All the fonts on the system are readable			1	1	9
9	All the system input fields buttons locations are consistent				1	10
10	Overall, the interface is pleasing and easy to use					11
Result in %				3.6%	10%	86.4%

4.10 Discussion of the Result

The newly Web-based liaison service System for Yekatit 12 Medical College was developed so that end users of the system could manage and transfer patient referral data, bed and ambulance management on online. But also two way communication between the health institutions and hospitals would be easily possible. Using standard liaison service have their own benefits in the way to decreases the time needed admit the patient. But also made possible the redirection of patient to alternative facility based on the information provided in advance to service delivery.

As compared to the existing system, the new automated system design can be integrated all functionality of liaison service activities of the hospital. The system starting the function based on the user personal account which is given by System administrator.

Report generating mechanism become an integral part of the system has a function of generating report based on the informational need of the user. This makes the retrieval of the information from the database easy, customized and appropriate.

Each activities or data of a single patient can be integrate and store uniformly from the time of request referral up to feedback mechanism. Besides that, it improves the security of the confidential information of the patient from unauthorized and illegal body. Commonly the system can help to use at the same time different users in request referral admission discharge, appointment and feedback mechanism validating, recording, retrieving and processing different data and information.

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion

The proposed liaison Service system designing and developing prototype is intended to support a consistent approach to the implementation of liaison service for Yekatit hospital. This System recognizes integration and coordination between health facilities on referral, bed and ambulance management.

The existing liaison service system is functioning manually based on the Federal Ministry of Health National Referral System Network Development Liaison Officer Reference Manual. This manual system identify problems regarding retrieval, register, validating, bed management appointment and feedback processing of the hospital system.

There is no doubt that having a web based liaison service can improve the quality of health service and timeliness of health institution communication. Beside Efficient, secure, and readily accessible communication among providers would improve the continuity of care, increase the timeliness of admission and treatments, and reduce the frequency of adverse events.

Systems analysis is the requirements determination phase of the systems development life cycle (SDLC). In this phase developers determine how the current system functions and what users would like to see in a new system.

For this newly developed system, the Unified Modeling Language (UML) is used as standard method for object-oriented analysis and design of software systems. Accordingly, UML is part of curricula in many universities engaged in the field of liaison service system. These findings were gathered during continuous evaluation of a project, in exposed to the real world of systems design, by making the requirement analysis for a customer relationship system.

Resulting the required analysis, system use cases were used to describe the basic functions of liaison service system boundary and illustrate detailed description of the activities.

In this newly project, system requirements are identified by consulting the users. Functional requirements are the system keep the basic information while non-functional one are the system available 24 hours in day.

As a model of the new system a prototype allows for several forms of communication. First, it allows the developer to communicate to the users their understanding of the requirements. The system includes different components like screen displays that provide navigation through the system, forms that capture data and reports that the system produces. As a final point user interface prototype design shows part of the system which the user interact to the system.

Evaluation user also proves that the system meets users interface factors such as screen terminology, system capabilities, user behavioral factors, such as attitudes, intention to use; completeness, timely available , and format of layout and perceived usefulness and delivered to the health workers of the study health facility. Therefore, regarding implementation of the system in the hospital and further researchers to extend the developed prototype are suggested in the recommendation section of the research project.

This liaison service system will make corrections and changes to the prototype based on user feedback and the users will view or interact with the prototype and make changes to the requirements. This continues until they come to an agreement on the requirements or run out of time or money or both

5.2. Recommendations

As an effect of the ageing and increasing population in general, the number of citizens with chronic and communicable diseases is increasing, especially on developing country. This is a great challenge for both the well-being of the citizens and the public health care systems. Health care solutions provided by information and communication technology (ICT), also known as eHealth, offer one solution to this problem. The tools and services which contribute to eHealth provide better and more efficient health care services for all.

FMoH develop HSTP strategic objective on ICT use in the health sector focused on tele-education, telemedicine and electronic health management information system (eHMIS) and Electronic Medical Records (EMR).

So I recommended that web based liaison service empower hospitals to take more responsibility for their people health and quality of life, and they lead to better cost-efficiency in the health sector. The use of the system allows a mutually beneficial collaboration and involvement of patients and

medical professionals in the prevention and treatment of diseases. Overall, the system can be used to ensure the top-quality health care of citizens.

5.2.1. Federal Ministry of Health and Addis Ababa Health Bureau

To implement the newly liaison service system FMOH and AAHB should play important role with external stakeholders, and also Evaluation of the implementation of the web based liaison service in facilities such A&D, bed management and referral services should be carried out by FMOH and AAHB.

5.2.2. Yekatit 12 Hospital Medical College

Yekatit 12 Medical Hospital College should be able to provide the necessary infrastructural support during the implementation of the system like electric power, internet access and computers.

5.2.3. To Researchers/Students

The newly system has limited functionalities that do not handle financial system and referral management etc. So the researchers/students should work on how to integrate the system with other systems and increase the overall functionality domain of the system.

5.3 Implementation Strategy

Liaison service system which are the system registers, update, notified and manage patient information by liaison officers, physician and health institutes. A single failure on a transaction of information may cause a serious damage on the provision of care and also on the day to day activity of the physicians at the health care setting. The web based liaison service system has to function 24 hours a day and 7 days a week. Ethical, legal and technical issues linked to accuracy, security confidentiality and access rights are set to increase as the systems come online. These issues become more pressing with the current movement to promoting consumer empowerment and information ownership which is leading towards patient records accessible the criticality issue. Major technological issues like maintainability, reliability and availability are also concerned.

Web based liaison service systems lie at the center of any computerized health information system. Without them other modern technologies cannot be effectively integrated into routine clinical workflow. The application of knowledge, skills, tools and techniques to project activities to meet project requirements(51). And also meet specific scope, time, cost, and quality goals of projects,

they must also facilitate the entire process to meet the needs and expectations of the people involved in or affected by project activities.

Throughout the deployment of the system there should be an IT personnel who will be in charge for providing any technical and professional guidance. Because of the web based liaison service system is a web based system any failure regarding the software can be handled.

Electric power supply may pose a constraint on a proper use of the system. And also internet connection and band width strength are vital for the full functioning of the system. Because of the issues of security and internet traffic a dedicated virtual private network is recommended to connect the liaison service system with the different health care service providers and health institutions for the secure information.

In web based information system a backup, or the process of backing up, refers to the copying and archiving of computer data so it may be used to restore the original after a data and information lost event. So that, in this project implementation need to consider backup the primary purpose is to recover data after its loss, be it by data deletion or corruption.

5.3.1 Hardware and software

This portion provides the hardware and the software requirements needed for effective and efficient running of the system. As this system is using four tiered architecture for the full functionality of the system; best performance is needed thus the below listed are recommended for the implementation. In addition to these, security issues have to be taken into consideration thus it is recommendable that the servers have to put in a safe and secure room.

5.3.2 System Requirement

This section describes the hardware components and software requirements needed for effective and efficient running of the system.

Table 16: Server side hardware requirements for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

COMPONENT	RECOMMENDED
CPU	2Quad Core Intel® / Core i(X) or Xeon processors at 2.33 GHz – 3.5 GHz Series Processor (implementing 64 bits architecture)
Hard disk	3 TB SAS disk array at 10k rpm (3 TB).
DVD-ROM	48 DVD+/-RW
Memory	From 12 GB up to 64 GB
Screen/Video adapter	17" Flat Panel
Backup streamer	Digital tape streamer with the same capacity as the total disk space
NIC	1GB, Network card supported by the network installed 100 Mbps for best performance
Number of users	2,200 to 3,600 users available access the system. Database Engine With 2,200 to 3,600 users easily to manage.

Software Requirements

Table 17: Server Side software Requirements for web based liaison service system at Yekatit 12 Hospital Medical College, January to May 2017.

COMPONENT	RECOMMENDED
Operating System (OS)	Windows Server 2003/2008 64bit (Server edition is required for networks with > 10 workstations)
Microsoft.NET Framework	.NET 3.5 SP1 is a requirement for SQL Server 2008 when you select Database Engine, Reporting Services, Master Data Services, Data Quality Services, Replication, or SQL Server Management Studio

REFERENCE

1. Federal Ministry of Health National Referral System Network Development Liaison Officer Reference Manual. 2013;
2. Leigh H., Liaison Psychiatry. Funct Consult Liaison Psychiatry, Washington hospital Center ER One Institute under contract to the California Emergency Medical Services Authority (EMSA).);11–5. 2015;
3. Askale R., Referral Management Centers Addis , Addis Ababa university school of public health and school of information science health informatics programme school of information science 2012
4. Craig D., Hospital incident command system Healthcare Continuity Management and Washington Hospital Center ER One Institute under contract to the California Emergency Medical Services Authority (EMSA). , 2006
5. Challenge Forward Theway. Federal Ministry Of Health 16 Th National Annual Review Medical Service Directorate. 2014;1–6.
6. Federal Ministry Of Health Ethiopia, Health Extension Program, 2012;1(September):1–24.
7. Yilebes A., A Framework For Multi -Agent Inter Bank Payment And Settlement in the organization Irhanu, 2009
8. Wong Rex., Improving Of Ethiopian Hospital Reform Implementation Guideline, Infection Prevention Standards, In Suhul Hospital, Northern Ethiopia. 2013;
9. Biraud G. Liaison offices in the united nations system., liaison Off United Nations Syst. 2007
10. Brisbane., Enhancing Integration : The General Practice Liaison Officer Model. Gen Pract Liaison Off Model. 2011;(General Practice Queensland).
11. Cervantes K, Kalter HD, Snow J., Rapid Assessment of Referral Care Systems. Rapid Assess Ref Care Syst, A Guid Progr Manag. ,2003;
12. Omaha K, Mele V., Study of a patient referral system in the Republic of Honduras. ,1998;13(4).
13. Carlos T, The National Liaison Officer : Roles And Responsibilities Iaea Department Of Technical

Cooperation. 2008;(February).

14. Kwok T, Lum ACM, Chan S, Ma M, Lee D, and Woo J., A Randomized , Controlled Trial of an Intensive Community Nurse – Supported Discharge Program in Preventing Hospital Readmissions of Older Patients with Chronic Lung Disease., 2004;1240–6.
15. Queensland T., Length of wait lists to access specialist clinics in the public system is problematic for, Health., GP Liaison Off. 2008;
16. Jhanjee A, Kumar P, Srivastava S, Bhatia MS. A Descriptive Study of Referral Pattern in Department of Psychiatry of A Tertiary Care Hospital of North India., 2011;14(1):0–2.
17. Carlo G., Mehdi J., Dino M., Fundamentals of software engineering.
18. Robison S., eHealth Strategy ,Scottish Gov Vis is that by 2020. 2017.
19. Fagan M., web enabling referral information systemliaison service system. 2000;5(1).
20. Conejar RJ, Kim H. Web-Based Service System Architecture for. 2015;95(Cia):115–8.
21. Director Of Health Services National Referral System. 2006;(April 2003).
22. Elsabet S., Patient Pathway Management Referral Facilitation Patient Pathway Management Referral Facilitation.
23. Riordan O., Imj J., A Web-Based Electronic Neurology Referral System : A Solution for an Overburdened Healthcare System A Web-Based Electronic Neurology Referral System,2017;
24. World Health Organization Geneva The Role Of Hospitals at the First Referral Level., 1987.
25. Murnik M, Randal F, Guevara M, Skipper B, Kaufman, A. Web-based Primary Care Referral Program Associated With Reduced Emergency Department Utilization., 38(2).
26. Abrahaley T., Improving Referral feedback for patients transfer from other health facility among health care provider in Mearge Hospital, Tigray region, North Ethiopia, Msc thesis, 2013;(October).
27. Isaac N., Vascular Surgeon Consulant Vasc Endovasc Surgon. 2010;3354128.
28. Smith L, Rscn, Weaving the seamless web of care : an analysis of parents perceptions of their needs following discharge of their child from hospital. 2000;31(4):812–20.
29. Kim Y, Chen A., Keith E, Kushel M.,Not Perfect , but Better : Primary Care Providers '

Experiences with Electronic Referrals in a Safety Net Health System. 2009;614–9.

30. Tongco MDC. Purposive Sampling as a Tool for Informant Selection. 2007;158:147–58.
31. Abdullahi F., Makurdi U., Design And Implementation Of A Web-Based Gis For Patients Referral To Hospitals In Zaria Metropolis. 2011;8(July).
32. Care S, Straus S., Chen A., Yee H.. Support rand For More Information Implementation of an Electronic Referral System for Outpatient. 2011;(October):1337–46.
33. Alemu N. Designing of a web based Social Health Insurance Information System. Addis Ababa Univ. 2016;Health Inf.
34. Siraj S., Design of a Web Based System to Support Nursing Care Planning For Wolaita Sodo Outona Referral Hospital, Msc thesis, 2015;
35. Mohammed N, Munassar A, Govardhan A., A Comparison Between Five Models Of Software Engineering. 2010;7(5):94–101.
36. Vliet H Van., Software Engineering : Principles and Practice. How to develop Syst. 2007
37. Williames L. Use Case-based Requirements. 2004;(Ues case based requirements for system development).
38. Health Sector Transformation Plan. Fedral Ministrt of Health, 2015/16 - 2019/20 (2008-2012 EFY) 2007;
39. Pressman R., Software Engineering. seven edit. burr ridge dubuque bangkok bogota caracas kuala lumpur, Newyork; 2001.
40. Vliet H Van., Software Engineering : Principles and Practice. Softw Eng Princ Pract. 2007;
41. Felici M., Class Diagrams. How to develop Class diagram, 2004;
42. Design and UML Class Diagrams Suggested reading: Practical UML: A hands on introduction for developers <http://dn.codegear.com/article/31863>.
43. Sommerville I. Software Engineering. Ninth Edit. Horton M, editor. Boston; 2011.
44. Poranen T, Erkki M, Nummenmaa J. How to Draw a Sequence Diagram. (Project 51528).
45. Hellerstein JM, Stonebraker M, Hamilton J., Architecture of a Database System. 2007;1(2):141–259.

46. Scott J., Online Application User Interface And Process Flow Diagram. 2017;(August).
47. Ambler S., User Interface Design : Tips and Techniques. Build Object Appl That Work Process Patterns. 2000;10.
48. Overview A. Usability Testing Basics. What to test, 2008; Available from: www.techsmith.com
49. Dubois A, Purcell K. Usability Test Plan Prepared for : Better World Books.
50. Molich R., Usability Test for system development in the case of Object oriented 2005;2001(August).
51. Robert PM, Information Technology Project Management, Revised 6ed 2010.

Annex I - Information Sheet

My name is Atkilt Michael. I came from Addis Ababa University and I am currently conducting a research project for the partial fulfillment of master's degree in health informatics. The purpose of this research project is to design and develop prototype web based liaison service System in Yekatit 12 Hospital Medical College.

I would like to ask you some questions related to the topic I mentioned above, the information you provide are confidential and will be used only for the purpose of the study. I would like to ask you to give your honest answers. However, you have the right not to respond if you are not voluntary.

The answers you give on this form will help in better understanding of the situation the existing system in the hospital and will help in designing and develop new project. Your honest and genuine participation in responding to the questions prepared is very important and highly appreciated.

May I get your permission to continue?

Yes ☐ Go to the consent form

No ☐ Stop

Principal investigator: Atkilt Michael

Email atkiltm@yahoo.com

Annex II- Consent form

I have been informed that this questionnaire is part of research project that used to design and develop prototype web based liaison service System in Yekatit 12 Hospital Medical College. Understanding the existing situation will be used as a base line for designing intervention program to alleviate the liaison service problems. The proposed project will be beneficial for all health professionals and health care organization. Finally, I am assured that confidentiality of my response will be strictly maintained. Therefore, I am agreed to participate in the study by signing this form.

The study participant's Signature_____

Date _____

Annex III -

Guide Line of Interview used for Design Web Based liaison Service system information to identifying requirement of the system and to analyze the system

Data and Process

1. What types of information is processed in liaison service the current system?
2. What data are included in each types of information processed?
3. How are data collected and stored?
4. What are the problems on the existing forms?
5. How do you retrieve patient information in the current system?
6. How do you get patient history?
7. How do you record data during the assessment of the patient in the current system?
8. That information is included in the assessment record?
9. What are the current problems on the data processing?
10. What types of error happen most in nursing care record process?

Report/ Communication

12. How is the collected data used or analyzed in the current system?
 13. How does patient information flow among the professionals?
 14. Who needs what information and when?
 15. How frequently do you review / prepare the report in the current system?
 16. For who does the report submitted?
 17. How do you prepare report currently?
 18. What does the information communication infrastructures look like in the organization?
- (Placeholder1)

People

19. How is patient information accessing privilege provided for the professionals?
20. Who is responsible for patient record error and how?
21. Who make the reports?
22. Did the nurses have computer skill?

Management (Procedure)

23. Where are the leverage points and critical processing points where a change in procedure could significantly improve efficiency and service?
24. Do you have guide line to help your assessment?
25. What are patient information recording procedures include?
26. How is a problem on patient information recording process handled?
27. Do have any system/mechanism to trace the problem?

Software

28. Is there any planned approach or computer system to improve the current system?
29. Do you have any software used to prepare reports? Which software?
30. Do you have computer network for sharing of the information such as reports?

Hardware

31. Do you have a computer? How many?
32. For what purpose do you use it?

Annex IV

User interface evaluation of Web based liaison service system.

No	Functionality Questionnaire					
	Rate your agreement with the following statements (Place a X in the appropriate column)	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	The system is easy to open and access the different options menus					
2	The system is easy to choose from the different options in the system					
3	The system is easy on using the different functionalities in the given privilege					
4	The system display the required information in a format					
5	The system saves entered data properly					
6	The system Views saved data accurately					
7	The System response time while saving searching is acceptable					
8	All the fonts on the system are readable					
9	All the system input fields buttons locations are consistent					
10	Overall, the interface is pleasing and easy to use					
Result in %						

Annex V

የካቲት 12 ሆስፒታል ሚዲካል ኮሌጅ
Yekatit 12 Hospital Medical College **№ 03394**

Ref. No. _____
Date _____

PATIENT REFERRAL SLIP

To _____ Hospital _____ Department _____
From _____ Hospital / H. center / _____ Department _____
Time _____
Name of Patient _____
Age _____ Sex _____ occupation _____
Address: Woreda _____ Kebele _____ House No. _____
Clinical Finding _____

Diagnosis _____
Investigation Result _____

Rx Given _____

Reason for Referral _____
Referred by _____
Name of Physician _____
Signature _____

№ 03394
Ref. No. _____
Date _____

FEED BACK

To _____ Hospital / H. center _____ Department _____
Name of Patient _____
Finding _____

Diagnosis _____
Headment Given _____
Followed By:- _____

Patient referral and feedback format

የካቲት 12 ሆስፒታል ሜዲካል ኮሌጅ
YEKATIT 12 HOSPITAL MEDICAL COLLEGE

DISCHARGE SUMMARY

Date: _____

Name: _____

MRN: _____

WARD: _____ BED: _____

Date of Admission: _____ Date of Discharge: _____

Hospital Course (Hospital Summary): _____

Diagnosis (including all Secondary Diagnosis): _____

Diagnostics Procedures and Laboratory findings: _____

Instructions for Home

Diet: _____ Activity: _____

Specific Care Needs: _____

Medications

Drug:

Dosage:

Frequency

Condition on Discharge

Cured Improved No Change Worse Discharge against medical advice

Follow up Care: _____

Appointment Date: _____ Place _____ To Be seen by: _____

Physician Signature: _____

Date: _____

Nurses Signature Date: _____

Date: _____

Patient or Family Signature: _____

Date: _____

Discharge form