ADDIS ABABA UNIVERSITY
School of Information Science
and
School of Public Health

Project conducted in partial fulfillment for the Degree of M.Sc in Health Informatics Program

Designing Electronic Key Performance Indicator Information System for Yekatit 12 Hospital

By
Getenet Kebede

June 2015

ADDIS ABABA

Affiliation: Addis Ababa University, School of Information Science and School of Public Health
Program: M.SC in Health Information

Project title: Designing Electronic Key Performance Indicator Information System for Yekatit 12 Hospital, Addis Ababa

Student's Name: Getenet Kebede

Date: June, 2015

Name and Signature of Members of the Examining Board

Prof.Ahmed Ali _____ _____

Advisor Date Signature

Dr. Rahel Bekele _____ _____

Advisor Date Signature

Dr. Solomon Teferra _____ _____

Examiner Date Signature

Dr. Ayele Belachew _____ _____

Examiner Date Signature

Dedication

I dedicate this work for my whole family, and friends who helped me throughout this project.

Acknowledgement

First and foremost, I would like to express my deepest gratitude to my advisors Dr. Rahel Bekele for her inspiration, drive and technical assistance, and Prof.Ahmed Ali for being helpful and co-operative in articulating the knowledge area of the study. Thank you both for your timely reviews, constructive comments and considerate advices during the period of the project.

I also express my deep gratitude to the Yekatit 12, Hospital KPI office and, other staff for their valuable guidance, provision of relevant resource and for consistently helping me to complete this project.

I extend my sincere thanks to all respondents who were tirelessly engaged in interview and further discussions that helped me realize this research project.

Finally, I appreciate the help of my friends Ato Yoseph Woubalem and Ato Ephrem Tekele.

Table of Contents

List of Tables **Page numbers**

List of Figures/Pictures **Page numbers**

Acronyms and Abbreviations

BPR	Business Processing Re-engineering
CRCPTs	Curative and Rehabilitative Core Process Teams
CSO	Central Statistical Office
DFD	Data Flow Diagram
EHR	Electronic Health Record
EKPIIS	Electronic Key Performance Information System
EMR	Electronic Medical Record
FMoH	Federal Ministry of Health
GB	Governing Board
HIT	Health Information Technologies
HMIS	Health Management Information system
HSDP	Health Sector Development Program
HTML	Hyper Text Markup Language
ICT	Information Communication Technology
KPI	Key Performance Indicator
LCMS	Living Condition and Monitoring Survey
MDGs	Millennium Development Goals
MSD	Medical Services Directorate
OOSAD	Object-Oriented Systems Analysis and Design
PHID	Public Health Infrastructure Directorate
PHP	Hypertext Pre-processor
RAD	Rapid Analysis and Design
RHB	Regional Health Bureau
SDLC	System Development Life Cycle
SMT	Senior Management Team
SQL	structured Query Language
SA&D	System Analysis and Design
SSADM	Structured Systems Analysis and Design Methodology
UML	Unified Modeling Language
ZDHS	Zambia Demographic Health Survey

Abstract

Electronic key performance indicator information system (EKPIIS) is a computerized system of accessing the report of performance indicator in real time of hospital within a single practice. The content of an EKPIIS is analogous to the paper record, but the electronic format creates usable data in hospital status studies, improves the quality, reliability and timely report that create efficient communication among stakeholders and makes easier management of health plans and strategy. The research project endeavored to design and integrate those functions to pave the way for the implementation so as to achieve efficient flexible information system that offers the customer and staff better satisfaction.

Phased development, Rapid Application Development (RAD) methodology of object-oriented approach was applied to the study of the design system. Interview and document analysis were used as a main tool to capture the business system requirement along with observation. Unified Modeling Language (UML) development techniques were applied in the process of requirements capture, model organization business system analysis and design. Argo UML and Microsoft Visio 2010 Software were employed in analysis and design models diagramming.

Data captured and guideline and standard documents referred were illustrated using activity diagram, use case descriptions, data flow diagram, contextual diagram, class diagram, entity relation diagram, user interface prototyping in the analysis and design models as appropriate to model analysis and design of the system under study. Evaluation and feedback were taken for consensus between the users and the designer.

The researcher recommends the implementation of the design in the Yekatit 12 Hospital, Regional Health Bureau or any concerned body.

CHAPTER ONE
INTRODUCTION

1.1 Background

In this age of information, almost all fields of endevour treat information systems as a need. Indeed, every activity in our daily life today requires people to get involved in the use of information systems which can support business operations to increase productivity, and help managers make decisions [1].

One of the sectors that ICT played crucial role is the health system. Advances in Information Communication Technology (ICT) have yielded substantial dividends to both individual and public health. Both at local and national level, ICT are changing the delivery of health care and how health systems are run. It supports critical functions by improving the ability to gather, analyze, manage and exchange information in all areas of health, from research on molecular genetics to large scale humanitarian interventions and disaster relief [2].

In health systems, ICT are being used to improve the timeliness and accuracy of public health reporting and to facilitate disease monitoring and surveillance. They are fundamental in distance learning, and in enabling rapid response in emergencies. Furthermore, the strategic use of eHealth can support sector-wide planning as well as coordinating decentralized district health systems, and improving the ability to plan, budget and deliver services [2].

Currently, health sectors apply different electronic health technologies to enhance the service delivery and decision making at all levels of the health system. Some of the eHealth technologies used in the health sector are: Electro Medical Record(EMR), An Electronic Health Record(EHR), A Patient Health Record(PHR), Telemedicine(telehealth),mobile health(mHealth), Decision support systems(DSS), Electronic medication services, health information systems facilitate gathering, aggregating, analyzing and synthesizing data from multiple sources to report on health situation and trends (disease burden, patterns of risk behavior, health service coverage and health system metrics) etc these are some of electronic systems that applying in the health sector [3].

The Federal Ministry of Health (FMoH) has recognized the benefits of ICT as a tool to support the health sector. The FMoH, supported by its technical partners, is involved in a number of ICT projects and services in order to enhance the health care service delivery and to get the above stated function of ICT (1). Those projects and services have been classified into the following major areas: Data Warehouse, Electronic Medical Records (EMR), Geographical Information Systems (GIS), Health-Net, IT Operations Support, Tele-Education, Telemedicine, Human Resource Information System (HRIS), Website Development, Health Integrated Financial Information System (HIFIS), Electronic Health Management Information System (eHMIS),

Woreda-Based Planning System, Other Systems (Logistics Management Information System, and so on)[1].

One of the information systems our health sector requires is electronic key performance information system which means the efficiency, effectiveness and quality of hospitals measure by key performance indicators and using electronic information system to measure the hospital performance which enable the stakeholder to generate relevant, quality and timely report for decision making and to measure the status of hospital related objective and strategy.

Currently, the FMOH and Regional Health Bureaus (RHBs) are using access database and excel to report KPI results, and manually report the performance of hospitals, but reporting manually has its own problems like quality and it takes time to report the performance for stakeholders and using access database and excel has its own problems like it is not really intended to support many users accessing the database simultaneously, it does not provide separate user account with different passwords and has poor security, it does not provide the same level of record and field locking provided by some database management systems etc [4].

The advantage of this electronic key performance indicator information system, for the hospital is to generate timely and an accurate monthly, quarterly and annual reports on performance indicator and make accessible to all stakeholders where they are able to undertake hospital performance monitoring activities in collaboration [5]. Thus, the general objective of this project is to design an electronic key performance indicator information system to the Yekatit 12 Hospital.

1.2. Statement of the problem

In the previous years, not far too much, interpreting and using of information for decision making has been abrupt. Nowadays, as the result of technological advancement, management and usage of information have become improved. Computers, networks and different software take the lion's share on these developments [5].

In Ethiopia, the FMOH is using different information systems to enhance the health care deliveries, and decision making process and performance monitoring activities. Ethiopia's health directorate performance monitoring has been conducted by medical directors in hospitals using different methodologies, where some hospitals have established hospital performance indicators. In some regions, supportive supervision has been conducted and some regions have established regular hospital review meetings. However, there has been no systematic effort to share performance monitoring experience between regions and the efforts of stakeholders (e.g. MSD staff, CRCPTs, hospital staff and partners) are poorly coordinated [5][6].

Currently, the FMOH and RHBs are using access database and excel to report KPI results, but using access database and excel has its own problems like it is not really intended to support many user accessing the database simultaneously, it does not provide separate user account with different password and has poor security, it does not provide the same level of record and field locking provided by some database management system etc .over using SQL database. And using manual system has the following problems: Inconsistency in data entry, room for errors, missing information, Reduction in sharing information and customer services, Time consuming, costly to produce reports and Lack of security etc [7].

Preliminary investigation of process related to KPI indicates that the access database they are using is not protected by password and any one access the system, it is not easy for new member of the office to easily use the system and it cannot have help menu even to guide (not user friendly), the KPI office collecting performance result of departments and reporting the hospital KPI report is manual and there is also internet connection problem and ICT department to troubleshoots problem faced in hardware and software of their computers and so on.

It is therefore, found necessary to design and develop a new information system for hospital key performance indicator information system to generate report. This is believed to help stakeholders to monitor hospital performance, focusing on a core set of Key Performance Indicators (KPIs) to ensure the effectiveness, efficiency and quality of services provided.

1.3.1. General objective

The general objective of this project is to design an electronic Key Performance Indicator Information System for the Yekatit 12 Hospital.

1.3.2. Specific objectives

The project will meet specific results and hence, the specific objective focuses to:

- collect requirement of the system.
- identify business requirement of the system.
- structure and depict the system requirement analysis using models.
- design the system and interface prototyping.

1.4. Significance of the project

It is expected that the new system design will have a significant impact as it systematically laid a foundation for the implementation that enables easy and much flexible data analysis and report aggregation in a timely and easy manner. Designing this system will have a significant impact for the KPI focal person ,hospital senior management teams (SMTs), Governing Boards (GBs) and higher health offices to monitor hospital performance, focusing on a core set of Key Performance Indicators (KPIs) to ensure the effectiveness, efficiency and quality of services provided. Designing this system could have the following significances.

- The hospital KPI focal person can easily enter all KPI elements and automatically generate KPI results and generate report in timely manner. The outcome of this Project is that KPI focal person can make use of this system to improve the quality and the total time taken to generate report for all stakeholders.

- Based on the report generated from the system, the hospital management will have a timely and reliable data about hospital performance status. This project will help to generate this information and report easily [5].

- The KPI information system could have a benefit for the hospital for collecting, organizing, analyzing and generate the hospital performance report that help to know the hospital status and for adequate planning and budgeting, for keeping adequate records, and service reporting purposes as a source of relevant information[5].

- The FMOH should review all regional KPI reports to compare hospital and regions, to monitor changes over time and to calculate national averages. The KPI information system can be used to get quality, reliable and timely report that enable the above stated purpose of KPI [5].

1.5. Project scope and limitations

The main aim of this chapter is to identify the project scope and limitation, in order to make the study manageable by focusing the inclusion and exclusion criteria of the project, and the researcher classified in facility category, department category, activity category, performance category and discussed below.

1.5.1. Inclusion

Facility Category

The project was conducted in Yekatit 12 Hospital.

Department category

In this project outpatient, inpatient, emergency and maternity departments were involved. Which are contributes major data set for the reportable KPI results.

Activity Category

The major activities that were done are studying the existing system and identify its gap gathering, analyzing and designing the requirements and documenting it.

Performance indicator category

Instead of trying to monitor everything, hospital SMTs, Governing Boards and RHBs need a core set of indicators that provide all the information they need to ensure that hospitals provide effective, efficient and quality services. These KPIs should describe the minimum information needed to effectively govern and manage hospital performance [5]. There are 36 National Key Performance Indicators which are organized into 10 categories: hospital management, outpatient services, inpatient services, maternity services, referral services, pharmacy services, productivity, human resources, finance and patient satisfaction [5].

1.5.2. Exclusion

Activity Category

In this study implementation, maintenance and review of the software and final testing will not be done because of time and resource constraints.

Health Institutions

This project has covered the design of KPI information system for Yekatit 12 Hospital; other hospitals are not included in this study.

CHAPTER TWO
LITERATURE REVIEW

2.1. General Literature

2.1.1. Introduction

There is so much information in the general area of health informatics applications. Nonetheless, there are no sufficient writings about electronic KPI. However, in this project, several sources like books, journals, articles, report papers and World Wide Web have been reviewed to construct a foundation theoretical framework for the study. The literature reviewed is specific and aligned with the objectives. In general, the practical approach, design methodology, challenges, opportunities and related concepts have been reviewed from different sources.

2.1.2. The Health system and ICT

ICT are being widely used in healthcare management systems. Rapid advancements in ICT in the last decade provide solutions to the problems in healthcare management systems. These include a wide spectrum of issues such as patient safety, dietary management, telemedicine, digital imaging, document management etc. Advances in ICT have yielded substantial dividends to both individual health and public health. From the local to the national level, ICT is changing how health care is delivered and how health systems are run. It supports critical functions by improving the ability to gather, analyze, manage and exchange information in all areas of health, from research on molecular genetics to large scale humanitarian interventions and disaster relief [8].

In health systems, information and communication technologies are being used to improve the timeliness and accuracy of public health reporting and to facilitate disease monitoring and surveillance. They are fundamental in distance learning and in enabling rapid response in emergencies. Furthermore, the strategic use of eHealth can support sector-wide planning as well as coordinating decentralized district health systems, and improving the ability to plan, budget and deliver services. eHealth has been described as a means to ensure that “the right health information is provided to the right person at the right place and time in a secure, electronic form to optimize the quality and efficiency of health care delivery, research, education and knowledge[8].

Towards that end, information exchange such as through electronic health records, patient registries and shared knowledge resources is critical. Information systems and tools for diagnosis, prevention and treatment support health care at all levels [9]. They also enable the efficient and accountable delivery of essential supplies, such as drugs, vaccines and equipment

through the management of procurement, supply and distribution chains [9]. Thus, nowadays ICT make the health care delivery a high quality, reliable, affordable and accessible to the clients/patient/ [9].

2.1.3. Health System and ICT in Developing Countries

Utilization of information communication for health and health related activities in developing countries is at infant level, but different countries are now applying ICT for health system. In Peru, Egypt and Uganda, effective use of ICTs has prevented avoidable maternal deaths. In South Africa, the use of mobile phones has enabled tuberculosis patients to receive timely reminders to take their medication. In Cambodia, Rwanda, South Africa, and Nicaragua, multimedia communication programs are increasing awareness of how community responses to HIV and AIDS can be strengthened. In Bangladesh and India, global satellite technology is helping to track outbreaks of epidemics and ensure that effective prevention and treatment methods can reach people in time .Investment in ICT in the health sector in Uganda and sub-Saharan Africa is limited for a number of reasons. One of those is failure by planners to appreciate that ICTs – computers, telephones, the Internet, radio, etc can improve health care delivery and different health information systems are applying to enhance the health care deliveries such as electronic health records, health management information system and telemedicine (telehealth), etc are the main information system applying for health care in developing countries [10].

2.1.4. Ethiopia's Health Sector and ICT application

ICT is a key area for improving service delivery, promoting easier information exchange, assisting in decision making processes, and improving the effectiveness of operations. Governments and organizations around the world are mainstreaming ICT as a tool in all sectors of activities. In this regard, organizations need to invest a lot of resources to use ICT as a supportive tool for the effective and efficient delivery of services. ICT is a cross cutting area which supports all functions and operation areas by facilitating the automation of various processes. The Ministry of Health (MOH) has recognized the benefits of ICT as a tool to support the health sector. The FMoH, supported by its technical partners, is involved in a number of ICT projects and services. These projects and services have been classified into following major areas: Data Warehouse; Electronic Medical Records (EMR); Geographical Information Systems (GIS); Health-Net; IT Operations Support; Tele-Education; Telemedicine; Human Resource Information System (HRIS); Website Development; Health Integrated Financial Information System (HIFIS); Electronic Health Management Information System (eHMIS); Woreda-Based Planning System; Other Systems (Logistics Management Information System, and the like)[11].

2.15. Key Performance Indicators

KPIs are specific and measurable elements of health and social care that can be used to assess quality of care. KPIs are measures of performance, based on standards determined through evidence-based academic literature or through the consensus of experts when evidence is unavailable [5].

2.1.6. Key performance indicators in Health sector

An indicator is a way to measure a specific issue, or a way of saying "how much" or "how many" or "to what extent". Performance Indicators help to understand a system, compare it and improve it. Different types of indicators are used for different purposes. For example, indicators could be used to monitor implementation of a specific program, to monitor the financial performance of a hospital, to monitor the quality of care provided by each clinical team or to monitor implementation of the hospital annual plan [9].

Few sectors of the economy depend on performance metrics as much as the health sector does. Within any health system, there can be many indicators of performance, from the facility level (hospitals, clinics, pharmacies), to the district or provincial level, all the way up to the national level, where information on the performance of health sector programs is typically aggregated for consideration by government leaders and policy makers . Yet, only a selected group of those indicators are systematically measured, aggregated, and tracked at higher levels. Those key performance indicators, or KPIs, are used because they highlight those aspects of performance that are integral above all others in providing insights on attaining the health sector's strategic goals, whether they are around promoting healthy population, equitable access to health services, or reduction of preventable diseases (9).
Well designed KPIs should help health sector decision makers to do a number of things, including (9):

- establish baseline information (i.e., the current state of performance).
- set performance standards and targets to motivate continuous improvement.
- measure and report improvements over time.
- compare performance across geographic locations.
- benchmark performance against regional and international peers or norms, and
- allow stakeholders to independently judge health sector performance.

In any given country, stakeholders can include a broad cross-section of constituencies, including the parliament, the supreme audit institution, service recipients, civil society, donor institutions, and, critically, the MOF, for whom the financial and non-financial performance of spending agencies are typically central concerns. For MOHs and MOF alike, the performance information generated from KPIs can help to underscore the relationship between resources, activities, and results. By aligning financial costs with overarching performance objectives, KPIs can allow the

MOH to show how resource changes affect outcomes and to project, year by year, the resources required to meet service standards, keep up with workloads, or even secure future cost savings, for instance, through investments in program expansion, process improvement, or technology upgrades [9].

In turn, these performance measures can be used to define performance commitments, in terms of service delivery and internal efficiency, and the outcomes a spending ministry or agency expects to achieve through its budget allocations. Resource allocation choices, thus, can be better informed by-or even linked to-spectral performance, targets, and projected workloads. Of course, KPIs cannot replace political imperatives as a key driver of policy and budgetary decisions; however, they can reinforce or even change such decisions by communicating vital information about program results [9].

KPIs can then be used as an ongoing source of management information, arming health sector managers with critical data to plan, revise, add, and cut programs; report results; and communicate and align strategy across the sector to better ensure that all the key parts of the health system from laboratories and clinics, to operators along the health supply chain are working to achieve the same strategic goals. Gathering the same figures year by year will gradually paint a sharper picture, for example, of how well the MOH is maintaining consistency in patient care, how productive its various personnel are, where supplies are in surplus or deficit, where costs are rising or declining, and where service delivery is getting better or worse. This information, in turn, can provide insight into changing needs, demands, and trends (e.g., using data on hospital diagnoses to drive drug orders), and can be used as reference points in costing and constructing annual budget estimates for the health sector[9].

2.1.7. KPIs for Ethiopian hospitals

The FMOH has been undertaking different reform programs through BPR principles to ensure the implementation of Health Sector Development Program (HSDP) and Millennium Development Goals (MDG). For the support of this vision, the Public Health Infrastructure directorate (PHID) has been piloting and implementing different Health Information Technologies (HIT) projects to support the national health program. The desires to have efficient HIT systems have defined the need for electronic KPI information system in Ethiopia. Electronic KPI information system could improve the process of providing reliable, quality and timely report of hospitals status to all stakeholders. In Ethiopia, FMOH, the implementation of electronic KPI information system is through excel KPI Database and all RHB and hospitals reporting using this excel database [5].

Like any other hospital working under FMOH, Yekatit 12 has 36 key performance indicators which are grouped in to 10 categories. The Yekatit 12 Hospital produce data using access database and report it to Addis Ababa City Administration Health Bureau by CD and hard copy. They are using HIS performance indicator for evaluating activities and for reporting [12].

2. 1.8. Information system analysis and design

The SA&D process can encompass many tools and techniques. Broadly speaking; there are two main modeling approaches to SA&D:

- The traditional or "structured" approach, which uses Data Flow Diagrams (DFDs) and Entity Relationship Diagrams (ERDs) as its modeling tools;
- The object-oriented (OO) approach, for which the Uniform Modeling Language (UML) has become the defacto standard.

The traditional approach to SA&D is generally considered process-centric and top-down, in so far as the problem under consideration is decomposed into a hierarchical set of processes. In the traditional approach, the systems analysis phase consists of all activities needed to understand the system and specify in detail what the system is to do. The system design phase consists of all activities needed to specify the solution and how it will be physically implemented [19].

The object oriented approach is generally considered data centric. It uses a set of entities (or more correctly, "classes") that encapsulate both the data (attributes) and processes ("methods") associated with each entity type [19].

The object-oriented approach to software development focuses on real-world objects. Object oriented popularity is increasing in concert with the increasing complexity of software systems. Object Oriented includes object-oriented analysis (OOA), design (OOD), and programming (OOP) [19].

The next table briefly describes the comparison of the traditional and object oriented.
Table1. Comparison between traditional approach and object oriented approach [21].

Traditional Approach	**Object-Oriented Approach**
Used to develop the Traditional Projects that uses Procedural programming.	Used to develop Object-oriented Projects that depends on Object Oriented Programming.
Uses common processes likes: analysis, design, implementation, and testing	Uses UML notations likes: use case, class diagram, communication diagram, development diagram and sequence diagram
Depends on the size of projects and type of projects.	Depends on the experience of the team and complexity of projects through the numbers of objects.
Needs to large duration sometimes to development the large projects.	Need to more time than Traditional approach and leads that to more cost.
The problem of Traditional approach using classical life cycle.	The object-oriented software life cycle identifies the three traditional activities Of analysis, design, and implementation.

Features of Object oriented system analysis and design (21).

1. Abstraction

Abstraction is an analysis issue that deals with what a class knows or does. It should include the responsibilities, the attributes, and the method of interest to your application and ignore the rest. OO systems abstract only what they need to solve the problem at hand.

2. Encapsulation

The values of the variables inside an object are private, unless methods are written to pass that information outside of the object. This has both substantive and practical implications. The substantive importance is that the representation of an individual actor now presumes that the actor is a self-contained entity and that other actors do not automatically have access to all information inside that actor. Like humans, objects have to take effort to convey information to each other about their internal states. The practical advantages of encapsulation, however, are just as important.

3. Inheritance (Code Re-usability)

Similarities often exist between different classes. Two or more classes often share the same attributes and/or the same methods. Because you don't want to have to write the same code repeatedly, you want a mechanism that that takes advantage of these similarities. Inheritance is that mechanism. It enables to reuse existing data and code easily.

4. Information Hiding

To make applications maintainable, access to data attributes and some methods must be restricted. If one class wants information about another class, it should have to ask for it, instead of taking it. By restricting access to attributes, it is possible to prevent highly coupled code. In highly coupled code, a change in one part of the code forces you to make a change in another, and then another, etc.

5. Polymorphism

Objects of different classes respond to the same message differently. The objects belonging to different types respond to method, field, or property calls of the same name, each one according to its own behavior. The programmer does not have to know the exact type of the object in advance, and so the exact behavior is determined at run-time. This is called late binding or dynamic binding [21].

System Design Life Cycle /Waterfall Model

The Waterfall Model was first Process Model to be introduced. It is also referred to as a linear sequential life cycle model. It is very simple to understand and use. Ina waterfall model, each phase must be completed before the next phase can begin and there is no overlapping in the phases. Waterfall model is the earliest SDLC approach that was used for software development.

The waterfall Mode illustrates the software development process in a linear sequential flow; hence it is also referred to as a linear-sequential life cycle model. This means that any phase in the development process begins only if the previous phase is complete. In waterfall model phases do not overlap [22].

The sequential phases in Waterfall model are the following:

- Requirement Gathering and analysis
- System Design
- Maintenance
- Implementation
- Integration and Testing
- Deployment of system

Requirement Gathering and analysis: All possible requirements of the system to be developed are captured in this phase and documented in requirement specification documentation.

System Design: The requirement specifications from the first phase are studied in this phase and system design is prepared. System design helps in specifying hardware and system requirements and also helps in defining overall system architecture.

Implementation: With inputs from system design, the system is first developed in small programs called units, which are integrated in the next phase. Each unit is developed and tested for its functionality which is referred to as Unit Testing.

Integration and Testing: All the units developed in the implementation phase are integrated into a system after testing of each unit. Post integration the entire system is tested for any faults and failures.

Deployment of system: Once the functional and nonfunctional testing is done, the product is deployed in the customer environment or released into the market.

Maintenance: There are some issues which come up in the client environment. To fix those issues patches are released. Also to enhance the product some better versions are released. Maintenance is done to deliver these changes in the customer environment.

2.2. Related Work

Research project paper on electronic KPI system design and development directly could not be found as far as the researcher' knowledge. Therefore, vehicle work was considered in broader sense.

2.2.1. Indian Hospitals

The Indian HIS consist of different software that are integrated in order to capture data in specific sections of the hospital handle the workflow of daily medical services and also assist in managing financial, administrative and clinical data. From the various definitions of HIS, it is understood that HIS is a very broad area as it encompasses services catering to varied departments and personnel of a hospital and finally satisfying the patient care in its true sense. Hospital Information Systems (HISs) are supposed to make the right information and knowledge available to the right people, in the right place, at the right time and in the right form. Modeling tools for this HIS are $3LGM_2$ (three-layer Graph based Meta model) is structured and in some countries already validated approach for modeling and analyzing HIS. $3LGM_2$ combine a functional Meta model with technical Meta models and is represented using the Unified Modeling Language (UML) [18].

E Hospital management solution (E-HMS) is designed for multispecialty hospitals, to cover a wide range of hospital administration and management processes. It is an integrated end-to-end Hospital Management System that provides relevant information across the hospital to support effective decision making for patient care, hospital administration and critical financial accounting, in a seamless flow. Even though this E – HMS / HIS has deferent module, the next two are related with my projects [18].

Pharmacy Module - Pharmacy module deals with the automation of general workflow and administration management process of a pharmacy. The pharmacy module is equipped with bar coding facility, which makes the delivery of medical items to the patient more efficient [18].

Emergency Management - Emergency module in the hospital management system software allows fast registration of patients by the capture of key and very specific registration details such as demographic information, keeping in mind the critically of this function. This module also collects information related to Medico Legal Cases (MLC) which is subsequently used for reporting to local authorities [18].

From the above literature reviewed Indian hospitals health information system organized in to deferent modules and each modules has data entry and report page and the result report separately. But in Ethiopia all 36 KPI result collecting and reporting together. This may similar with this proposed system which the 36 KPI divided in to 4 module and results collect from this modules and but the difference is this system report with one page /together as the hospital key performance status report.

2.2.2. Thailand Hospitals

Report on the routine data of the MoPH is mainly used for administration and monitoring of performance of its own facilities. Surveillance data are for monitoring, controlling, and prevention of particular diseases or condition. In addition, these data are used for the development of health policy and planning by the ministry Health care utilization database of each health insurance scheme are solely used for financial management such as calculating and allocating the budget and paying the providers. Use of these database for monitoring of the system the performance of the systems remain limited and is in the process of development survey data have been widely used along with routine report at the time when administration database on utilization were not available for calculating the capitation of the universal coverage scheme and assessment of the impact of providing universal coverage in Thailand [17]. From the above reviewed literature the Thailand hospitals performance data collecting form routine data, surveillance data, and insurance database.

2.2.3. Zambian Hospitals

In Zambia indicators are divided in to three categories including Health status indicator, Health system indicator and Risk factor indicators.

2.2.3.1 Health status indicators

In Zambia, health status indicators are collected through surveys such as the ZDHS and the LCMS. The CSO in collaboration with the MOH coordinates the collection of these data [8].

2.2.3.2 Health System Indicators

The health systems indicators are collected routinely by the MOH through the HMIS. The HMIS indicators provide information on the performance of the health system (including human resources and drug supplies), and disease burden which includes incidence and case fatality

rates. For indicators on finances, this data is complied through the NHA. It was disclosed that data audits are conducted in each province by the centre annually, with the aim of verifying the data for completeness and consistency [8].

2.2.3.3 Risk Factors Indicators

In Zambia, the risk factor indicator are collected through the ZDHS and the LCMS such as violence against women, housing characteristics, household amenities and access to facilities, and HIV/AIDS/STI-related knowledge and behavior and smoking, alcoholism etc, [8].When we compare the Zambian experience with Ethiopian, the main difference is the in Zambian KPI divided in to three categories, and collected by different stakeholder but in Ethiopia there is 36 KPI in ten categories and collected by hospital KPI office.

2.2.4. Key Performance Indicator System in Ethiopia

The FMOH is undertaking different reform programs through BPR principles to ensure the implementation of the Health Sector Development Program (HSDP) and Millennium Development Goals (MDG). For the support of this vision, the Public Health Infrastructure directorate (PHID) has been piloting and implementing different Health Information Technology (HIT) projects to support the national health program. The desires to have efficient HIT systems have defined the need for electronic KPI information system in Ethiopia. Electronic KPI information system could improve the process of providing reliable, quality and timely report of hospitals status to all stakeholders. In Ethiopia FMOH, the implementation of electronic KPI information system is through Access KPI Database and excel and all RHB and hospitals reporting using this access database and excel [1].

2.2.4.1. Relationship with HMIS

The Health Management Information System (HMIS) draws its data from routine service and administrative records and is primarily designed to monitor and refine implementation programs of the Health Sector Development Plans. Additionally, the indicators are based on the priorities of the Plan for Accelerated and Sustained Development to End Poverty, the needs and priorities of local authorities, and the requirements of international agreements, such as the MDG. On the other hand, the hospital KPIs, are a small set of 36 indicators with the primary function of assisting hospital SMTs, Governing Boards, RHBs and FMOH to oversee hospital operations. The hospital KPIs do not replace the HMIS indicators and existing HMIS reporting, review and monitoring processes should continue [1].

CHAPTER THREE
METHODOLOGY

The objective of this project is to design electronic KPI information system in order to meet this objective the researcher applied a phased development methodology of object oriented approach to the study of the design system. Interview and document analysis were used as a main tool to capture the business system requirement along with observation. Unified Modeling Language (UML) development techniques were applied in the process of requirements capture, model organization business system and design. An open source software Argo UML, coda and Microsoft Visio 2010 Software were employed in analysis and design models diagramming and interface prototyping.

3.1. Study Area / Setting

The study was conducted in Yekatit 12 Referral Hospital from February to June 2015. It is one of the oldest hospitals under the Addis Ababa City Administration Health Bureau. The hospital was established in 1915 with the aim of providing health care services. The Swedish physician Dr Hanner was among the founders of the Hospital. He was also the first medical director of the Hospital during 1926-1936. At the time of establishment, the Hospital had one physician, 2 nurses and 3 health assistants. Currently, the Hospital has more than 243 health professionals and 208 supportive staffs. The hospital is located in northern part of Addis Ababa in Gullele Sub-City.

3.2. Source population and study population

The source population of the study was individuals working at Yekatit 12 Hospital. For this project, the researcher used purposive sampling techniques to select the sample and KPI focal person, data owners of each KPI and medical director were purposively selected as a study population and a total sample of 12 respondents were involved in this study. In addition documentary sources and literatures were used as source of study.

3.2.1 Primary data source

The researcher was collected primary data from direct contact with respondents and gathering data through interview and observation. Primary data was gathered from the participants of the study at Yekatit 12 hospital.

3.2.2 Secondary data source

Secondary data was gathered from written documents, which consists of reference books, website, guidelines, and research papers.

3.3. Data collection (tools, variables)

Data were collected through interview, observation and document review. Sample data recording, calculation, analyzing, and reporting forms were reviewed in line with the report forms and requirements of the hospital in order to elicit the business requirement.

I. Interview

In this project the KPI focal person and data owners of each KPI and the Medical Director were interviewed about the current KPI reporting system and related business and the features the new system will have.

II. Observation

The current business process, the data flow of the current system in general and the day today activities were observed in order to identify problem with the current system using observational checklist.

III. Document review

Some literature review, national KPI guideline, formats which are data collection, analysis and reporting format were reviewed to understand and define problems.

3.4. Data analysis and design

The collected data by different mechanisms such as interview, observation and document revision were analyzed after requirement gathering. The result of the system modeling that helps to understand the system models used for analysis of the system was done using tools like the use cases description, contextual diagram, DFD (Data flow Diagram).To help users critically examine the current state of systems and processes (the as-is system), identify exactly what needs to change, and develop a concept for a new system (the to-be system). A phase based object oriented approach is adopted by this study.

Structured Analysis and Design

Structured Systems Analysis and Design Methodology (SSADM) is a systems approach to the analysis and design of information systems. Structured systems analysis and design methodology (SSADM) is a set of standards for systems analysis and application design. It uses a formal methodical approach to the analysis and design of information systems and it is an open methodology based on the waterfall model. It has been used by many commercial businesses, consultants, educational establishments and CASE tool developers.

It is an integrated set of standards and guidelines consisting of Structural standards, which define the structure of a development project in the form of explicitly defined tasks, with clearly defined interfaces between them, and also the tangible products.

Water Fall Approaches

Water fall approaches is one of the method in Software Development Life Cycle (SDLC. This method majorly follows the following major phases in a sequential manner. These phases are:

- Systems Investigation -Identify problems or opportunities
- Systems Analysis -How can we solve the identified problem
- Systems Design -Select and plan the best solution
- Systems Implementation -Place solution into effect
- Systems Maintenance and Review - Evaluate the results of the solution

Because designing is the scope of this project the researcher work only system investigation, system analysis, and system design phases and the rest system implementation, and maintenance and review is no part of this paper

3.4.1. Data Analysis tool and techniques

After requirement was captured using the interview, observation, and document review the result was analyzed. The result of the system modeling that help to understand the system models used for analysis of the system was done using some UML modeling, contextual diagram, data flow diagram (DFD).

3.4.2. 1. Models

A model is a representation of an important aspect of the real world. It is sometimes called an abstraction as it is used to separate out and aspect of particular importance. Data depiction were made using the following models

- System Use Case Description
- Contextual Diagram
- Data Flow Diagram
- Class Diagram
- Activity Diagram
- User interface
- Entity Relationship Diagram

3.4.2. 2. Tools

A tool in software development is software support that helps to create models or other components required in the project.

The tools used for analysis and design in this project were.

Visio2010 which is an open source which was used for analysis of system by providing the modeling of system such as the system use case diagram , contextual diagram and data flow diagram and also for design of system the ER diagram and user interface prototyping.

3.4.2.3. Techniques

A technique in system development is a collection of guidelines that help an analyst complete a system development activity or task.

The techniques used in SSADM are logical data modeling, data flow modeling and entity behavior modeling.

Logical data modeling
The process of identifying, modeling and documenting the data requirements of the system being designed. The result is a data model containing entities (things about which a business needs to record information), attributes (facts about the entities) and relationships (associations between the entities).

Data Flow Modeling
The process of identifying, modeling and documenting how data moves around an information system. Data Flow Modeling examines processes (activities that transform data from one form to another), data stores (the holding areas for data), external entities (what sends data into a system or receives data from a system), and data flows (routes by which data can flow).

Entity Event Modeling
A two-stranded process: Entity Behavior Modeling, identifying, modeling and documenting the events that affect each entity and the sequence (or life history) in which these events occur, and Event Modeling, designing for each event the process to coordinate entity life histories.
In general the techniques used for the system analysis and design in this project were;

- Data-modeling techniques using the tools data flow diagram.
- User-interviewing techniques using the Microsoft visual studio 2012.
- Relational-database design techniques using entity relationship diagram.

3.4. Method of dissemination of results

The study aimed to be compiled and disseminated as a project thesis report and makes it available to the School of Information Science and School of Public Health Library, Yekatit 12 Hospital and FMOH-Medical Sector Directorate. Attempt will also be made to publish on local as well as international publication outlets.

3.5. Evaluation techniques

The researcher lets KPI focal person and data owner other than the respondents to review and comment on the analysis and design models and work procedure descriptions in order to validate the design and have a mutual understanding of the new system design performance. Their evaluation and comment report were incorporated both into the conclusion section and the respective area.

3.6. Operational definition

Key Performance Indicators: An indicator is a way to measure a specific issue, or a way of saying "how much" or "how many" or "to what extent". Simply defined, KPIs are measures that a sector or organization uses to define success and track progress in meeting its strategic goals.

KPI focal person: is a person assigned to collect all KPIs and the data elements from the data owners and to prepare the hospital KPI report.

KPI data owner: is an individual who is responsible for the primary data source (e.g. register, record or database) from which the KPI is drawn and who has responsibility for the service area that is being measured.

Entity relationship diagram: An entity-relationship diagram (ERD) is a data modeling technique that graphically illustrates an information system's entities and the relationships between those entities. An ERD is a conceptual and representational model of data used to represent the entity framework infrastructure.

Data flow diagram: is a graphical representation of the flow of data through an information system, modeling its process aspect.

SSADM: Structured systems analysis and design methodology (SSADM) is a set of standards for systems analysis and application design.

3.7. Ethical clearance

The project has been carried out after getting permission from the ethical clearance committee of Addis Ababa University, Medical Faculty through School of Public Health and Yekatit 12 Hospital. Information sheet and consent forms were delivered along each interview and all interviewees have been asked their willingness to participate in requirement gathering; and informed verbal consent were also obtained from all study participants and from every interviewee after the objective of the study was communicated . The researcher professionally kept the hospital information security and did not disclose the information to anybody, except for the project purpose. The researcher also maintains confidentiality in order to protect the privacy of the respondents

CHAPER FOUR
SYSTEM REQUIREMENT

Introduction

The main aim of this chapter is to identify the business requirements and elicitation the requirement using UML functional analysis models and design models of the system needed to design electronic key performance indicator information system for Yekatit 12 Hospital.

4.1 Requirement documentation

The questions asked to the interviewees with the answers replied during the semi structured questionnaires are presented as follows.

(I). In the question it was asked what are the major activities carried in this section the respondent replied that Preparing department activity report form, Collecting KPI results from department's data owners, organize and identify reportable KPI data, analyze the collected data, and generate report, present the hospital KPI results report to senior management team, intervene on the problem domains (training, Human and material support) and send the hospital KPI result report to Addis Ababa Health Bureau and other stakeholder. This question intended to get the blueprint of the activities

(II). the response given for the question that asks what are your customer and their types, was that Hospital managements, Federal Ministry of Health medical directorate, Regional health bureau, Clinton foundation and data owners of each KPI in Yekatit 12 Hospital. This question helped to find the actors which are the primary actors and secondary actors of the system

(III). In the question it was asked what sort of services accept and/or render to the section, the respondent replied that reporting on the 36 national key performance indicators, follow the reforms on the 36 KPI (monitoring and evaluation), supportive cite visit. This question helped to understand the business domain of the system.

(IV). Another question was raised regarding which services incorporated into database system, the respondent replied that only the national KPI reporting part automated as a national access data base. This question helped to understand the integration domain of the system.

(V). the response given for the question that asks what are the rules, guidelines and standards guiding KPI reporting, was that the national hospital monitoring and evaluation manual and guideline. This question helped to understand the integration domain of the system.

(VI). In the question it was asked what reports are organized the respondent replied that it organized in monthly, quarterly, six months and annual report manner on the 10 categories of National Hospital KPI. This question helped to understand report requirements.

(VII). In the question it was asked the problems/drawbacks of the existing system the respondent replied the data collection mechanism in department is manual, the database which mean the access database is not user friendly and every one cannot easily use the system, and anyone can access the database and it expose to security problem and the KPI result report to RHB is by hard copy/manually/ and that may cause delay to report sending date and no internet connection to email the report and ICT department to troubleshoot problems on computers. In general, the above stated problems may cause the delay of reporting period and accuracy of the KPI results. This question helped to understand the problems of existing system.

(VIII). Another question was raised regarding the features you need to incorporate in the new system the response found reflected that the system with departments module and each department data owner enter the data and access by local area network and enable them to insert and send to the KPI office through network, and the report generated from the proposed system should be send to RHB through web based, and the system with log in. This question helped to understand the user needs on the new proposed system.

4.2 System Requirement specifications

The requirements gathered through interview, discussion and observations are determined and defined below.

4.2.1 Functional Requirements

Functional requirements associated with specific functions, tasks or behaviors the system must do. The following requirements are some of the functional requirements that the proposed system will exhibit.

- The system registers/encode/ outpatient department KPI results.
- The system registers/encode/ inpatient department KPI results.
- The system registers/encode/ emergency department KPI results.
- The system registers/encode/ maternity department KPI results.
- The system should be able to generate reports of outpatient, inpatient, emergency and maternity departments and hospital performance report.
- The system Comment on department KPI report.
- The system updates user account

In addition, this setup leads to the functional requirements described below.

System login:

- User name: it is unique and given to specific user.
- Password : length of the maximum character char(30) and minimum character char(6)

Username and password match with the one given by the administrator login to the system direct to the home page of electronic key performance indicator system.

Logging out

The user shall log out of the system by clicking "log out".

The system should allow the printing of individual department KPI report and the hospital KPI report on the appropriate paper or card. Only authorized personnel in the office can perform issue registration/encoding KPI result and generate reports and give comment or feedback to the departments into the system.

The system has allowed to each departments data owners and KPI focal person to correct error committing in the data entry process and update the corrected results.

4.2.2. Non-functional requirements

A nonfunctional requirement describes user behavioral properties that the system must have, such as performance, security, maintainability, usability, reliability, supportability, interface; implementation, operation, and legal. The ability to access the system through a Web browser would be considered a nonfunctional requirement. They are often considered as called the quality of a system.

- The system should have a capacity of handling huge amount of data within the database in deferent table (performance).
- The system should be a web-based application.
- Menus should be organized in a hierarchical manner (usability)
- The system must be password-protected.(Security)
- During the fault occurrence there is less chance to lose data within the system because there will be continuous data back up from server (maintainability)
- The system should be available 24/7 (availability)

4.3. Proposed system

The proposed system works on computers via network in line with the requirements of departments. There is a centralized database to store the hospital key performance indicator data as well as to integrate the department's outpatient, inpatient, emergency and maternity departments. The users use computers to record and review the performance information.

4.3.1 System Analysis

4.3.1.1. Identified actors

Actor name	Description
Data owner	Data owner refer to an individual who is responsible for the primary data source (e.g. register, record or database) from which the KPI is drawn and who has responsibility for the service area that is being measured and generate department status report and send to the hospital KPI office.
KPI focal person	KPI focal person refers to person who collects all KPIs and the data elements from the data owners and to prepare the hospital KPI report.
Administrator	Administrator is refers to the person who administer the system.

Table 2: Identified actors

4.3.1.2. Identified use cases

- Login
- Register outpatient KPI data
- Register inpatient KPI data
- Register maternity KPI data
- Register emergency KPI data
- Register /encode hospital KPI result
- Generate report
- Manage user account

4.3.1.3. System use case description

Use case 1: Login

Use Case ID	UC_1
Use case name	Login
Priority	High
Stakeholders and interest	Wants to log into the system
Primary actor	User (outpatient department data owner, inpatient department data owner, maternity department data owner, emergency department data owner, KPI focal person.)
Summary description	This describes how the users log into the system to view or modify requests.
Precondition	The user must have user name and password
Post condition	The user logs into the system
Main success scenario	1. The users run the application. 2. The application will be displayed. 3. The user click on the respective department module 4. The system displays the login screen. 5. The user enters the username and password 6. The system verifies the information and set access permission. 7. The system will display the main screen. 8. Use case ends
Alternative path	6a. If the username or password is not valid, an error message is displayed. 6a.1. The user clicks an ok button. 6a.2. The user is returned to login screen and reenter user name and password.
Business rules	After 3 trial the system shutdown automatically

Table3: login system use case description

Use case 2: register/encode outpatient attendant data

Use Case ID	UC_2
Use case name	register/encode outpatient attendant and pressure ulcer report data
Priority	High
Stakeholders and interest	The data owner wants to register/encode department KPI data and report to KPI office.
Primary actor	Outpatient department data owner.
Summary description	The data owner enters or changes information about department KPI result and send to KPI office. This Use Case describes the process of how the data owner is entered KPI data into the outpatient department module.
Precondition	The data owner has successfully passed through Authentication and Authorization.
Post condition	The department KPI data is registered or encoded on the system and send to KPI office.
Main success scenario	1. Run Application 2. The data owner clicks on the OPD KPI module and enters user name and password. 3. The data owner clicks on registration link. 4. The system displays the registration form. 5. The data owner collects and organizes data from the daily registration book. 6. The data owner enters the data. 7. The system validates the correctness of the data entered. 8. The data owner click submit button and stored/save the record in the system. 9. The data owner sends the data to KPI office. 10. Use case ends
Alternative path	1a. If the username or password is not valid, an error message is displayed. 1a.1. The user clicks an ok button. 1a.2. The user is returned to login screen and reenter user name and password.

Table 4: outpatient attendant system use case description

Use case 3: register/encode inpatient activities data

Use Case ID	UC_3
Use case name	register/encode inpatient activity data
Priority	High
Stakeholders and interest	The data owner wants to register/encode department activities data and report to KPI office.
Primary actor	Inpatient department data owner.
Summary description	The data owner enters or changes information about department activities data and send to KPI office. This Use Case describes the process how the data owner is entered inpatient department activities data into the inpatient department module.
Precondition	The data owner has successfully passed through Authentication and Authorization.
Post condition	The department activities data is registered or encoded on the system and send to KPI office.
Main success scenario	1. Run Application 2. The data owner clicks on the inpatient KPI module and enters user name and password. 3. The data owner clicks on registration link. 4. The system displays the registration form. 5. The data owner collects and organizes data from the daily registration book. 6. The data owner enters the data. 7. The system validates the correctness of the data entered. 8. The data owner click submit button and stored/save the record in the system. 9. The data owner sends the data to KPI office. 10. Use case ends
Alternative path	1a. If the username or password is not valid, an error message is displayed. 1a.1. The user clicks an ok button. 1a.2. The user is returned to login screen and reenter user name and password.

Table 5: inpatient system use case description

Use case 4: register/encode delivery attendances data

Use Case ID	UC_4
Use case name	register/encode delivery activity data
Priority	High
Stakeholders and interest	The data owner wants to register/encode department attendant data and report to KPI office.
Primary actor	Maternity department data owner.
Summary description	The data owner enters or changes information about department delivery result and send to KPI office. This Use Case describes the process how the data owner is entered delivery data into the delivery department module.
Precondition	The data owner has successfully passed through Authentication and Authorization.
Post condition	The department delivery data is registered or encoded on the system and send to KPI office.
Main success scenario	1. Run Application 2. The data owner clicks on the delivery KPI module and enters user name and password. 3. The data owner clicks on registration link. 4. The system displays the registration form. 5. The data owner collects and organizes data from the daily registration book. 6. The data owner enters the data 7. The system validates the correctness of the data entered. 8. The data owner click submit button and stored/save the record in the system. 9. The data owner sends the data to KPI office. 10. Use case ends
Alternative path	1a. If the username or password is not valid, an error message is displayed. 1a.1. The user clicks an ok button. 1a.2. The user is returned to login screen and reenter user name and password.

Table 6: delivery attendance system use case description

Use case 5: register/encode emergency department data

Use Case ID	UC_5
Use case name	register/encode emergency admission and referral data
Priority	High
Stakeholders and interest	The data owner wants to register/encode department admission and referral data and report to KPI office.
Primary actor	Emergency department data owner.
Summary description	The data owner enters or changes information about department emergency and send to KPI office. This Use Case describes the process how the data owner is entered data into the emergency department module.
Precondition	The data owner has successfully passed through Authentication and Authorization.
Post condition	The department admission and referral data is registered or encoded on the system and send to KPI office.
Main success scenario	1. Run Application 2. The data owner clicks on the emergency KPI module and enters user name and password. 3. The data owner clicks on registration link. 4. The system displays the registration form. 5. The data owner collects and organizes data from the daily registration book. 6. The data owner enters the data. 7. The system validates the correctness of the data entered. 8. The data owner click submit button and stored/save the record in the system. 9. The data owner sends the data to KPI office. 10. Use case ends
Alternative path	1a. If the username or password is not valid, an error message is displayed. 1a.1. The user clicks an ok button. 1a.2. The user is returned to login screen and reenter user name and password.

Table 7: emergency system use case description

Use case 6: register/encode hospital KPI data

Use Case ID	UC_6
Use case name	register/encode hospital KPI data
Priority	High
Stakeholders and interest	The KPI focal person wants to register/encode hospital KPI data and report the hospital performance status to stakeholders.
Primary actor	KPI focal person.
Summary description	The KPI focal person enters or changes information about hospital KPI result and send to stakeholders. This Use Case describes the process how the KPI focal person is entered KPI data into the hospital KPI information system module.
Precondition	The KPI focal person has successfully passed through Authentication and Authorization.
Post condition	The hospital KPI data is registered or encoded on the system.
Main success scenario	1. Run Application 2. The Use Case starts when a KPI focal person clicks on the hospital KPI module and enters user name and password. 3. The data owner clicks on registration link. 4. The system displays the registration form. 5. The focal person collects and organizes departments performance result from there report. 6. The KPI focal person enters the data (hospital KPI results) 7. The system validates the correctness of the data entered. 8. The KPI focal person click submit button and stored/save the record in the system. 9. Use case ends
Alternative path	1a. If the username or password is not valid, an error message is displayed. 1a.1. The user clicks an ok button. 1a.2. The user is returned to login screen and reenter user name and password.

Table 8: hospital KPI system use case description

Use case 7: generate report

Use Case ID	UC_7
Use case name	Generate report
Priority	High
Stakeholders and interest	The user wants to generate report from the system.
Primary actor	KPI focal person.
Summary description	Generate report based on the request of the KPI focal person.
Precondition	The KPI focal person should have authentication to generate report
Post condition	The user generates report from the system.
Main success scenario	1. Run Application 2. The Use Case starts when the user clicks on the report link. 3. The KPI focal person click on the generate report form. 4. The system provides the report generation form. 5. The KPI officer selects report generation buttons from Different departments. 6. The system processes and generates report. 7. The system displays and prints the result as well as save the result in the system 8. The KPI focal person sends the hospital KPI status report to regional health bureau/Addis Ababa health bureau/. 9. Use case ends
Alternative path	_____

Table 9: generate report system use case description

Use case 8: maintain user account

Use Case ID	UC_ 8
Use case Name	Maintain user account
Priority	High
Stake holder and interests	The user wants to manage files and users of the system
Primary actor	System administrator
Summary description	This describes how the administrator maintains the users.
Precondition	The administrator should register as an authorized administrator.
Post condition	The administrator maintain user account/manage the system
Main success scenario	1. The Use Case starts when the user starts the application. 2. The administrator enters in to login screen. 3. The system display the login screen 4. The administrator enter user name and password 5. The System displays the user account form. 6. The administrator performs create new user, update user account 7. The System validate the information which the Administrator enters 8. End the Use Case
Alternative path	4a the administrator username or password is not valid, an error message is displayed. 4a.1. The administrator clicks an ok button. 4a.2. The administrator is returned to login screen and re-enter user name and password.

Table 10: maintain user account system use case description

4.3.1.4. Process modeling

A process model is a formal way of representing how a business system operates. It illustrates the processes or activities that are performed and how data move among them. A process model can be used to document the current system (i.e., as-is system) or the new system being developed (i.e., to be system).

4.3.1.4. 1. Contextual diagram

The first data flow diagram in every business process model, whether a manual system or a computerized system, is the context diagram. As the name suggests, the context diagram shows the entire system in context with its environment. It shows the overall business process as just one process.

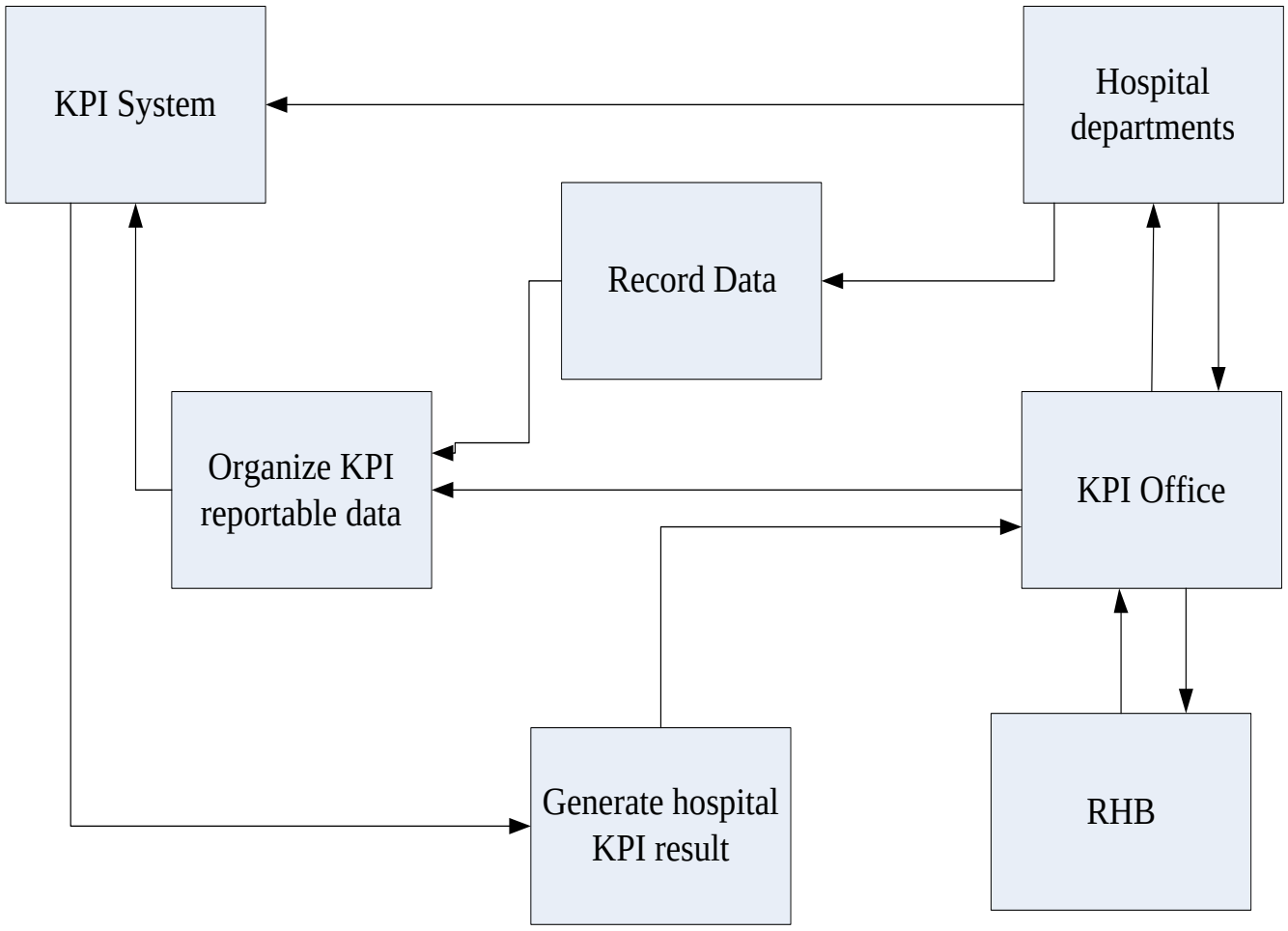


Figure 1: Contextual Diagram

4.3.1.4.2. Data flow diagram

It is the most commonly used way of documenting the processing of current and required systems. As their name suggests, they are a pictorial way of showing the flow of data into, around and out of a system. They can be understood by users, and are less prone to misinterpretation than textual description.

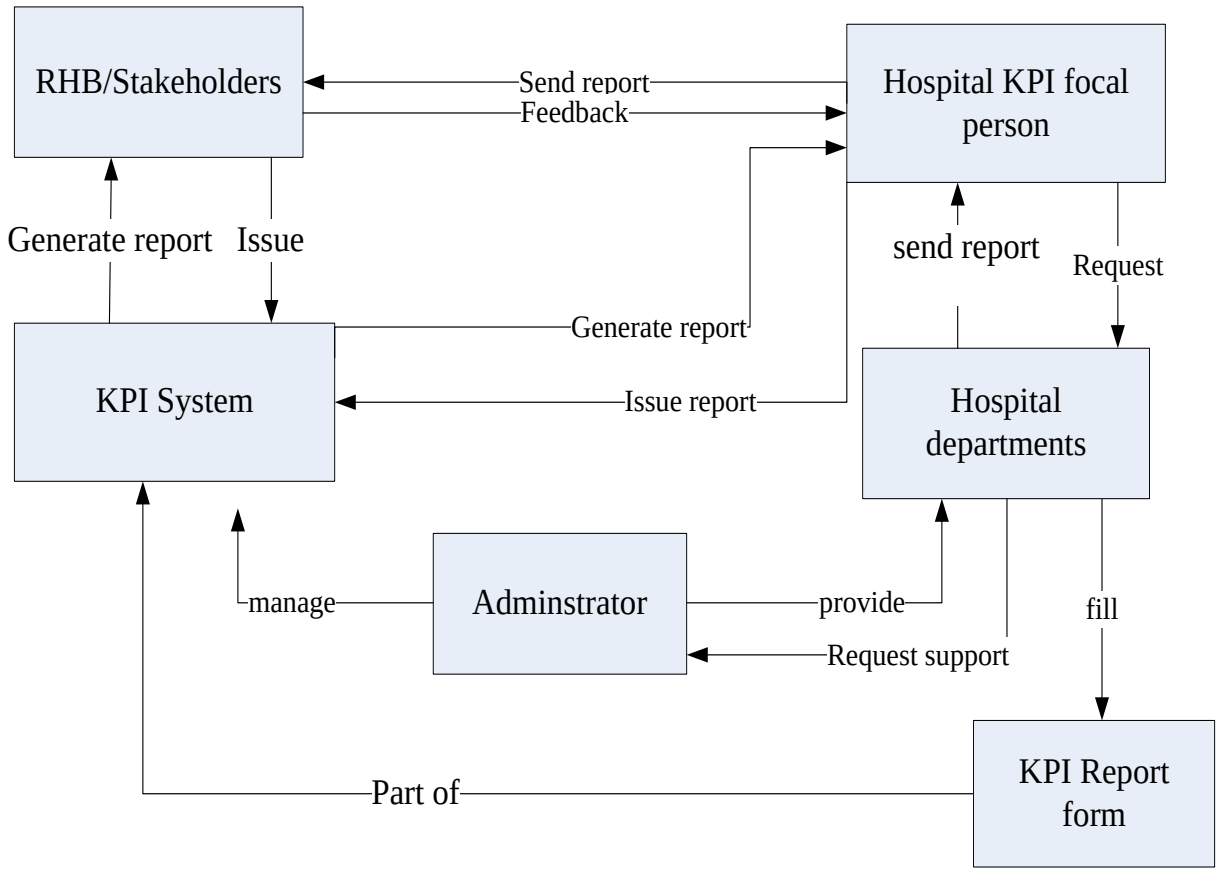


Figure 2: data flow diagram

CHAPTER FIVE
SYSTEM DESIGN

5. Data model

A data model is a formal way of representing the data that are used and created by a system. It illustrates people, places, or things about which information is captured and how they are related to each other.

5.1. System Architecture

A system architecture or systems architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system.

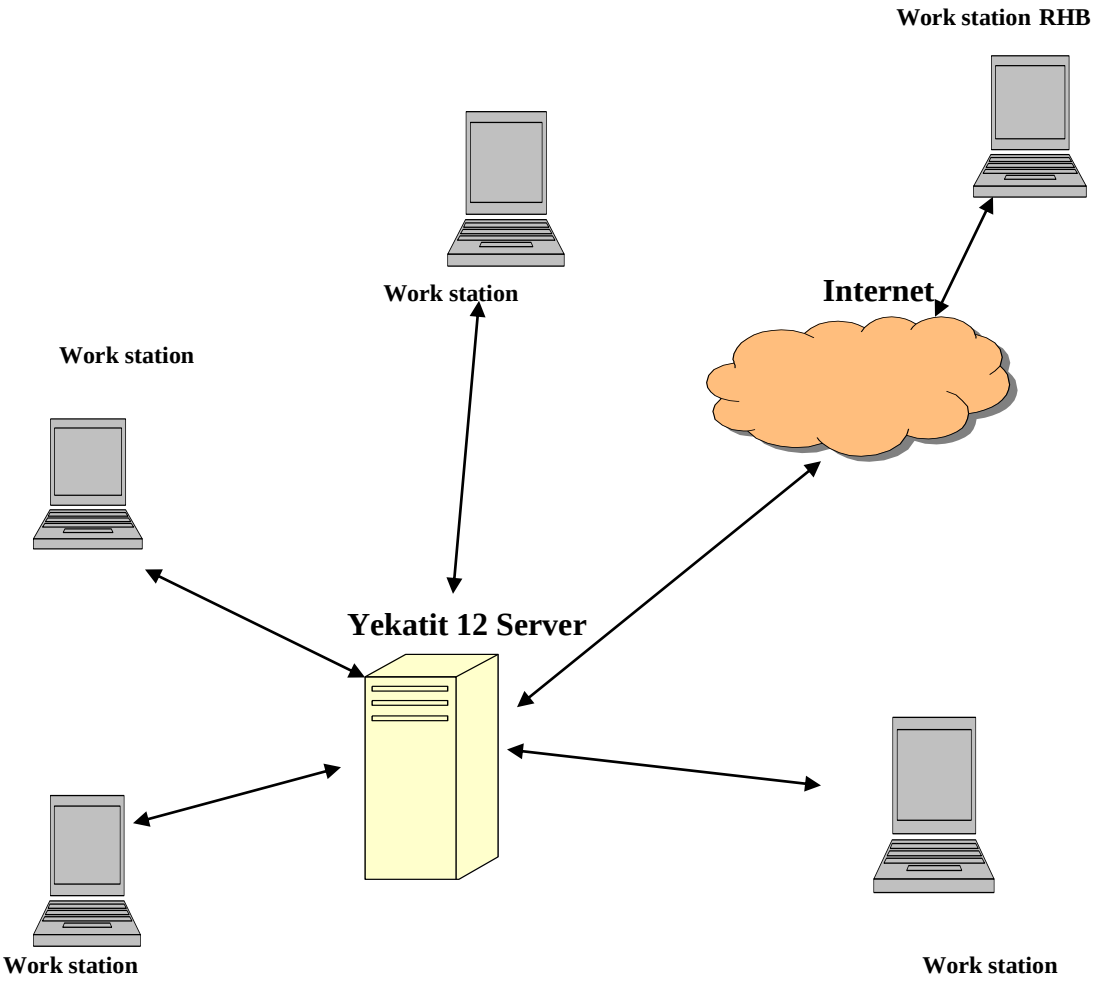


Figure 3: system architecture

5.2. Class diagram

The class diagram represents a collection of objects with common structure, common behaviour, common relationships, and common semantics. It shows the classes and their relationships (Use case responsibilities are allocated to objects. Grouping these objects into classes helps us manage the complexity) .

Entity; the entity is the basic building block for a data model. It is a person, place, event, or thing about which data is collected.

Attribute; an attribute is some type of information that is captured about an entity. The entities and attributes of the system are listed below.

Entity and attribute

Table 1. User Attribute Description

Table 2. KPI Data Attribute Description

Table 3. Administrator Attribute Description

Table 4. User Role Attribute Description

Table 5. Medical record Attribute Description

Table 6. Report Attribute Description

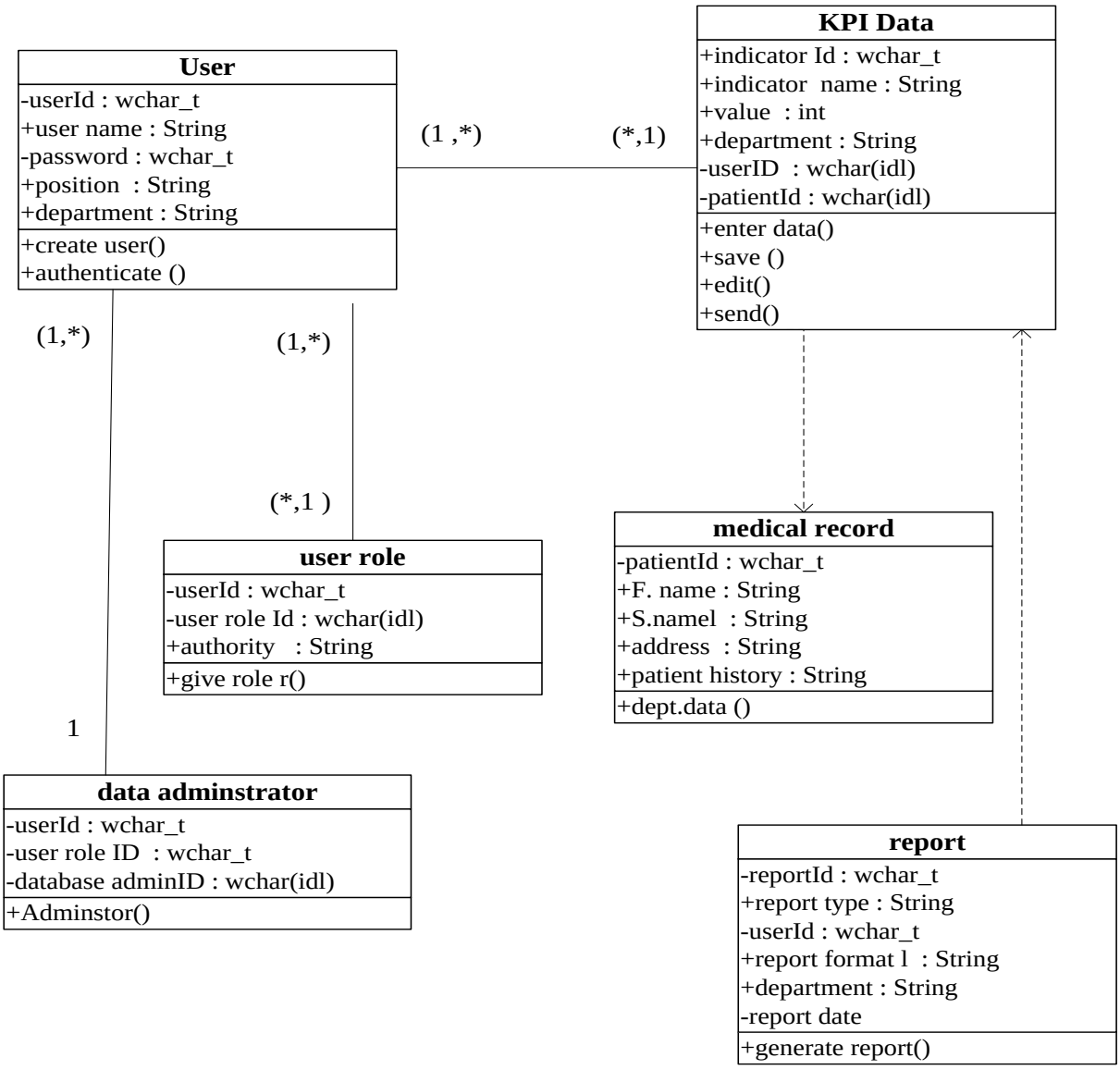


Figure 4: class diagram

5.3. Activity diagram

The Activity Diagram is a multi-purpose process flow diagram that is used to model behavior of the system. It is used to model sequential (possibly concurrent) steps in a computational process. It is used to model the flow of an object as it moves from state to state at different points in the flow of control .It emphasizes the flow of control from activity to activity.

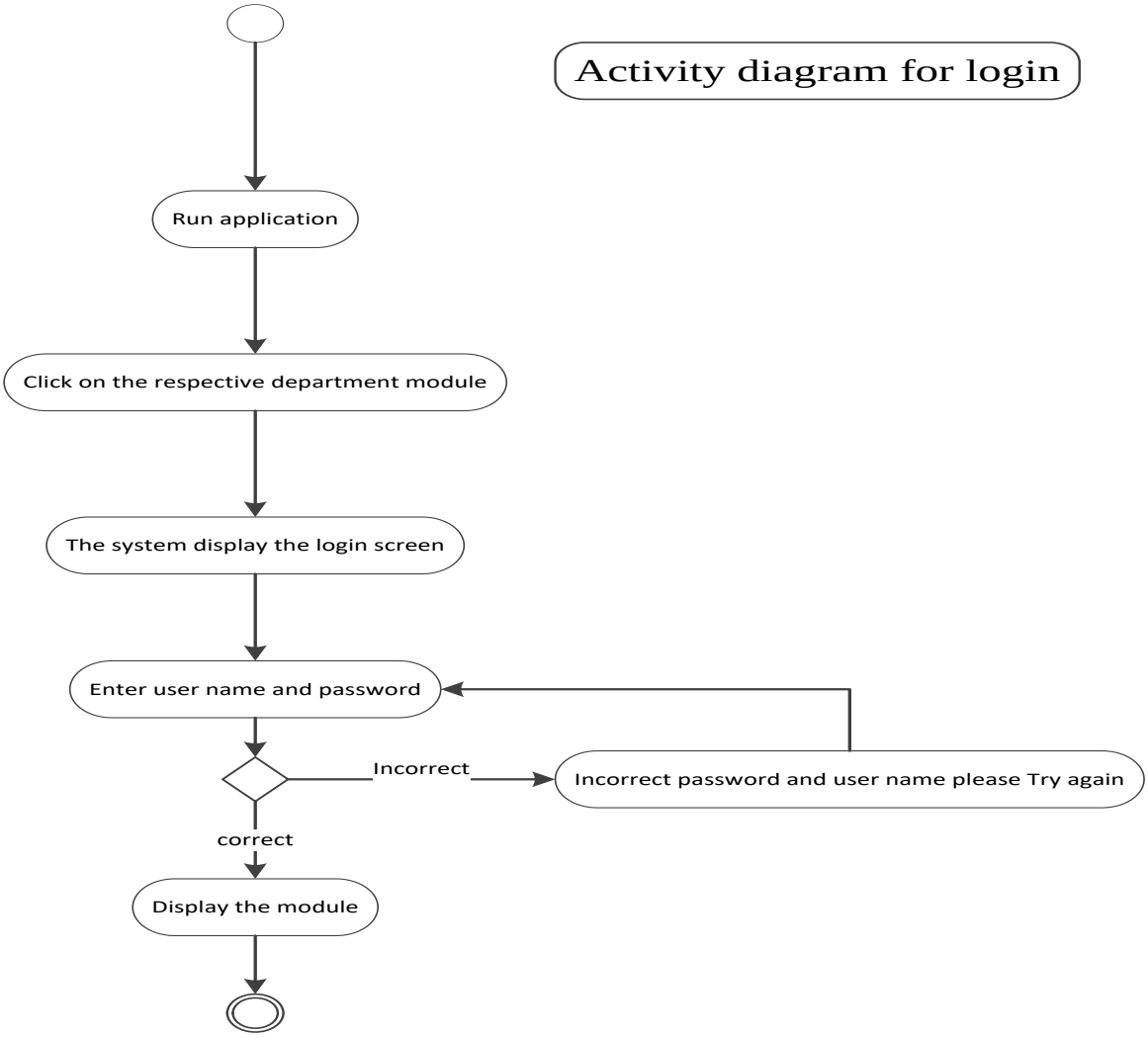


Figure 5 Activity diagram for user login

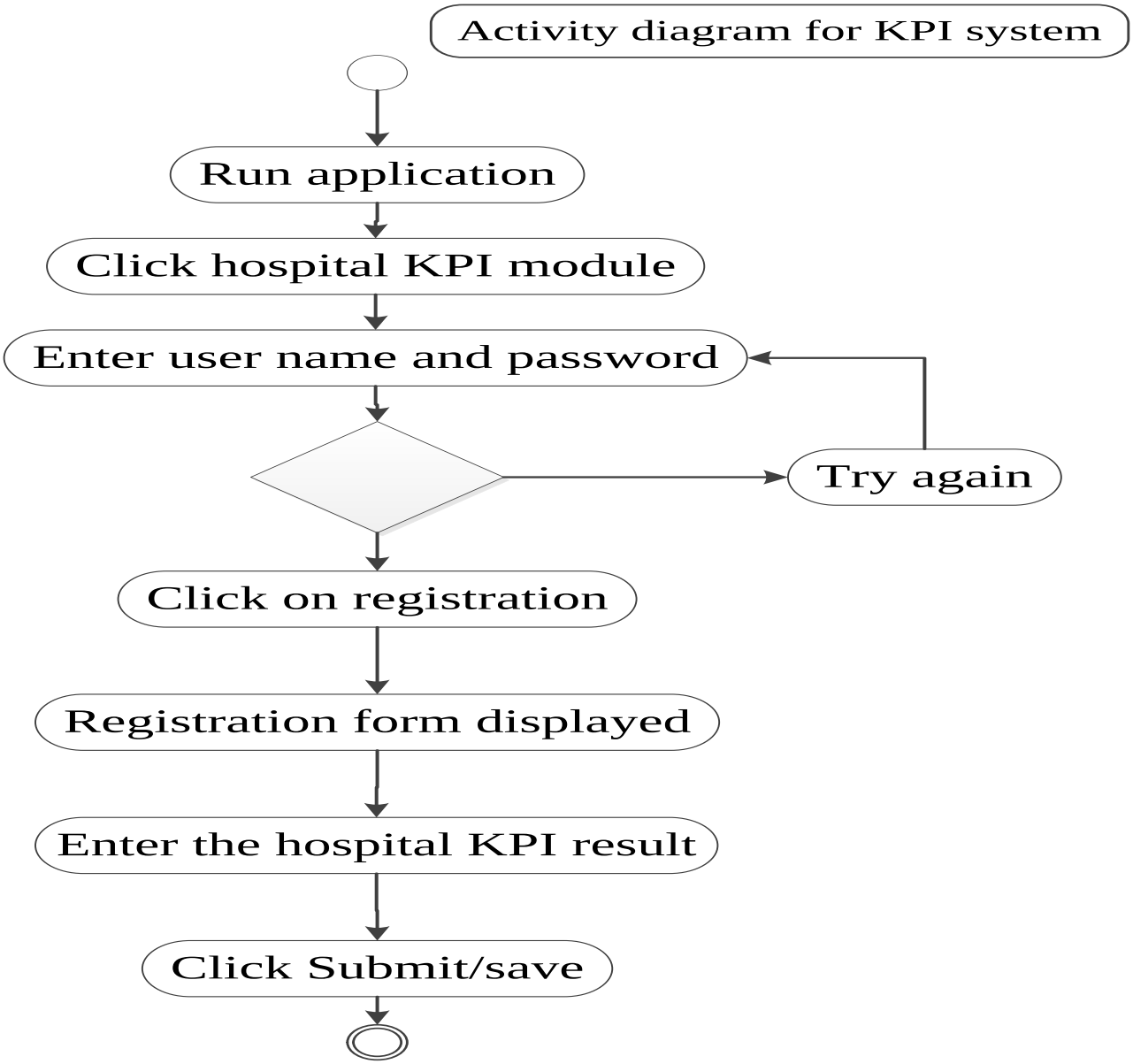


Figure 6 Activity diagram for Hospital KPI system

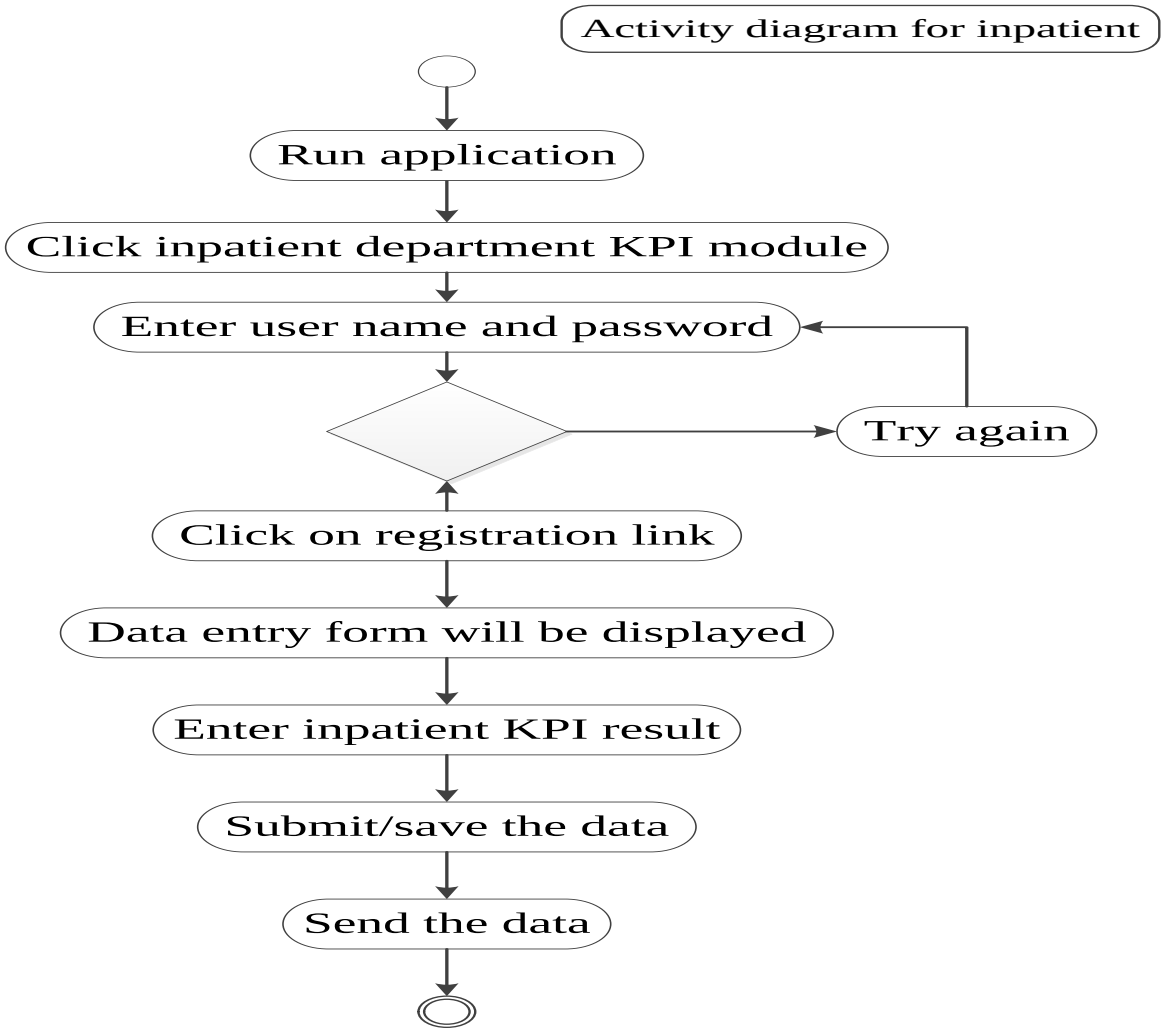


Figure 7 Activity diagram for inpatient module

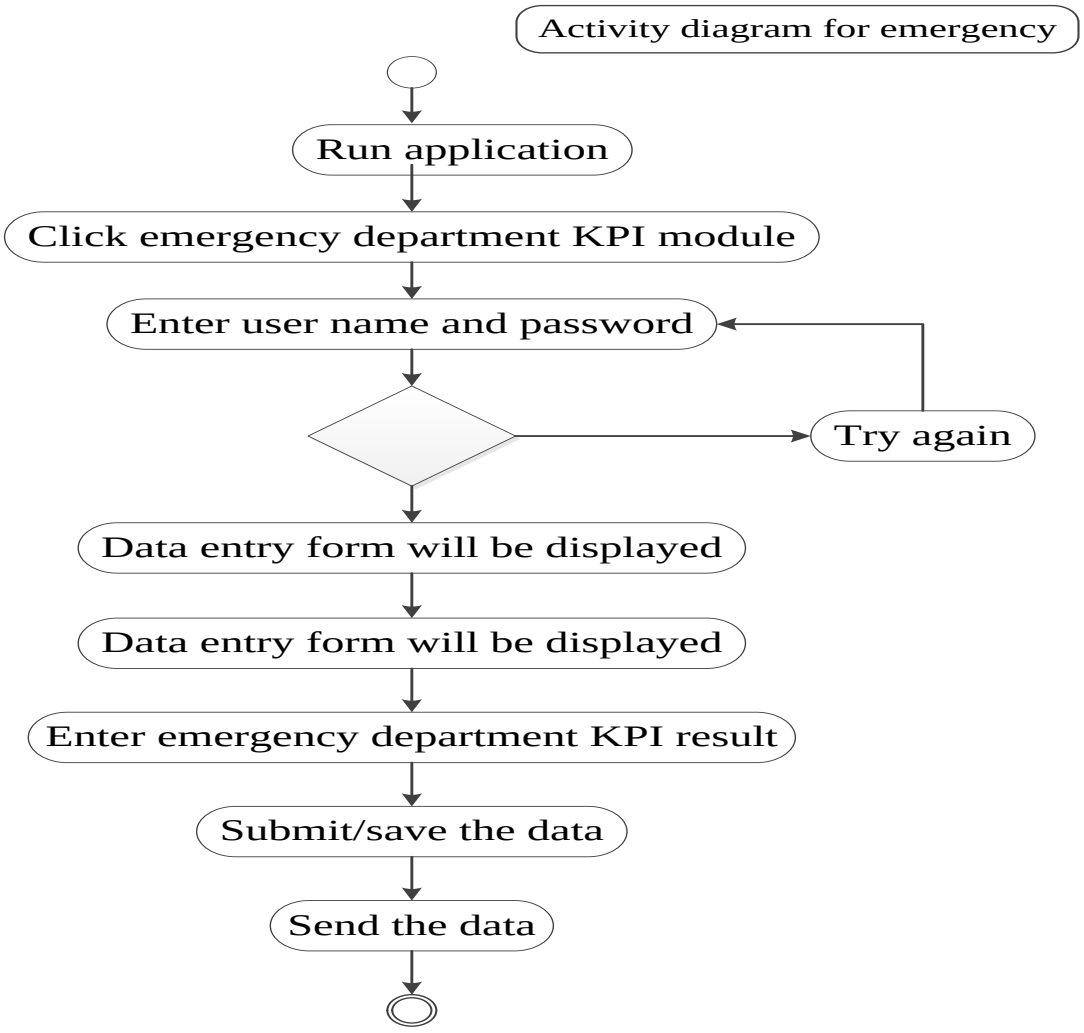


Figure 8 Activity diagram for emergency module

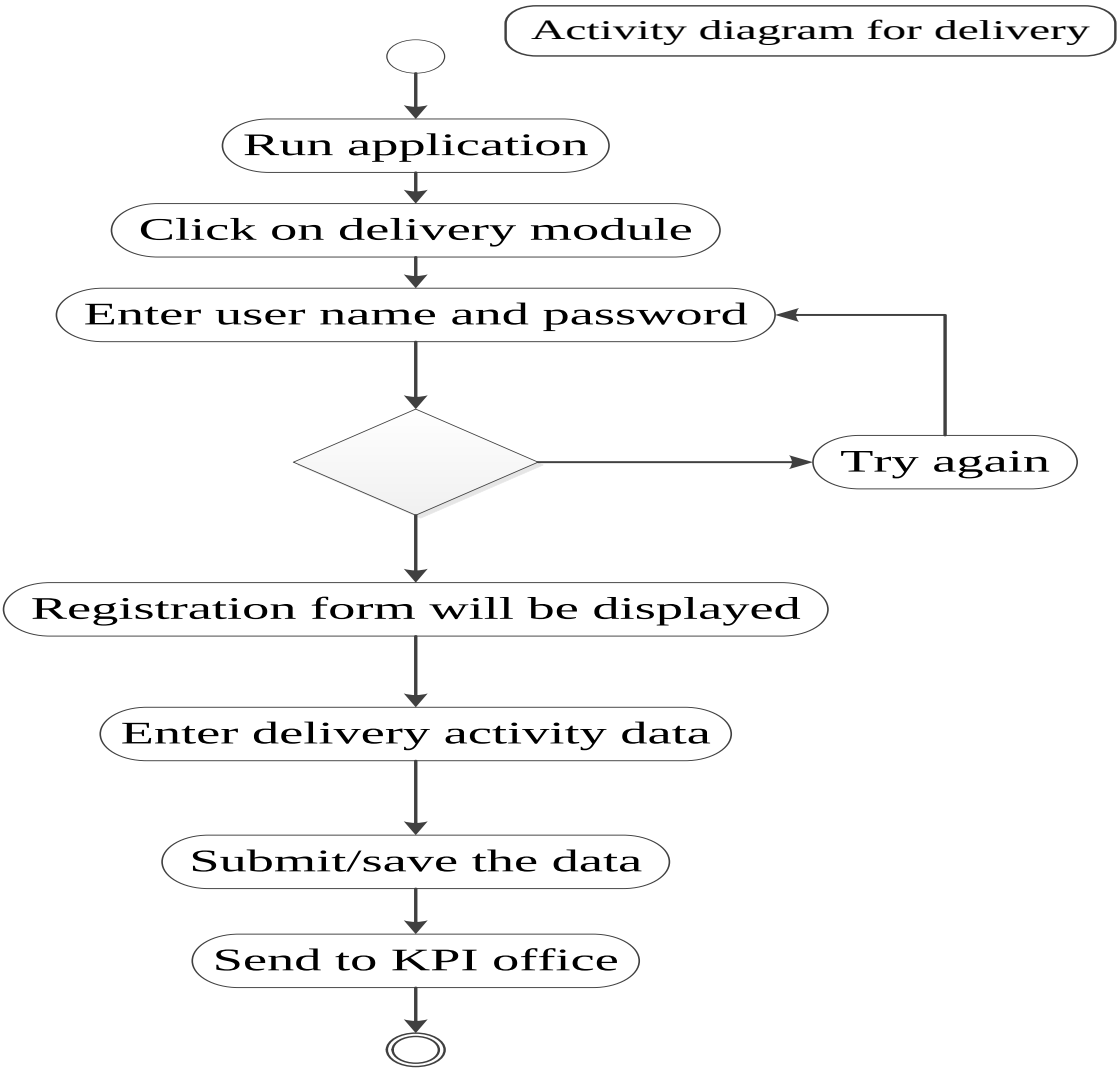


Figure 9 Activity diagram for Delivery module

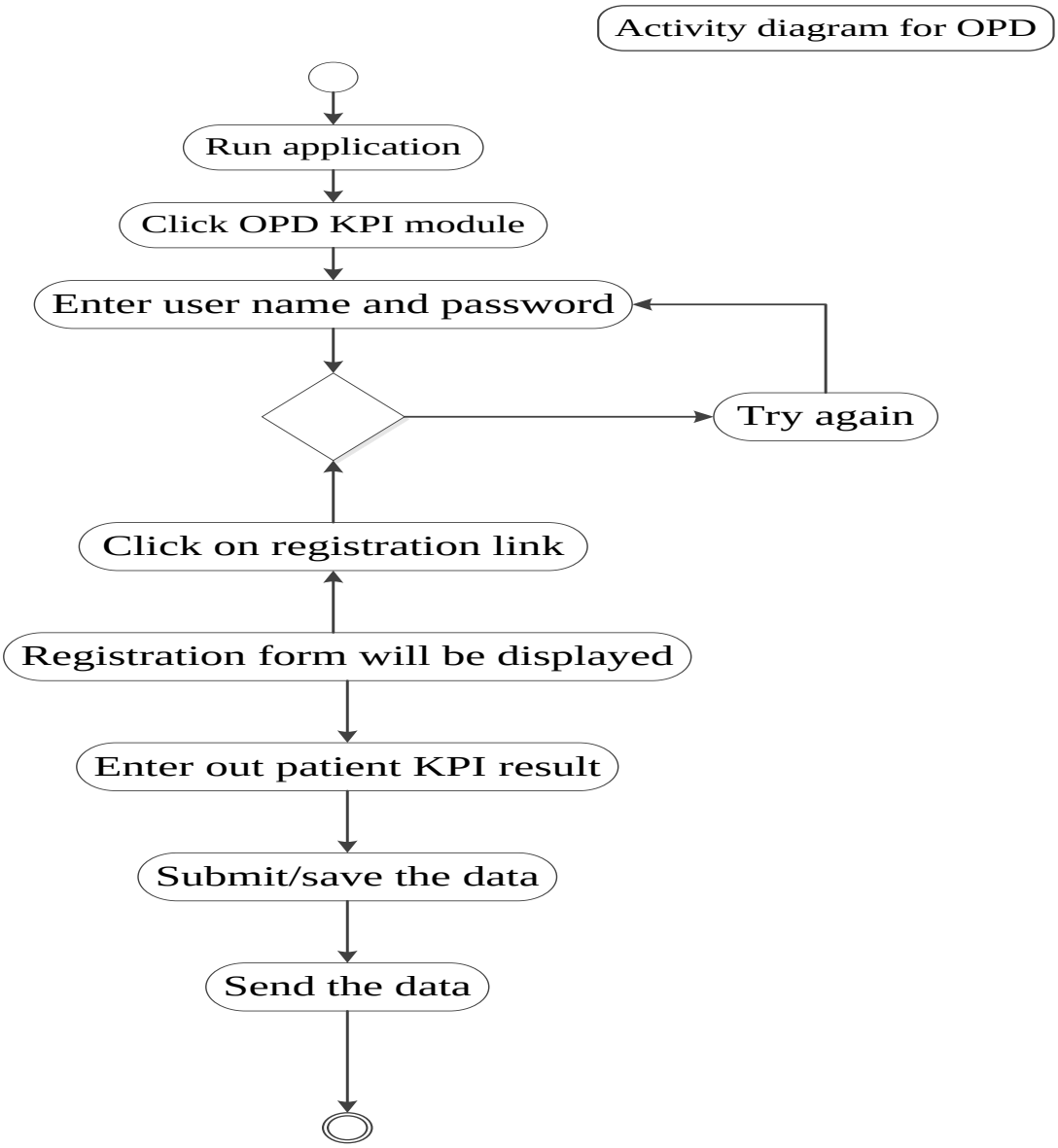


Figure 10 Activity diagram for outpatient module

5.4. Entity relationship diagram

Relationships are associations between entities, and they are shown by lines that connect the entities together. Every relationship has a parent entity and a child entity, the parent being the first entity in the relationship, and the child being the second.

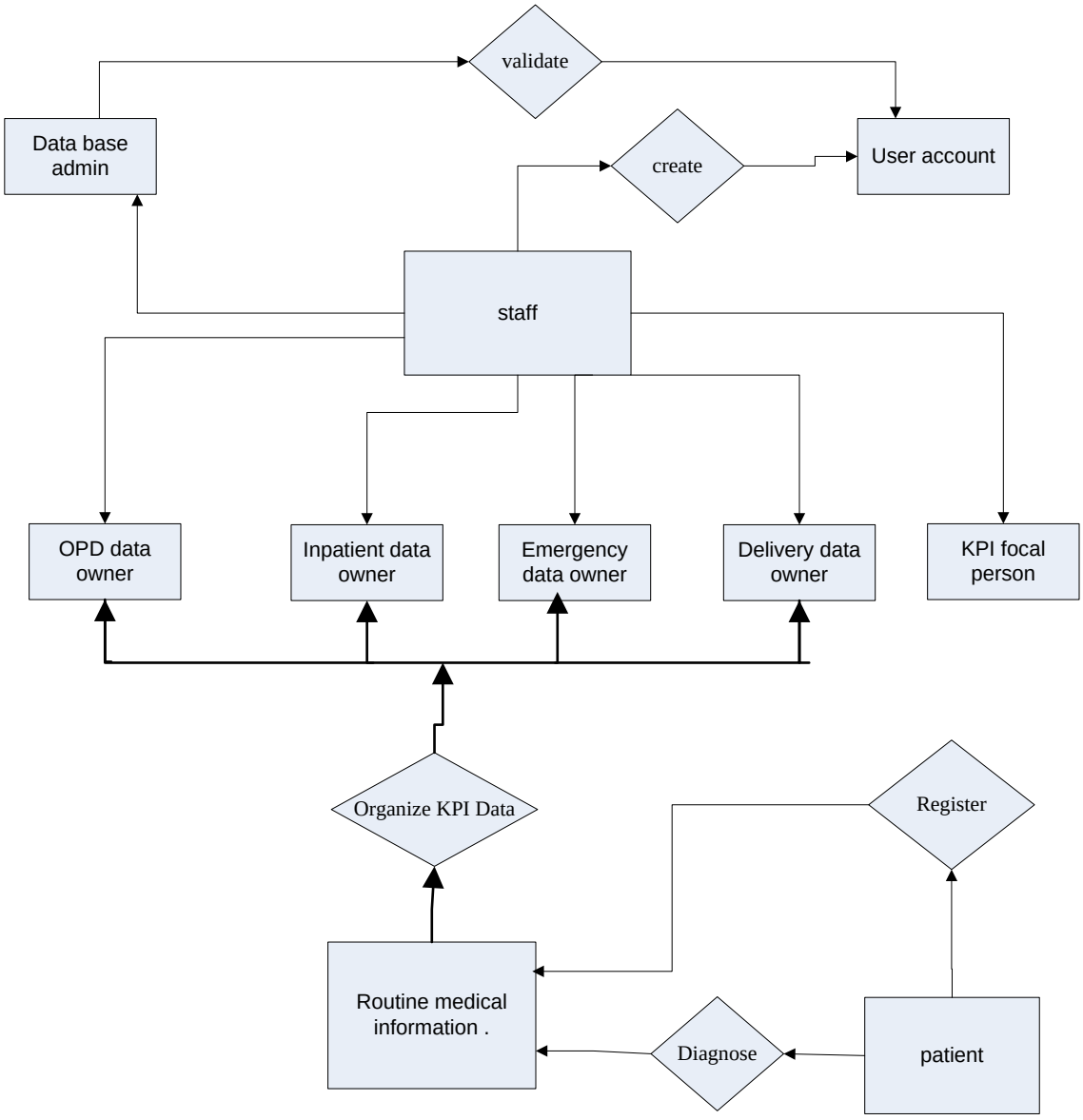


Figure 11: ER diagram

5.5. System User Interface

5.5.1. User interface for login screen

First the user enters his user name and password to login into the system and the password is a six character along alphanumeric string. Successful login shall direct link the user to the registration page of the department. And if the users enter wrong user name or password, the system automatically displays error massage. After doing all necessary things the user will logout from the system by clicking "Log Out". The login submits the user name and password to the login table.

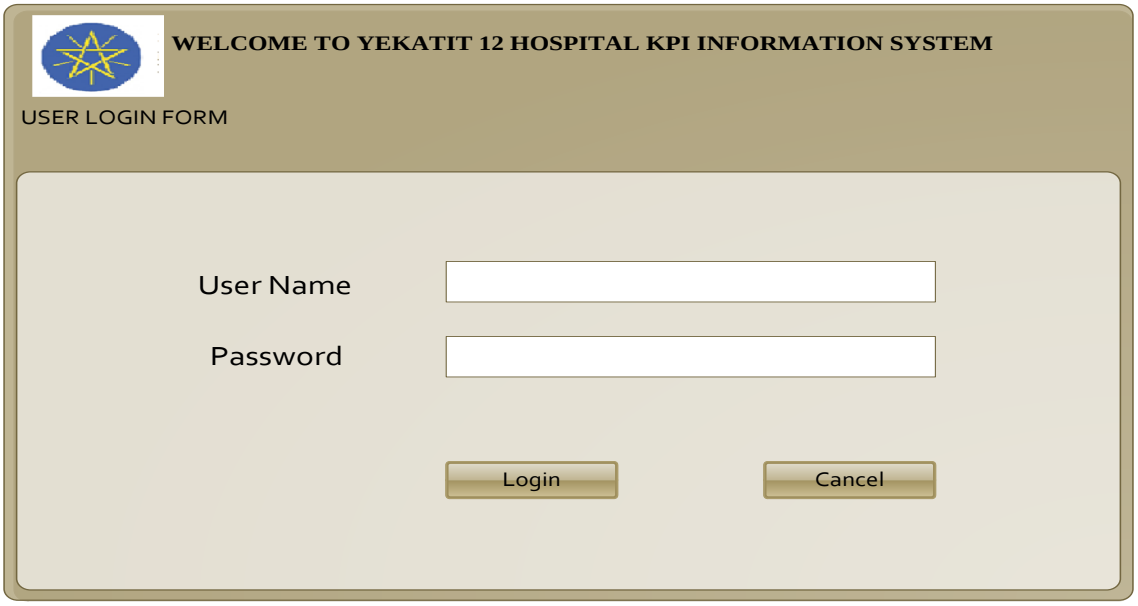


Figure 12 Login User Interface

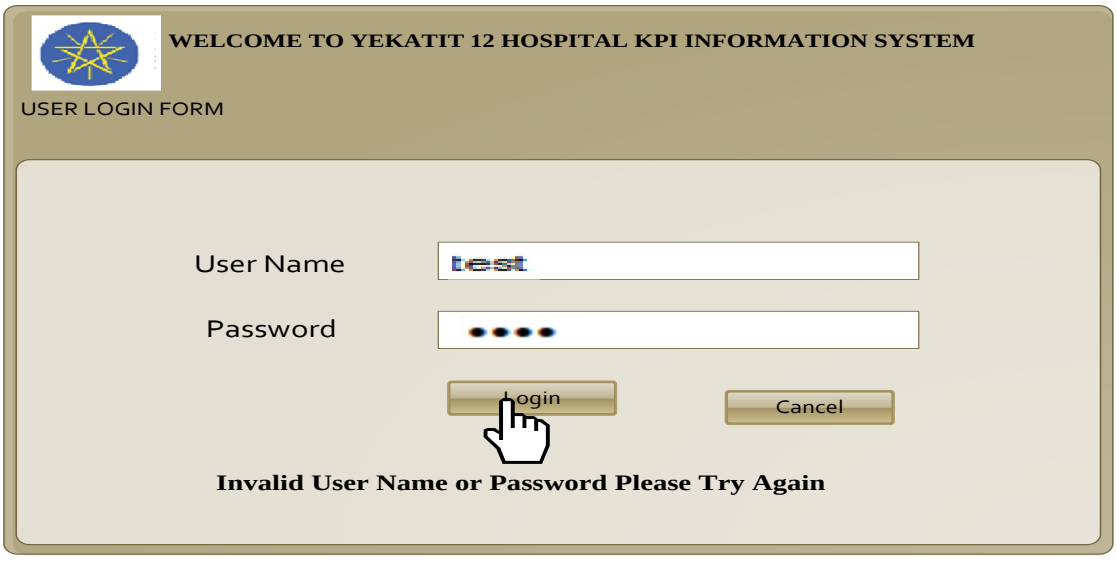


Figure 13 Invalid username/ password User Interface

5.5.2. User interface for Hospital KPI system

This page displays a welcome screen after the user enters the application URL to the any browser .
The pages have departments' module, report module and contact information and other menus.

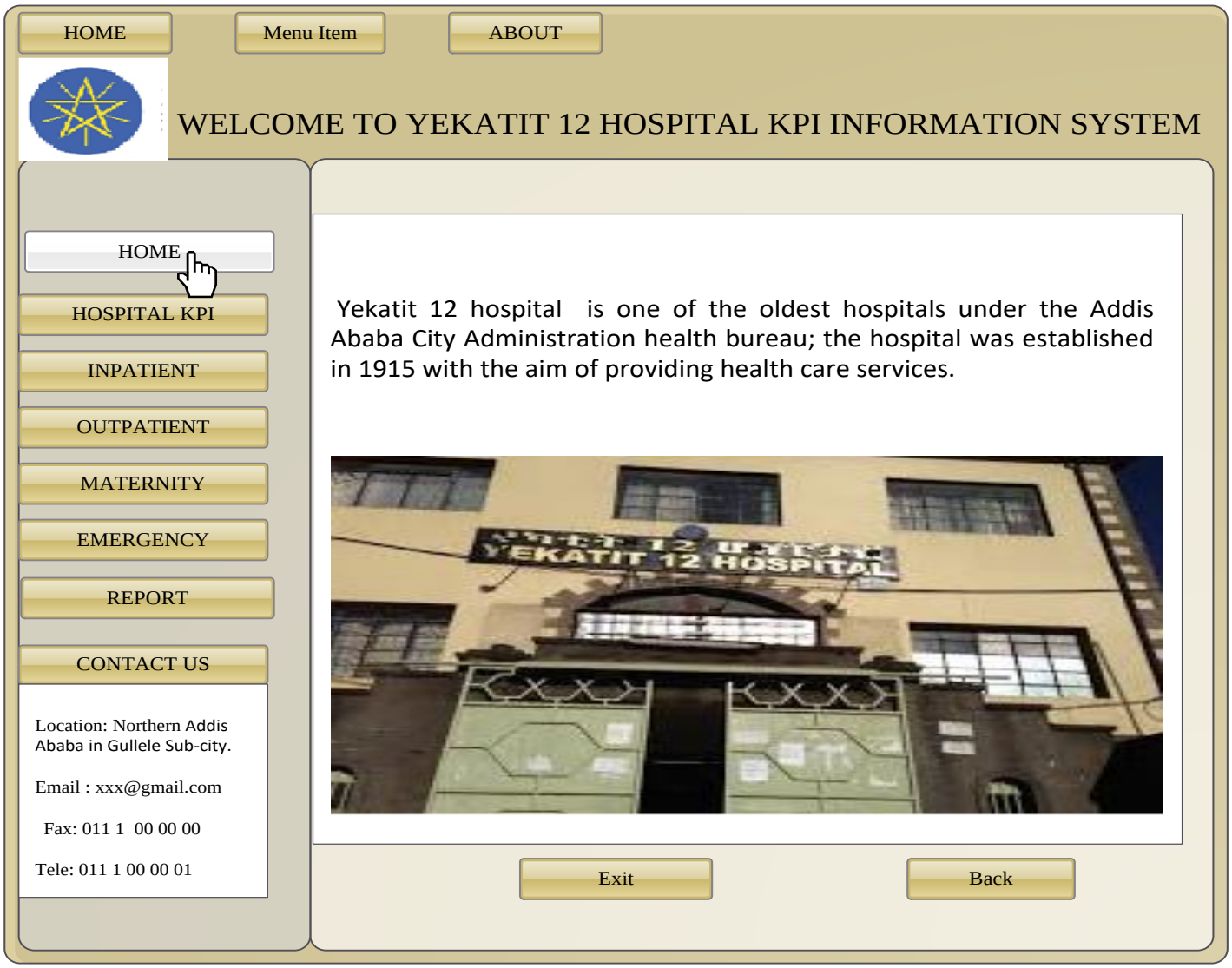


Figure 14 User Interface for Hospital KPI system

5.5.3. User interface for inpatient registration form

This page displays the inpatient department registration form screen after login to the inpatient module.

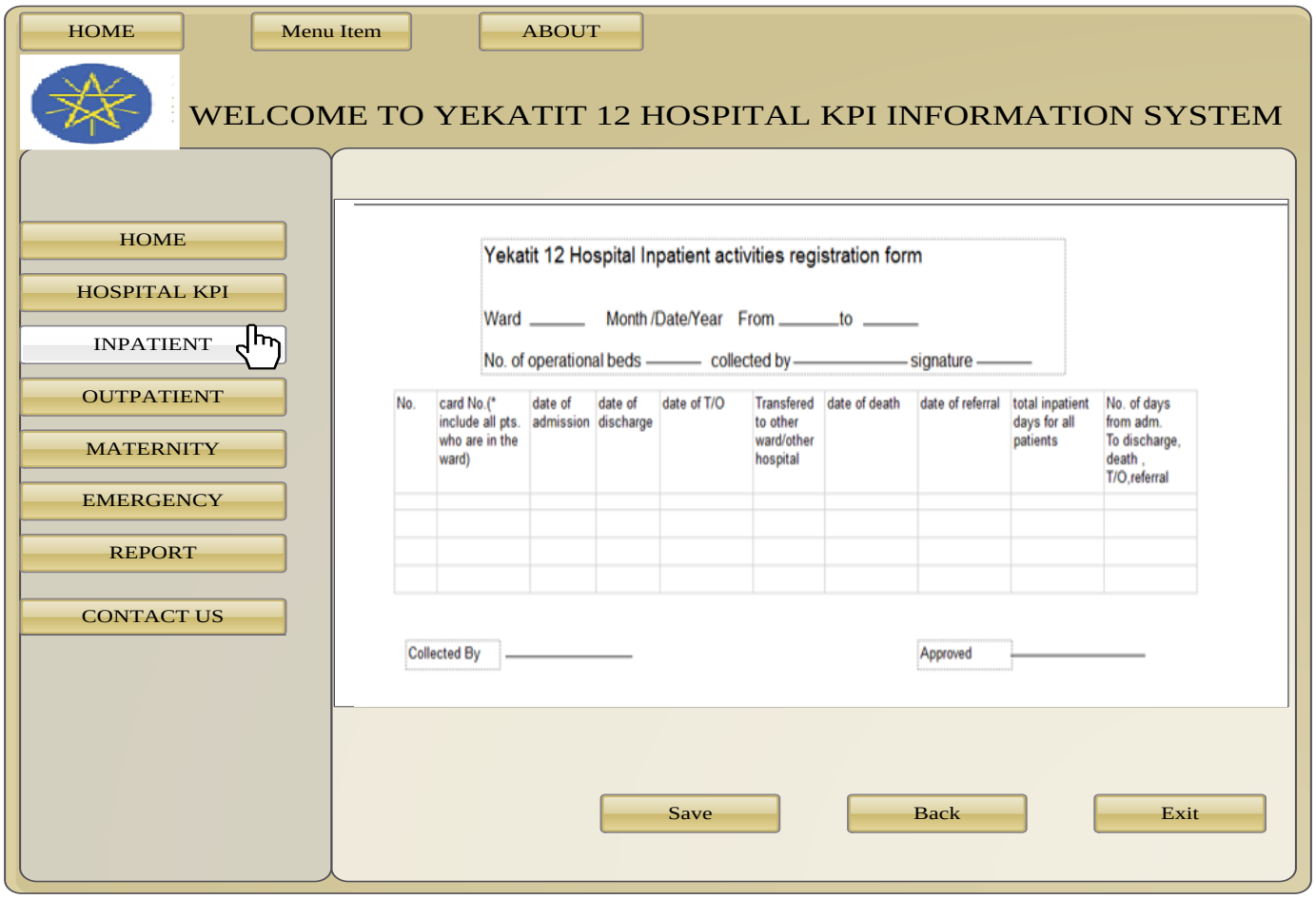


Figure 15 User Interface for inpatient registration form

5.5.4. User Interface for emergency department registration form

This page displays the emergency department registration form screen after login to the emergency module.

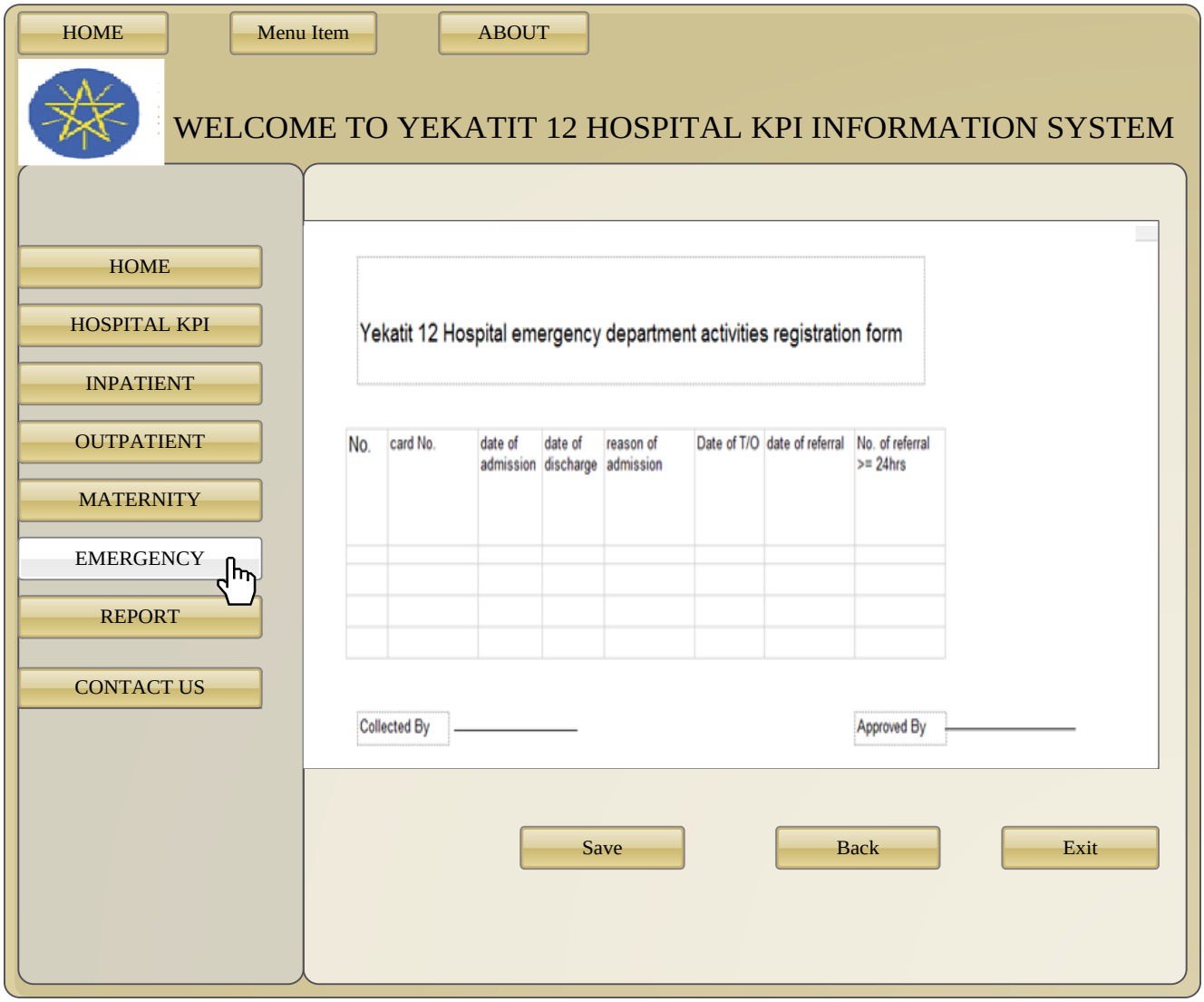


Figure 16 User Interface for emergency department registration form

5.5.5. User Interface for maternity department registration form

This page displays maternity registration form, when the users click the maternity department module and entered his/her user name and password.

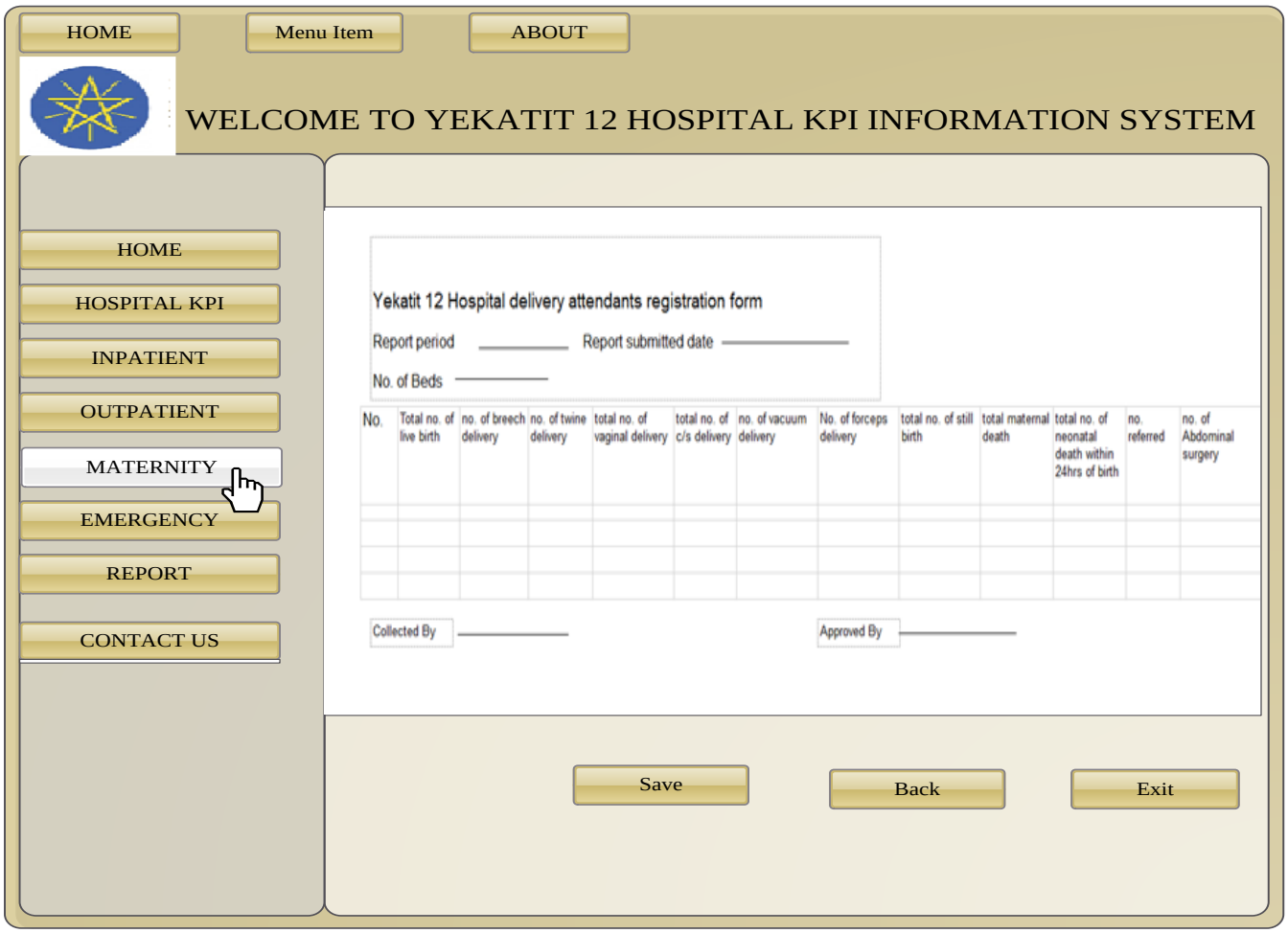


Figure 17 User interface for Maternity registration form

5.5.6. User Interface for OPD department registration form

This page displays when the user click the OPD department module and entered his/her user name and password.

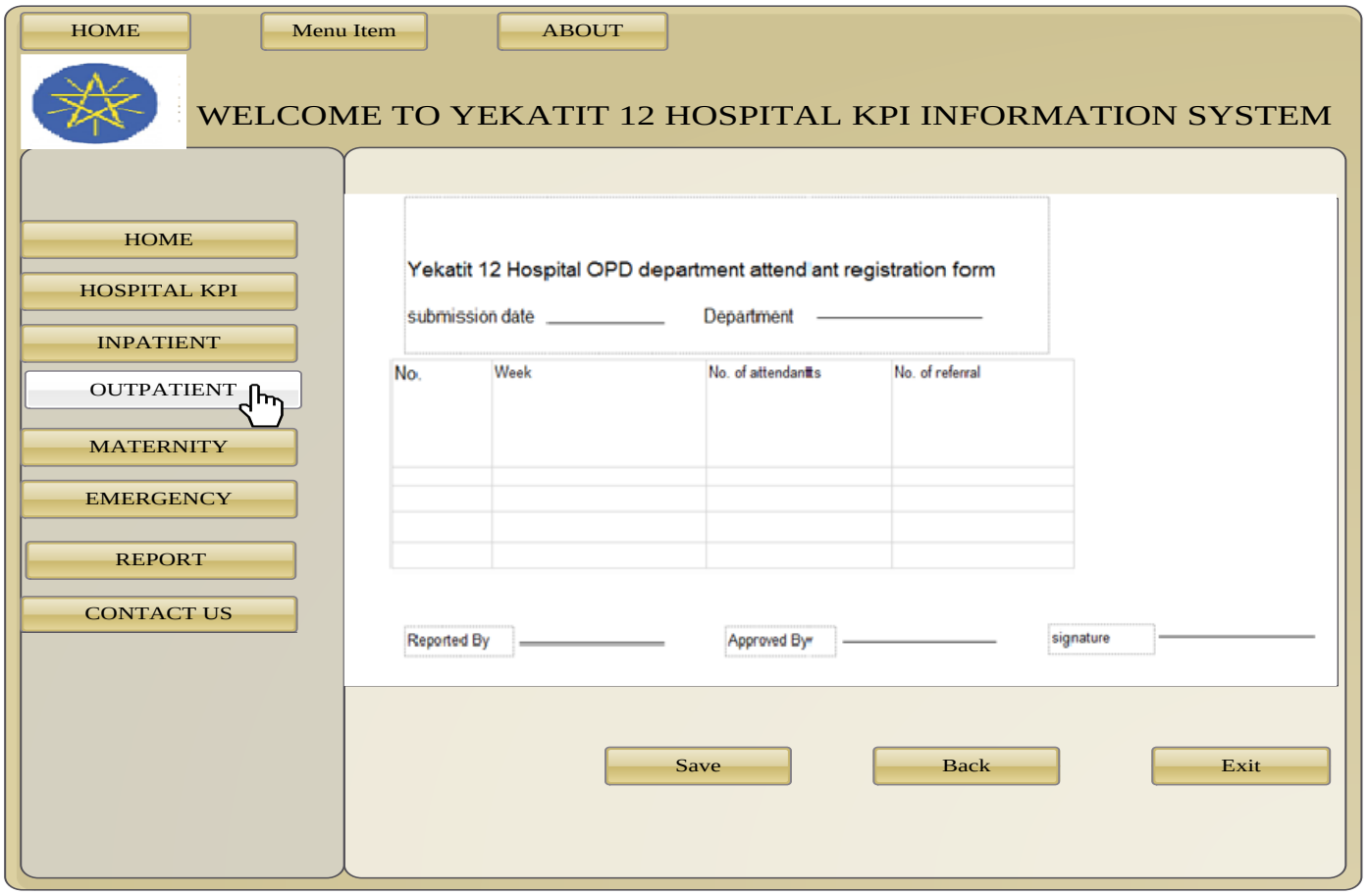


Figure 18 User interface for OPD registration form

5.5.7. User Interface for Hospital KPI report form

This screen display when the end users need to generate the hospital KPI report. These reports describe result of the hospital KPI information in table form and bar graph and the user can select the report format and the report type.

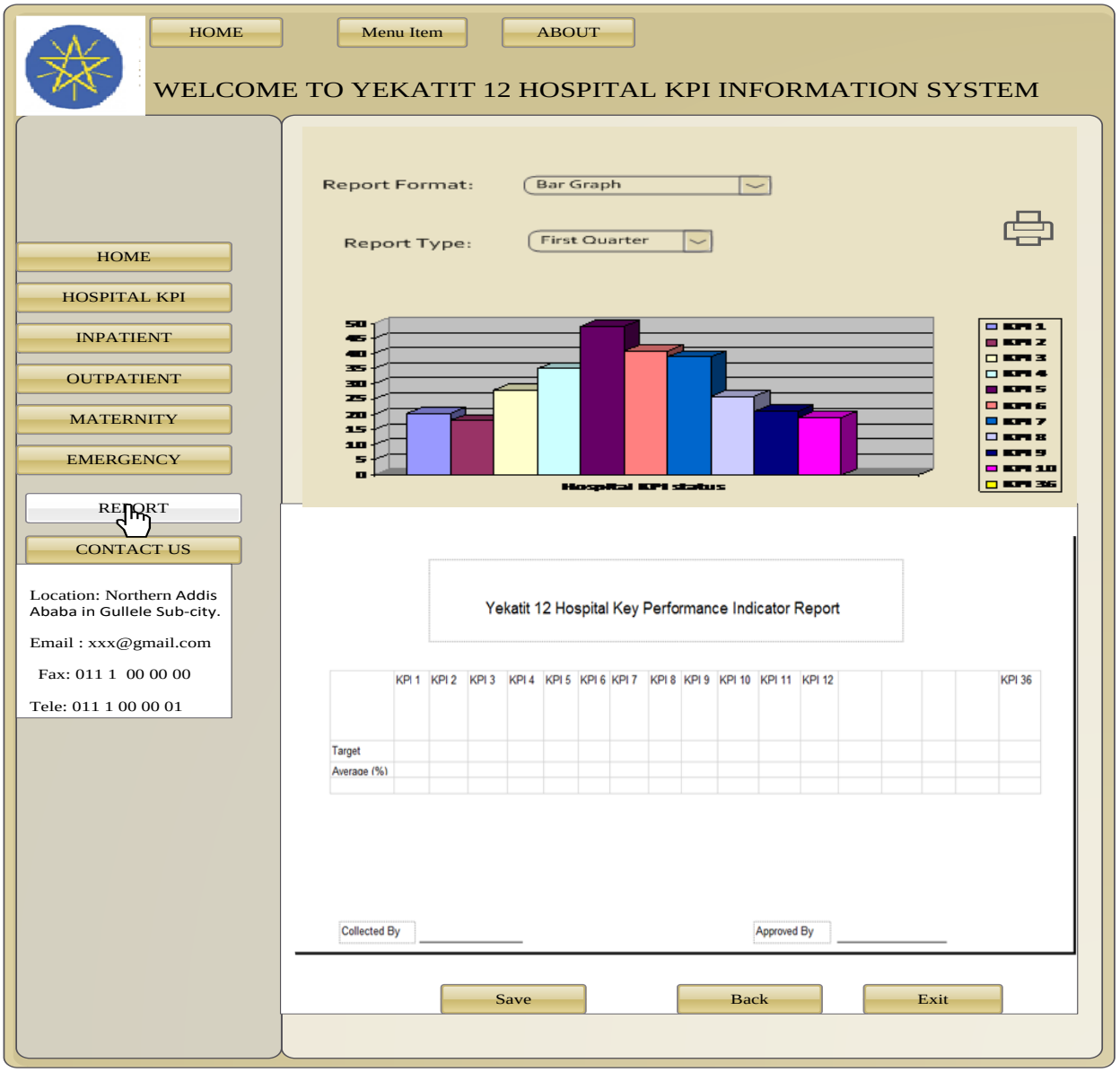


Figure 19 User interface for Hospital KPI report form

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1. Summary

Hospital performance monitoring and improvement is a process by which hospitals are supported and held accountable for providing effective, efficient and quality health services. To achieve their functions, stakeholders (Governing Boards, CRCPTs and MSD) require accurate and timely information about hospital performance to ensure that expectations are being met and to take timely action to address any problems identified. Additionally, hospitals would benefit from experience sharing and identification and dissemination of best practice.

Developing and using KPIs requires systematic processes and methods for gathering, managing, analyzing, distributing, and ultimately reporting performance information. Currently, Yekatit 12, Hospital uses manual/paper based and semi electronic system, therefore, it has problems associated with the reliability and timely reporting of the hospital performance. This project will contribute to better understanding of the use of key performance indicator information system and solve the current problems and an integrated information system will pull together data from a range of sources, so that all information is stored in such a way that users in different locations can easily find the data, in a form that is suited to their needs.

The project study shows a wide range of hospital Key Performance Indicator information system in maintaining a quality health service to the public. Moreover, national standards and guideline documents were consulted along with interview and discussion with KPI focal person and data owners of each KPI in order to determine the requirement for the new system.

The requirements of the new system were collected using data collection tools and techniques. The business process of current system, the functional requirement and non functional requirement and system requirement were described. The analysis of the proposed system were analyzed using the analysis model such as use case description and process model such as contextual diagram , data flow diagram. And the designs of the proposed system were analyzed using the design model such as activity diagram, class diagram and entity relationship diagram.

The methodology used in this project was structured analysis and design. The techniques used for analysis and design in this project were DFD, contextual diagram and entity relational diagram .micro soft Visio 2010 and visual studio 2012 were the tools used for analysis and design of the system.

The researcher acquainted with the hospital key performance indicator rules, regulations, guidelines and practices and various object oriented analysis and design tools particularly UML

tools for the first hand on experience to realize course work in the health industry for quality improvement.

6.2. Recommendations

- The hospital may use this project report as an initial document for implementation as requirement.
- The hospital should establish ICT department and recruit an IT professional to manage IT related problems and KPI system issues.
- The developer and students may use this document for further improvement and implementation of the system
- The developer should test the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use that mean the usability of the system should first test before the implementation of the system.
- The developer should involve the end user in user interface prototyping which is an iterative analysis technique in which users are actively involved in the mocking-up of the UI for a system. Because it enables the developer to explore the problem space the system addresses and to explore the solution space of the system, at least from the point of view of its users, and provides a vehicle for the developer to communicate the possible UI design of your system.
- The developer and students may use additional tools and techniques as well as other method ,tools and techniques for the improvement and development of the system
- The FMoH may expand this Yekatit 12 Hospital KPI information system to other hospitals with similar organizational structure and use this project as initial document.

7.1. References

1. Mihane Berisha Ph.D the role of information system in management decision making. Kosova: University of Pristina ; (2010).

2. G. Hübner-Bloder Medical Informatics and Technology. Hall in Tyrol, Austria: E. Ammenwerth Institute for Health Information Systems, UMIT – University for Health Sciences; (2009).

3. Safer Better Care Developing National eHealth Interoperability Standards for Ireland A Consultation Document. Health Information and Quality Authority; (2011).

4. Health Sector Development Program-IV. Addis Ababa: Federal Ministry of Health; November 2010/11.

5. Medical Services Directorate Hospital Performance Monitoring and Improvement Manual. Addis Ababa: US Center for Disease Control; July 2011.

6. Hospital Authority New Framework for Key Performance Indicators; February 2008.

7. Rod Stephens beginning database designing solution. Wiley publishing .Inc; 2003.

8. John Wiley & Sons Health Care Information Systems 2nd edition. 989 Market Street, San Francisco, CA 94103-1741: Jossey-Bass A Wiley Imprint; 2009.

9. Safer Better Safe Guidance on developing Key Performance Indicators and Minimum Data Sets to Monitor Healthcare Quality KPI. version 1.1 : Health information and quality authority ; February,2013

10. World Health Organization and International Telecommunication Union National eHealth strategy toolkit: WHO Library Cataloguing-in-Publication Data; 2012.

11. Federal Ministry of Health eHealth implementation status; 2009.

12. Hajira Mohammed (Health Informatics) Introduction to Health Informatics indicators. Addis Ababa; Jan, 2013.

13. Steve Rozner Developing Key Performance indicators. united state: the United States Agency for International Development; December 2013.

14. Hibbert, P., Hannaford, N., Long, J., Plumb, J. and Braithwaite. J Final Report on Performance indicators used internationally to report publicly on healthcare organizations and local health systems. University of New South Wale: Australian Institute of Health Innovation; (2013).

15. PacificHealthInformationNetworkhttp://phinnetwork.org/Resources/HIS.aspx; 2011.

16. ICT in Health care delivery system: A Framework for developing nations.

17. Sciverse science directs www.sciencedirect.com .

18. Premkumar Balaraman, Kalpana Kosalram E –Hospital Management & Hospital Information Systems Changing Trends. India: School of Management, SRM University, Vadapalani, Chennai; 2006.

19. Okwor Emeka Daniel design and implementation of an electronic patient management system; 2011.

20. Nabil Mohammed Ali Munassar (Phd) , Dr. A. Govardhan Comparison between Traditional Approach and Object-Oriented Approach in Software Engineering Development; (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 2, No. 6, ;2011

21. Office of the Chief Government Information Officer An Introduction to Rapid Application Development (RAD): The Government of the Hong Kong Special Administrative Region; Oct. 2009.

22. http://www.tutorialspoint.com/sdlc/sdlc_waterfall_model.htm.

7.2. Annexes

1. Interview questions and observation check list

I. Interview guide and observation check

Purpose: the interview question will help to assess the current system and design current key performance indicator information system for Yekatit 12 Hospital.

General information

Interviewee: ----------

Responsibility: ----------

1. What are the major activities carried out in this section?
   _____.
2. What are your customers and their types?
   _____.
3. What sort of services they accept and or rendering to the section?
   _____.
4. Which of the services incorporated into database information system?
   _____.
5. What are the rules, guide lines and standards guiding for KPI reporting?
   _____.
6. What reports are organized?
   _____.
7. Please mention the problem /drawback of the existing system?
   _____
   _____
8. Please mention the features you need in the new system?
   _____
   _____

II. Observation

Department: _____

Date: _____

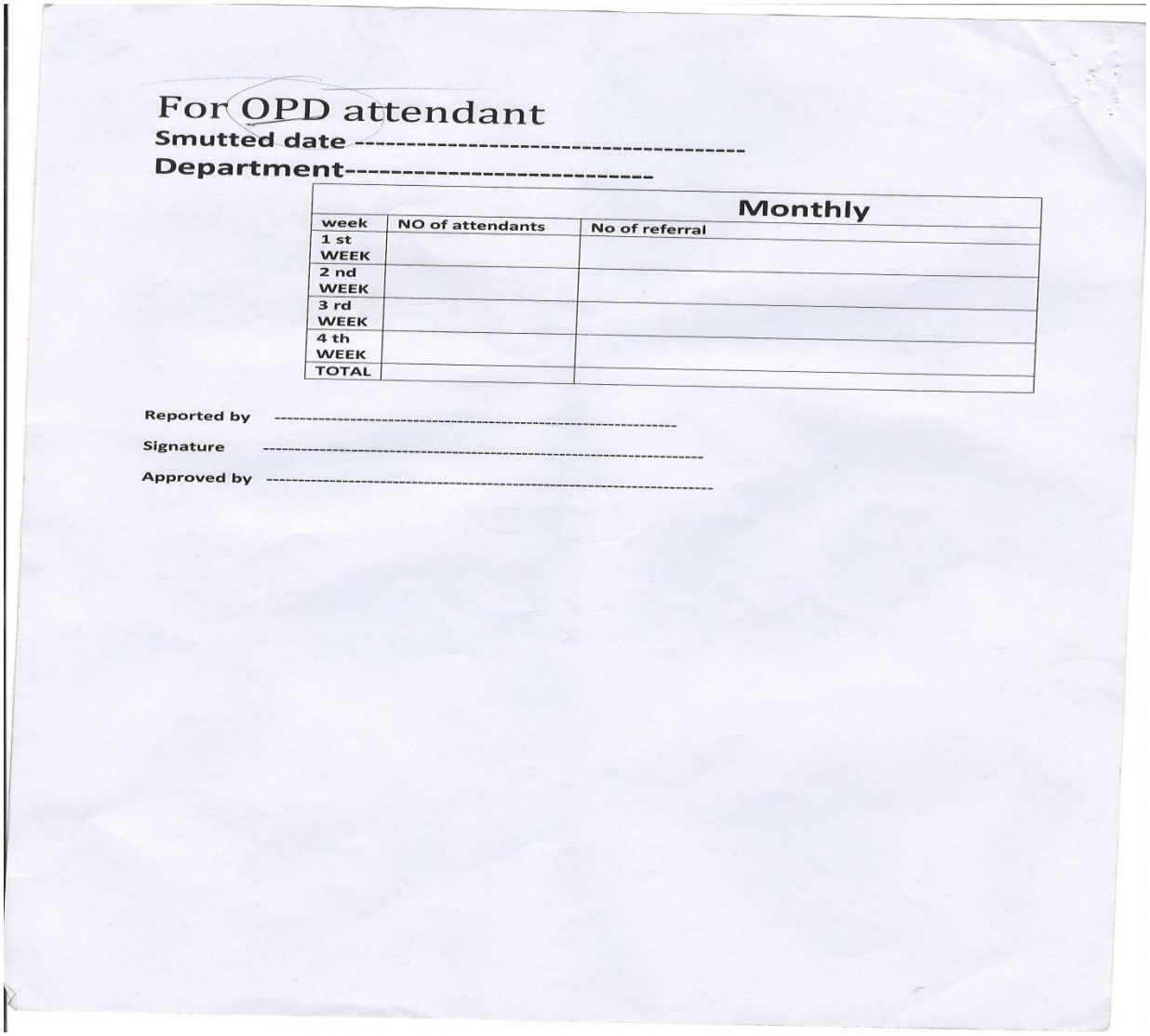
Process to be observed	Yes	No	Remark
1. Does Key performance indicator calculation and analysis carried out according the standard.			
2. Key performance information system are placed in its place			
3. Do all department data owners use all format provided by KPI office			
4. Does reporting generation process is time taking?			

Observer Name----------

Signature ----------

Date----------

2. Registration forms



For OPD attendant

Smutted date ----------

Department----------

		Monthly
week	NO of attendants	No of referral
1 st WEEK		
2 nd WEEK		
3 rd WEEK		
4 th WEEK		
TOTAL		

Reported by ----------

Signature ----------

Approved by ----------

E-R

Yekatit 12 Hospital medical college Admission & referral registration form

No	Card number	Admission date	Discharge date	Reason of admission	Date of t/o	Referral date	No of >24hs	Comment
1								
2								
3								
4								
5								
6								
7								
8 9								
10								
11								
12								
13								

YEKATIT 12 MEDICAL COLLEGE Hospital daily Delivery attendances reporting form

Report period_____

Report submitted date_____

No of Beds ----------

No	Total no of live birth	No breech delivery	No of twine delivery	Total of vaginal delivery	Total of C/S delivery	No of vacuum delivery	No forceps delivery	Total of still birth	Total of MATERNAL death	Total of Neonatal death within 24 hrs of birth	referred	No of Abdominal surgery

Collected by_____

Yekatit 12 medical college in-patient activities registration form
(Dates of admission, discharge, T/O, death, and referral)

Ward_____ **Month** _____ **week dates**
from_____**to**_____ **From**_____ **to**_____
No. of operational beds_____**collected by**_____**signature**_____

No.	card No. (*include all pts. Who are in the ward	date of admission	date of discharge	date of T/O	Transferred to other ward/other hospital.	date of death	date of referral	Total inpatient days for all patients	No. of days from adm. To discharge, death, T/O, referral

Collected by ----------

Approved by ----------