ADDIS ABABA UNIVERSITY
FACULTY OF INFORMATICS
DEPARTMENT OF INFORMATION SYSTEM

Development of web-based database system for national and regional external quality assurance of laboratory service

By

Bekalu Assamnew

A thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirement for Masters of Science Degree in Health informatics

July, 2009

Addis Ababa, Ethiopia

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By:
Bekalu Assamnew (Bsc.)

Advisors:
Ato Henok Lulseged (MSc.)
Ato Getachew Belay (MSc.)

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Bekalu Assamnew (Bsc.)
Addis Ababa University, Faculty of Medicine
School of public Health

Approved by the examining board:

_____ _____

Chair man Dep. graduate committee

Ato Henok lulseged _____

Advisor

_____ _____

Examiner

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Acronyms

ADLC	Automated Differential Leukocyte Count
CD4	Cluster of differentiation 4
EHNRI	Ethiopia health and nutrition research institute
EQA	External quality assurance
GLP	Good laboratory practice
HIV	Human Immunodeficiency Virus
HTML	Hypertext markup language
HTTP	Hypertext transfer protocol
ICT	Information communication and technology
NEQAS	National external quality assurance scheme
NRL	National Reference Laboratory
OSE	On-site Evaluation
PBLI	Practice-based learning and improvement
PHP	PHP: Hypertext Preprocessor
QA	Quality Assurance
QC	Quality Control
QI	Quality Improvement
QO	Quality Officer
RBRC	Random Blinded Re-Checking
RDBMS	Relational database management system
REQAS	Regional external quality assurance scheme
RLS	Regional Laboratory Supervisor
RRL	Regional Reference Laboratory
RTLC	Regional TB & Leprosy Coordinator
SPARC	Systems and Practice Analysis for Resident Competencies
TB	Tuberculosis
TLCP	Tuberculosis and Leprosy Control Programme
Web-SP	Web-based Virtual Patient Case Simulation environment
WHO	World health organization

Abstract

Background: External quality assurance is concerned with the evaluation of performance of a number of laboratories by external agencies. It's aimed at assessing the general standard of performance, assessment of the effects of analytical procedures and assessment of individual laboratory performance and compare result between different laboratories.

Objectives: the aim of this paper is to assess and produce a user friendly web based database system for the national and regional external quality assurance scheme that help in the improvement of patient care through increasing the quality of data, quality control of service (trainings), and more efficient laboratory monitoring and reporting system.

Methods: A survey study was conducted to assess the external quality assurance scheme of laboratory service during March 2009 to April 2009. Different fact finding techniques (reviewing documents, reports, files etc, interview and questionnaire) has been used for assessing the current system and to discover the requirement of the system. An object oriented system development methodology was used to analyze and design the system. PHP, MySQL and apache were the tools used to develop the database and the web.

Result: The laboratories use manual data collection means in about 90% of the cases. As compared to the previous method of data reporting and feedback generation, the newly developed web-based EQA has improved the performances by reducing the response time and loss of information. Only 27 % receive feedback timely, this is as a result of result submission system used and the time staffs needs to make the feedback report. Access to computers is 36.4% and internet (22.5%) in the laboratory. Internet access in the facility is a little higher but still in shortage (51.2%) and restricted to federal hospitals. In most of the cases the automated system have been recommend to use in the facility for their organized handling of information related activities and there has been indicated that this system will make their work easy, reduce workload, it is an accurate method, fast, time saving etc.

Conclusion: The constantly increasing volume of data collected from different laboratories is creating difficulties in manipulation of all available information. The development of an integrated system is crucial. The web based database system developed as enormous potential in reducing time for the submission of result, the response time of feedback and workload on the N/REQAS staff.

Chapter 1 INTRODUCTION

1.1 BACKGROUD

In health laboratory services, the product is the report by the laboratory after analysis of the samples received. Physician or public health professional uses this report for the benefit of the patient or the community. A quality laboratory report thus helps the physician or public health professional in establishing proper diagnosis rapidly and supports better health care for the patient or the community. A quality system is part of an overall quality management that aims at ensuring consistency, reproducibility, traceability and efficacy of the products or services.[1] The laboratories continue to play a critical role in all disease control and prevention programmes by providing timely and accurate information for use in patient management and disease surveillance.[2]

External quality assessment (EQA) is an idea evaluation of performance of several laboratories by an external agency on a sample that is supplied by them. It is frequently organized on a national or regional basis. The main purposes of EQA schemes include: assessment of the general standard of performance, assessment of the effects of analytical procedures and assessment of individual laboratory performance and compare result between different laboratories. It is also a vital supplement to the internal quality assessment. [3]

The national and regional external quality assessment scheme in Ethiopia started with the aim of improving the service delivered to the community especially in the laboratory service. A known same sample (prepared locally or donated from abroad) is sent to a number of laboratories with an instruction sheet and report format from a national or regional centre. All the laboratories after performing the test they will send the results back to the centre mainly by postal service and some times through phone or fax. Where, the results are analyzed and interpreted and a feedback is given to those laboratories. The information generated is used for planning and policy making that contribute for better improvement of the health service. (Source: EHNRI NQEAS)

1.1.1 Ethiopian health and nutrition research institute

The Ethiopian health and nutrition research institute is formed by the merge of the three former independent sisterly institutions, namely

- The National Research Institute of Health (NRIH) formerly known as Paster institute after a French Dr Luis Paster.
- The Ethiopian Nutrition Institute (ENI) and
- The Department of Traditional Medicine (DTM) of the ministry of health.

The institute has been established on the act of council of ministry of regulation Number 4/1996 of the federal democratic republic of Ethiopia. The regulation recognizes the institute as an autonomous public authority, having its own legal personality, and its accountable to the federal ministry of health.

The major *objectives* of the institute are:

- To conduct research on the cause and spread of disease, nutrition, traditional medicines and medical practices and modern drugs and thereby support the activities for the improvement of the health in the country.
- To contribute to the development of health science and technology.
- To serve as a referral medical laboratory services relating to the occurrence, causes prevention and diagnosis of major disease of public health importance.
- To establish the support national laboratory Quality assurance programs and system

Vision

The main institute's visions are

- Prevent and eradicate diseases from Ethiopia and
- To see healthy, productive and prosperous Ethiopia.

Mission

- To generate and disseminate scientific knowledge obtained through research on health significance and to contribute quality services for health improvements of the general public
- To fulfill and accomplish its vision and mission the institute structured, constituted under the board of directors and further divided into departments and sections

1.1.2 External Quality Assurance (EQA)

The quality system of Ethiopia was first integrated in the national laboratory master plan in 2005 G.C. In 2006 G.C. operational plan was developed which addresses the twelve essentials of the quality system with priority and focus on basics of laboratory quality assurance. These are:

- Safety
- Standard documents & guidelines
- Training
- Maintenance
- EQA/IQC
- Certifications for improvement and accreditation

The approaches used in the implementation of the quality system are:

- Phase-wise and decentralized
- Comprehensive and integrated
- Focus on major diseases
- Utilization of a tiered laboratory network
- Collaborations & partnership
- Vision for sustainable GLP(good laboratory practice)
- Cross-reference with international recommendations

Ethiopian is participant of international EQA in panel testing of CD4, chemistry and hematology. At the national EQA HIV rapid testing, TB, Malaria… and at regional EQA HIV rapid testing and TB are implemented and currently on run. These panel testing are conducted in quarterly base 4 times per year. The implementation of IEQAS/NEQAS was started on 20 pilot site in 2007 G.C. and REQAS on 200 sites. In 2008 G.C. EQA was reviewed and improvement plan developed. Expansion of NEQAS was done on June, 2008 for 52 labs of ART monitoring and HIV rapid testing and 145 testing points for HIV rapid testing. REQAS also undergo expansion on 300 health centers labs including private sectors and 200 testing points.

1.1.2.1 The purpose of EQA

EQA is aimed at assessing the performance of laboratories in different ways. These includes assessment of the conditions and skills practiced in the laboratory, to determine whether a laboratory technician can adequately perform laboratory tests (individual performance), and to provides reliable assurance that the laboratories can perform the test as required standard.

The EQA allows for assessing QC, evaluation of entire process in the laboratory test, and random blinded re-checking of routine tests and also allows participant laboratories to assess their capabilities by comparing their results with those obtained in other laboratories in the network (intermediate or regional and central or national reference laboratory) through panel testing and rechecking of patient slides, using both un-blinded and blinded procedures.

1.1.2.2 Major function of the EQA

Three external quality assessments (EQA) major activities have been pointed out in the newly revised network for quality assurance to evaluate performance of the laboratories. These are:

- On-site Evaluation
- Panel Testing
- Random Blinded Rechecking

1.1.2.2.1 On-Site Evaluation

A field visit which aimed at assessing the realistic conditions and skills practiced in the laboratory and it is concerned with a comprehensive assessment of

- laboratory safety including infection control measures
- conditions of equipment
- adequacy of supplies as well as the technical components of laboratory tests.

It is performed

- at least once a quarter by RRL Supervisors to evaluate the overall operational conditions in the peripheral laboratories and
- once a quarter by EHNRI to Federal Hospitals and

- three times a year by EHNRI Supervisors to evaluate RRL EQA and supervisory responsibilities of RRLs.

This assessment is believed to respond to immediate problem solving, corrective action and on-site retraining. If the laboratory has poor performance, extra visits will be made by trained laboratory personnel from a higher level laboratory.

It is organized using a check list that asked for different points in the laboratory like General information of the site visited, List of actions taken during the previous visit, the current visit particulars, On-site panel slide testing results and assessment of EQA.

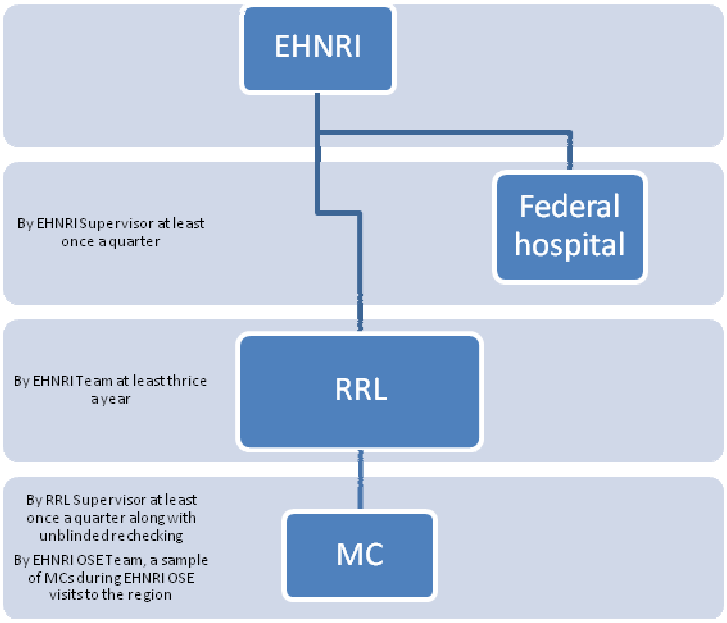


Figure 1-1 On-site Evaluation levels

1.1.2.2.2 Panel Testing

Panel testing is a method of EQA that is used to determine whether a laboratory technician can adequately perform the different laboratory tests. It aimed at evaluating individual performance in undertaking each test and result reading, it does not evaluate all the laboratory activities on there routine performance. It is use full to

- Supplement re-checking programmes

- Provide information on the capabilities of the regional laboratories prior to implementing a re-checking program
- Assess status level of performance or to quickly detect problems associated with very poor performance
- Evaluate proficiency of laboratory technicians following training
- Monitor performance of individuals when adequate resources are not available to implement a re-checking program

A panel consists of a batch of samples that are sent out by the higher-level reference laboratory to the peripheral laboratories for processing, reading and reporting of results. Numerous issues are considered for implementing panel testing, include:

- Proper preparation of sample
- Number of sample to be included in the test panel set
- Types of sample to be included (prepared and unprepared, low positives, poorly prepared smears).
- Forms for test laboratories to record results
- Time allowed for all laboratory technicians and microbiologists in the test laboratories to complete panel and report results.
- Evaluation criteria for acceptable performance.
- Plan for reporting results to the test laboratory and implementing corrective action if needed.
- Mechanism to resolve discrepant results.

EHNRI will conduct panel testing of RRLs at least thrice a year. EHNRI may decide on additional panels during OSE, depending upon the results of obtained through integrated method.

1.1.2.2.3 Random Blinded Rechecking slides

Blind rechecking is a process of rereading a statistically valid sample of slides from a laboratory to assess whether that laboratory has an acceptable level of performance. Random blinded rechecking (RBRC) of routine slides from the MCs is to be

implemented throughout the EHNRI/TLCP laboratory network. It is only done for malaria and tuberculosis.

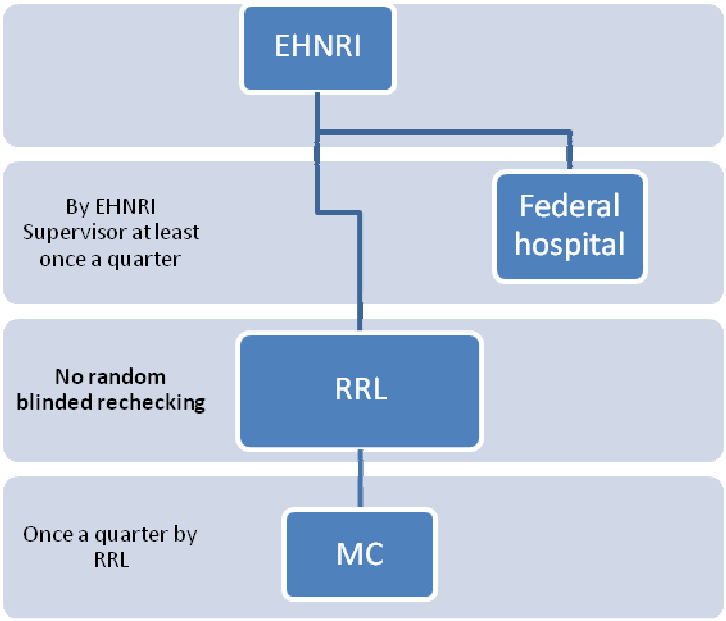


Figure 1-2 Random blinded Rechecking levels

1.1.2.3 IT Practice in EQA automation

EQA has long recognized the use of computers in the EQA can make a difference in the quality work. Especially, the development of database for their activities and documentation. Automation has been exercised in the quality system of laboratory services where Training database have been developed using Microsoft access but it is not yet function.

1.2 STATEMENT OF THE PROBLEM

Availability and access to quality laboratory services are among the major challenges contributing to delayed or inappropriate responses to epidemics, disease control and patient management. The result has been continued reliance on empirical patient care, a practice that not only wastes resources but also contributes to drug resistance. The majority of the estimated 12 million annual deaths in sub-Saharan Africa remain uninvestigated.[4]

Quality Assurance is achieved by a series of processes that assure the most accurate and highest quality result. To achieve high quality results, input from all members of laboratory in a testing network is required. Laboratory personnel should be aware of the need for a quality performance. This requires education throughout the testing system. [5]

In the assessment of the Ethiopia health management information system there have been identified a number of problems like quality of data, information use, data burden, human resource and the lack of the use of ICT.[6]

The world health organization (WHO) has considered information communication and technology as a strategic resource to the health system because of the various reasons. Among them, they have said ICT will:

- "empower individuals working to improve the health of all people";
- "Increase the productivity of teams and of individuals";
- "Facilitate knowledge-sharing and new ways of working within WHO" and
- "Act as a catalyst for providing new and innovative services to Member countries."

Also they have stated objectives to ICT and these are: "To make more effective use of ICT across the Organization in order to improve its ability to deliver on its mission of health for all" and "to support the initiatives aimed at strengthening health systems and improving health outcomes in countries."[7]

In the Ethiopian EQA, there is no fully operating automated system. They have tried to develop training database but it is not functional. All of the collection of data from different health facilities all over the Ethiopia is through postal mail, phone and fax and analyses of those data collected are handled manually. And also the feedback mechanism

is poor (untimely). So, this study tried to assess the current information system of EQA and developed a web based database system. It is also believed that the finding of this study will help in improving reporting system and feedback system of the EQA which in turn improve laboratory service delivery to patients.

1.3 OBJECTIVE OF THE RESEASRCH

1.3.1 General Objective:

- To assess and develop a web based database system for the national and regional external quality assurance scheme of laboratory services.

1.3.2 Specific objectives:

- To assess the current information system of national and regional external quality assurance related to collection, organization and reporting
- To define the Requirement of the national and regional EQA scheme (Problems discovery and analysis, Requirement discovery, Documenting and analyzing requirement and Requirement management).
- To design the web based database system of the national and regional external quality assurance scheme.
- To evaluate the web based database system developed

1.4 Scope

The scope of the study was to develop web based database system for the national and regional external quality assurance scheme of laboratory service. These includes the HIV, TB, Malaria, Hematology and Clinical chemistry data on there collection, organization, and analysis, manages information posted by the national or regional EQA (reference materials, instruction, etc) and the feedback mechanism on their performance, and information on training and its events. The web based database system has been developed for only panel testing of HIV, TB and malaria and training.

1.5 Strength and Limitation of the Study

1.5.1 Strength of the study

For the development of the system an object oriented system analysis and design is used which will make the system easy during the change management so that it makes it scalable, flexible etc.

1.5.2 Limitation of the study

- This study address the assessment and development of a web based database system of the national and regional EQA in only Addis Ababa
- One federal institute has refused to participate in the study because of the security issue.
- Due to time constraint for some panel testing web pages have not been developed.
- Limited literature in the area

1.6 Significance Of The Study

As indicated in most literature, the quality of information collected and availability of reliable information timely is crucial for the development of any information system. The World Wide Web (www), which originally was nothing more but a system allowing researchers to link static documents, turned out to be an interesting place for all types of companies to advertise their system on one hand and to interact with potential customers on the other hand. The use of powerful server-sided applications (like PHP, ASP, JAVA and Cold Fusion) in order to add interactivity to static web sites has pose a interest to may organization.[8] The creating of the web based database system for national and regional external quality assurance scheme of the laboratory service it is believed to be help in improving the quality of data collected, quality control of service (training), and more efficient laboratory monitoring and reporting system of EQA data and also improve the feedback mechanism of the system, which on the other hand improves the quality of service delivered to the community.

1.7 Organization of the paper

The paper is organized into six sections. The first section describes about the background of EQA, the institute (EHNRI), and the objective, scope, limitation and significant of the study. Section two presents a literature review that describes about what an EQA is, object oriented system development and the web based database system. In section three the methodology used for the study is described. In section four the study assessment result and system design is explained in detail. At section four discussion of the study is presented and in the final section conclusion based on the assessment and evaluation of the system have been presented and also recommendation on what should be done in feature is indicated.

Chapter 2 LITERATURE REVIEW

2.1 Introduction

2.1.1 External quality assurance

A quality laboratory report helps the physician or public health professional in establishing proper diagnosis rapidly and supports better health care for the patient or the community. In health laboratory services, the product is the report by the laboratory after analysis of the samples received. These reports are used for the benefit of the patient or the community. Quality system is part of an overall quality management that aims at ensuring consistency, reproducibility, traceability and efficacy of the products or services.[1] The laboratories continue to play a critical role in all disease control and prevention programmes by providing timely and accurate information for use in patient management and disease surveillance.[2]

In 1999, Quality System Essentials were introduced to laboratory practice by the National Committee for Clinical Laboratory Standards, identifying 10 or more major laboratory activities that are important components of a laboratory quality program [9,10]. The some of essentials include equipment, process improvement, safety and personnel development among others. All of these essentials were developed to ensure that data reported from the laboratory are as accurate as possible and serve the needs of patients and clinicians. An important component in the control of any laboratory procedure is the participation in an external quality assurance (EQA) to demonstrate that the method will give the correct result with an unknown random specimen. [11].

External quality assessment (EQA) is an idea evaluation of performance of several laboratories by an external agency on a sample that is supplied by them. It is frequently organized on a national or regional basis. The main purposes of EQA schemes include: assessment of the general standard of performance, assessment of the effects of analytical procedures and assessment of individual laboratory performance and compare result between different laboratories. It is also a vital supplement to the internal quality assessment. [12]

2.1 Object oriented system analysis and design

It is a software engineering approach that models a system as a group of interacting objects. Each object represents some entity of interest in the system being modeled, and is characterized by its class, its attributes, and its behavior.

Object-oriented analysis looks at the problem domain, with the aim of producing a conceptual model of the information that exists in the area being analyzed. Focuses on *what* the system does, with out considering any implementation (i.e. how the system is to be built). Analysis applies object-modeling techniques (such as the Unified Modeling Language (UML)) to analyze the functional requirements for a system.

The result of object-oriented analysis is a description of *what* the system is functionally required to do, in the form of a conceptual model. That will typically be presented as a set of use cases, one or more UML class diagrams, and a number of interaction diagrams. It may also include some kind of user interface.

Object-oriented design transforms onto implementation classes and interfaces. The result is a model of the solution domain, a detailed description of *how* the system is to be built (technological or environmental – constraints, such as transaction throughput, response time, run-time platform, development environment, or programming language.)[13,[14]]

2.2 Web And Health Care

The web (internet) is used as a source of information and for the dissemination of information by many different public and private organizations. After many usability tests, there has been concluded that people do not come to the web for an ‘experience’ they come for information.[15] Similarly, a study on monitoring the use of, and archives, the web has reported that ‘roughly two-thirds of users are looking for specific information’ [16]

The development of a protocol for information distribution in 1990 by Tim Berners-Lee paved the way for the emergence on the Internet applications with broader public demand.[17] The World Wide Web has become an indispensable tool in education,

government, business, news media and, most important for the purposes of this paper, medicine and research.

The advantages of using Web-based means to collect information include the speed of response, the economy of data collection, (not having to print or post, and needing less staff to manage data, enabling researchers to focus on analysis and dissemination of results).[18]

A study by Jason A. Lyman and his colic's, on the development and implementing of web based tools for residents to use and evaluate their outpatient continuity practice experiences, there have been found the SPARC (Systems and Practice Analysis for Resident Competencies) to be useful for learning about practice-based learning and improvement (PBLI) and believed it would improve the care they provide to their patients. The residents also reported increased confidence in their ability to conduct PBLI tasks. In addition, they recommend that tools like SPARC may be an important component of a PBLI curriculum that directly engages residents and helps them acquire these important skills.[19]

A study in Peru, to improve the timeliness and quality of laboratory data especially on pulmonary tuberculosis (TB), they tried to develop and implemented a web-based laboratory information system named "e-Chasqui". The study concluded that the use of e-Chasqui has the great potential for creating a national TB laboratory network in Peru to facilitate the communication and analysis of all bacteriological results country-wide. The use of the system have many additional advantages such as having the test always available during clinical decision making, reducing duplicate tests performed, and reducing the time and money spent by staff checking the status of their samples.[20]

The study on asthmatic patients, the experience in extracting information from the website, the use of web site has a greater potential to improve the way patients communicate with their provider and that the suggested questions from the system can overcome the clinical inertia of providers. The main findings suggest that use of the

website is well accepted and is perceived to improve the quality of care that patients receive.[21]

A study in Ireland on the use of ReplaySuite (a web-based, user-friendly software tool that enables pathologists to replay virtual slide examinations), Even though there were some limitations (bias and limited set of evaluation) in the study, the response form the participant was positive and shown to have a great potential benefit to pathology training and quality assurance. And also it is valuable in evaluating the diagnostic trace of an examination. The system has permitted the assessment to be reviewed at different times and in different locations to the original examination which contribute in eliminating temporal and spatial issues that surround the use of double-headed microscopes.[22]

In a study at the united states on the design and implementation of a comprehensive web based for intensive care unit reporting system, it is an important safety improvement mechanism. 66% of participant that have completed the study evaluation found the system to be less time consuming, and 68% noted questions were clear.[23]

In a support for easy authoring, management and presentation of virtual patient cases, a Web-SP (Web-based Virtual Patient Case Simulation environment) system was constructed and piloted in Sweden. The students has found the system to be vital and commented that the system as “I can test my knowledge.”, “I can work on my own pace, whenever and wherever I want.”, “More realistic than paper-based cases.”, “ It motivates me to acquire more knowledge.”, “I get immediate feedback on how I performed.”, “Easy to use and interactive.”, “I can freely choose what to examine and I need to motivate my diagnosis.”, and “It was fun and engaging.”[24]

A case study done in Starr country, Texas on web based data collection, the use of dynamic approach for web-based data entry has shown to be a very efficient and effective data collection system. This system accelerates data processing and analysis and eliminated cumbersome and expensive transfer and tracking of forms, data entry, and verification. Also this system is effectively applicable to other research areas. [25]

On the 106th annual meeting on medical laboratory technology, it has been said that, the innovation of information discovery and delivery is facing many new roles and challenges that expecting professionals. Using these new opportunities, the professionals have to build new joint ventures in order to permit our professional expansion and recognition as the best providers of quality information for improved health. And also, in order to be successful in the new practice field, we need to make sure that we are equipped with the needed skills and knowledge. [26]

In the assessment of the Ethiopian health information system there has been found that data management (33%), dissemination and use (36%) and HIS resources (39%) was not adequate. It was also learned that, the assessment findings of all categories (resource, indicators, data source, data management, information product and dissemination and use) were as 'not functional', 'not adequate' and 'present but not adequate'. From the analysis it has been indicated that these aspects of the national HIS are the most deficient areas and need tremendous efforts to change the existing situation. [27]

2.3 EQA AND ICT

The effective delivery of EQA services is almost totally dependent now on information technology (networks, computers and software). The ability to acquire, collate and reduce large quantities of data and then to generate individualized, structured reports, are presently simple routine tasks performed in a tiny fraction of the time taken a decade ago. The current pace of change, however, is dramatic, and opportunities now exist which can take EQA to its next phase of existence using 'Internet technology' (email and World Wide Web browsing). The main advantages of Internet working include time, geography and hardware independence, greater security and improved accuracy. [28]

Web-based data entry has been available for the UK NEQAS General Hematology Automated Counting Schemes (Full Blood Count, Automated Differential Leukocyte Count (ADLC) and Reticulocytes) since January 2007. More than 75% of participants in these schemes are now registered as 'web-users' because of the multiple benefits that

they get from the system which are rapid, reliable and secure return of their UK NEQAS (H) survey data and on-line access to reports. [29]

The beginning of the Internet has allowed health professional, patients and other healthcare providers to access large volume of information in an easy and cost-effective way. This new situation opens up front line to medical activity and changes the way health professionals act with obvious effects on healthcare services, quality and effectiveness. The privacy, the quality and reliability of information are important issues in this kind of systems. Also, in many real-world situations information is still kept on paper due to the unavailability of adequate ICT support or to the traditional technophobia of many users. [30]

As it has been clearly shown on the above paragraphs, the use of web based system has many advantages over the routine manual system, therefore the aim is to assess the current information system and to develop the database system that can have a great potential in improving the patient care through improving quality of data, quality control of service (trainings), and more efficient laboratory monitoring and reporting system.

Chapter 3 METHODS

3.1 Study design

A survey was conducted on government hospitals (federal, regional and sub-regional) found in Addis Ababa, Ethiopia to assess the information system of national and regional external quality assurance scheme of laboratory service and to develop a web based database system for the NQAES and REQAS.

3.2 Study area

This study was conducted from march, 2009 to April, 2009 G.C in Addis Ababa government hospitals laboratory units. Addis Ababa is one of two self-governing administrations in the nine ethnically based states that make up the Federal Democratic Republic of Ethiopia. Addis Ababa is the capital city of Ethiopia located in the foothills of the Entoto Mountains and standing 7,726 feet (2,355 meters) above sea level, with a population of 2,738,248.[31]

The federal Ministry of Health has given all mandates to the Ethiopian health and nutrition research institutes (EHNRI) concerning the laboratory services. The national external quality assurance scheme of laboratory service is located in the EHNRI, which governs the regions (REQAS). There are currently many laboratories included in the external quality assurance of which the about 13 institutions (laboratories) and one regional laboratory located in Addis Ababa. (Source: FMOH and EHNRI)

3.1 Study population

All laboratories at the national and regional levels which were included in the external quality assurance scheme were the source population.

3.2 Sampling procedures

There are about 13 government laboratories and one regional laboratory in Addis Ababa and all of them were included in the study.

Inclusion criteria

All laboratorain in the hospitals that have processed and know the EQA activities in the institute were taken as participant of quantitative study. For the interview, the head of the laboratory or quality officer (QO) of the laboratory were the participant.

3.3 Data collection procedures

3.3.1 Questionnaire

A semi-structured questionnaire was used to collect the information concerning the external quality assurance scheme of laboratory service. The questions included in semi-structured questionnaire are based on the objective of the study so as to get clear picture of the system running currently.

3.3.2 Semi structured interview

Semi structured interview was conducted with key informants on the national external quality assurance, and in the thirteen federal/city laboratories and in the regional laboratory of Addis Ababa. The area in which the interview was concentrating is on the collection, organization, use and dissemination of information in the external quality assurance system. This will helps to have detailed information about the objective of the study.

3.3.3 Document review and Analysis

Analysis of documents, forms, reports and registers was conducted to have information required for answering the research question and gain an insight into the structure, activities and patterns of information flow in the external quality assurance of laboratory service.

3.4 System development methodology

For the development of web based database system for the national and region external quality assurance scheme of laboratory service an object oriented system development methodology was used because it is stable, flexible and easy maintainable and manageable during changes. The modeling techniques used for the development of the system was a:

- use case diagram: describes the functionality of the system from the user's point of view and define the boundary of the system.
- sequence diagram is used because it clearly depict the sequence of events in a given time period, provide ideal snap shot what happen in a time period, enable identification of missing or lost classes and object, messages with their signature are source of information to the designer and programmer are excellent at depicting concurrent operations, and are invaluable for hunting down race conditions
- Class diagram: used to represent the structure of a system in terms of objects, their attributes, and relationships
- Deployment diagram: it clearly depicts the relationship among run-time components and hardware nodes.
- Persistent object modeling diagram: it is useful for the mapping of classes so as to avoid redundancy and anomalies and also to make easy in creating the database.

A server side scripting language PHP v 5.0 was used for the development of the web page because of its stability, easy to use, the speed, fast feature development, not costly (open source software) and HTML-embedded and the database was built by MySQL which is a powerful standards-compliant RDBMS and with apache web server since PHP is an official module of Apache HTTP Server.

3.5 Operational definitions

Quality assurance (QA): is the total process that guarantees that the final results reported by a laboratory are as accurate as possible.

Quality assessment: is a means of determining the quality of results. It is undertaken to evaluate the effectiveness of the quality assurance programme and usually an external evaluation of a laboratory's performance using proficiency panels.

Information: data in the external quality assurance that have been processed to have meaning.

Data: the results generated in the laboratories that has been produced in the external quality assessment.

3.6 Data Analysis procedures and Data quality management

The data collected has been analyzed using statistical package for social science (SPSS) version 11 and the results was presented using descriptive statistics methods like tables and graphs.

To ensure the quality of data, the questionnaire was pretested on EHNRI laboratory by the principal investigator to check for ambiguity and amendments like (arrangement of the questions order, options for the questions and skipping pattern) were made accordingly.

The principal investigators also checked all the data from each laboratories for completeness, clarity and consistency immediately after the data collection. Before analysis the data was cleaned thoroughly to check for errors during entry.

3.7 Ethical consideration

To all the federal hospitals an official letter form the faculty of informatics, information system department was given and for the city hospitals an official letter from Addis Ababa city administration health bureau was given. The importance of the study was explained to the professionals in the study sites.

3.8 Dissemination of results

The result of the thesis finding will be disseminated to the department of community health, AAU, the Ethiopian health and nutrition research institute (EHNIR), the department of the national external quality assurance scheme and the participating laboratories.

Chapter 4 SURVEY RESULT

4.1 Quantitative result

A total of 13 laboratories (federal, regional and city) are included in the study. All of the laboratories are participating one or the other types of EQA activities. All the laboratories participate in HIV and CD4 external quality assurance program and only Ras desta hospital do not participate in the EQAS of hematology and clinical chemistry. Minilik II and Zewditu memorial hospital don't participate in the EQA of tuberculosis and all the rest are participants.

The figure below shows the percentage of mechanism how those institutes receive information about the sample. The information about the sample is received mainly through written paper accounting 92.5% of the respondent.

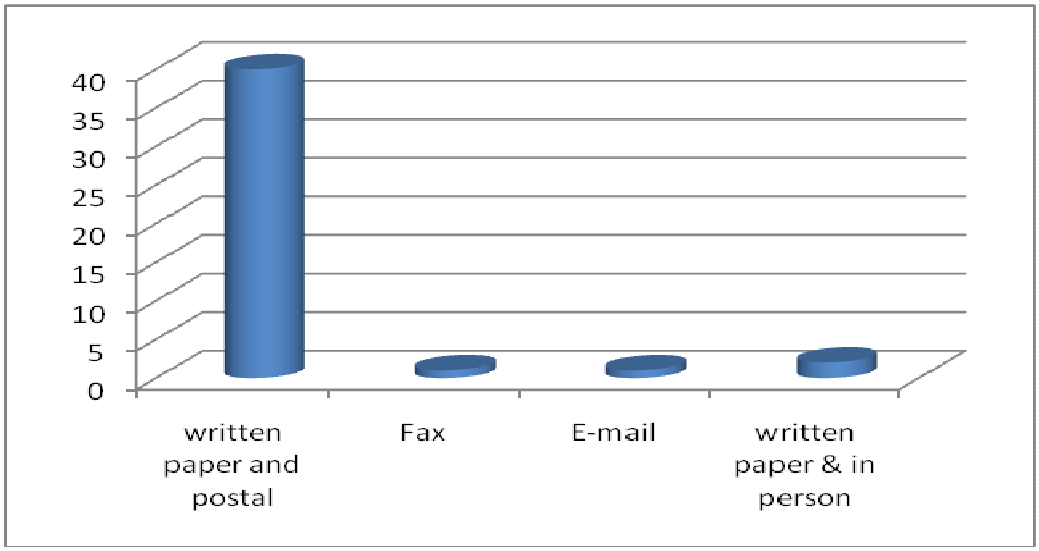


Figure 4-1Mechanism of how information about the sample received

The information included with the sample ranges from the simple code of the sample to detailed information including sample type, dead line, procedures, storage condition and safety precautions with most prevalent response of sample code, sample type and dead line (25%).

90% respondent indicates that Information sent by the EQA to there facilities is enough. The rest 10% said not enough, the commonly missed information were source of sample, date of collection, expiry date, sample preparation and preservative used.

80% of the information received is consistent or moderately consistent and 95% accurate or moderately accurate and the rest where poorly consistent /inconsistent and inaccurate in 20% and 5% respectively. The reason they gave to the poorly consistent /inconsistency is described in the Table 4-1 below.

Table 4-1 Type of reason for poorly consistent/inconsistent information

Type of reason	*Frequency*	*Percentage*
For poorly consistent/inconsistent		
absence of organized/integrated information technology	3	30
low level of application of information technology	2	20
duplicated external information source	3	30
loss of records	2	20
For inaccuracy		
absence of organized/integrated information technology	1	
duplicated external information source one times	1	

Four institutes (ALERT, Addis Ababa regional lab, federal police referral hospital and Bella defense referral hospital) reported that they collect information other than the EQA result. These are mainly information on instrument type, condition etc. Also person performing the test, time of test performed, and information on reagents and other materials supplies were among information collected.

90.9% of the respondent said that they are using a manual system and the remaining said they are using automated or both systems for information collection as described in the Figure 4-2 below.

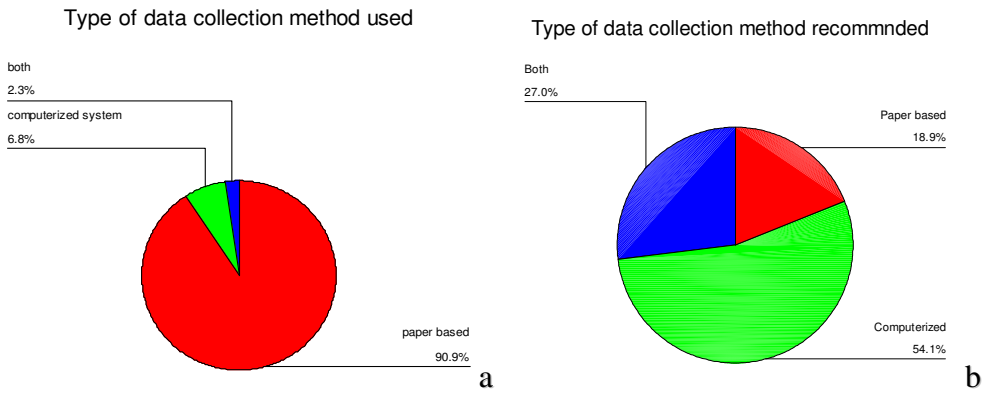


Figure 4-2 Type of data collection method used and recommended for EQA activities

54.1% recommended using computerized system for the EQA data collection as described in Figure 4-2b. Table 4-2 below shows the reasons for the recommended data collection method. The most common reason for recommending computerized system was simplicity, accuracy, fast (time saving), and the need small storage space. For recommending paper based system was cheap, easy, not affected by computer virus, easily portable, and the situation of country once. One respondent said that "even though computer system is fast and easy the paper based system will prevent loss of information by virus."

Table 4-2 Reason for recommended system for data collection

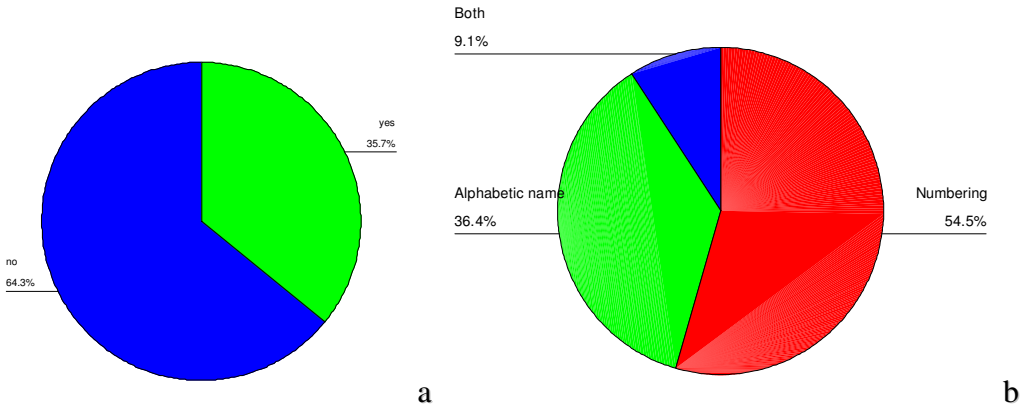
Reason	***Frequency***	***Percentage***
computerized system		
easy, simple, accurate, fast, and time saving	7	63.63
need small storage space	4	36.36
paper based		
consistent for long period of time	2	28.58
cheap, easy, not affected by computer virus	3	42.87
easily portable	1	14.29
situation of country	1	14.29
Both		
durability and rapid retrieval information system	3	37.5
Prevent loss of information	5	62.5

There are many challenges on the current system of data collection that the professional are facing. Among them are data incompleteness, loss of information and lengthy (time consuming) are the most common one followed by need of large storage space, no proper recording, tedious and technical problems.

Table 4-3 Challenges of the current system on data collection

challenges	*Frequency*	*Percentage*
Delay (time consuming)	7	26.95
Incomplete data	6	23.1
Loss of information	5	19.25
Need larger space	2	7.7
Tedious (challenging)	4	15.4
No proper recording	2	7.7
Total	26	100

As shown in the Figure 4-3 a and b, 64.3% respondent replied that they don't use an indexing system for EQA activities in the laboratory. From 35.7% said there is the indexing system, six of them are using numbering, 4 are using alphabetic names and one is using both numbering and alphabetic names. From those said they used indexing, 69.9% of them said it facilitates cross referencing and 76.9% of them contain up to date and complete information.



a b

Figure 4-3 Availability of index and type used

The retrieval of information of the EQA data is 7.1%, 47.6% and 45.2 % for "very fast", "fairly fast" and "not fast at all" respectively. The Table 4-4 below describes reason

specified for “not fast at all”. The most common were loss of record, absence of finding aids, miss filing, storage system used and mistakes in initial registration. And the least common were improper tracking system, lack of proper matching of finding aids and volume of file and large number of users.

Table 4-4 Reason for not fast at all

Reason for non fast all	*Frequency*	*Percentage*
loss of record	9	20.9
absence of finding aids	7	16.3
storage system	6	14.0
miss filing	6	14.0
mistakes in initial registration	5	11.6
improper tracking system	4	9.3
lack of proper matching of finding aids	3	7.0
volume of file and large number of users	3	7.0
Total	43	100.0

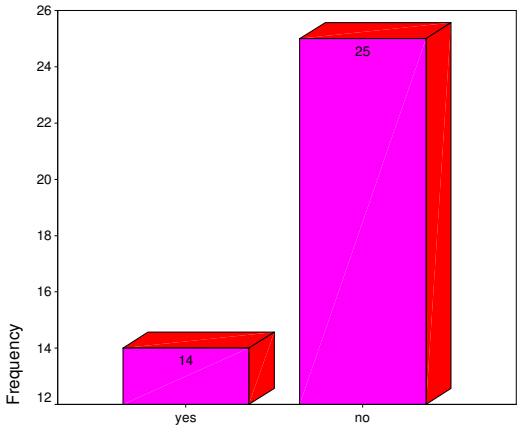


Figure 4-4 Availability of access policy

35.9% have an access policy for their information and 64.1% have no access policy as described in Figure 4-4. The Table 4-5 illustrates, 67.4% have very good/good information access and the rest have fair/poor access. The reasons for fair/poor access was absence of central database and poor manual system , low level of IT utilization, lack

of efficient retrieval system, poor information exchange, lack of properly trained manpower in the area of IT, absence of finding aids and low level of recognition of the role of information.

Table 4-5 Reason for fair/poor information access

Availability of information	*Frequency*	*Percent*
Very good	9	20.9
Good	20	46.5
Fair	9	20.9
Poor	5	11.6
Total	43	100.0
Reason for fair/poor information access	**Frequency**	**percentage**
absence of central database and poor manual system	13	25.0
low level of IT utilization	7	13.5
lack of efficient retrieval system	7	13.5
poor information exchange	7	13.5
lack of properly trained manpower in the area of IT	7	13.5
absence of finding aids	6	11.5
low level of recognition of the role of information	5	9.6
Total	52	100.0

Table 4-6 shows the most important aspects consider as important factor to their information requirement. These were timely information 25.53%, pertinent and relevant information to the immediate need 22.2%, reliable information 22.2%, information presented in simple and direct form 17.76%, and easy of access to the information services and resources 12.21%. From these factors the once that lack in EQA system are timely information 24.42%, pertinent and relevant information to the immediate need 12.21%, reliable information 6.66%, information presented in simple and direct form 8.88% and easy of access to the information services and resources 16.65%.

Table 4-6 Factors for information requirement

Factors for information requirement	*Frequency*	*Percentage*
timely information	23	25.53
pertinent and relevant information to the immediate need	20	22.2
reliable information	20	22.2
information presented in simple and direct form	16	17.76
easy of access to the information services and resources	11	12.21
Total	90	100
Factors Lacking in the system		
timely information	22	24.42
pertinent and relevant information to the immediate need	11	12.21
reliable information	6	6.66
information presented in simple and direct form	8	8.88
easy of access to the information services and resources	15	16.65
Total	62	100

The type of reporting system that the laboratories use for the exchange of information are postal mail in about 31(68.9%), in person 4(8.9%), phone 4(8.9%), fax 4(8.9%) and email 2(4.4%) as shown in the

Figure 4-5 below. 43.6% said that, these mechanisms are appropriate for the exchange of information. 56.4% did not agree on type of reporting system they are using. Table 4-7 shows the challenges faced on the current reporting system used and these were delay, loss or missing of information and lack of human resource and management. They also recommend to use technology like computerized system with internet, fax and phone.

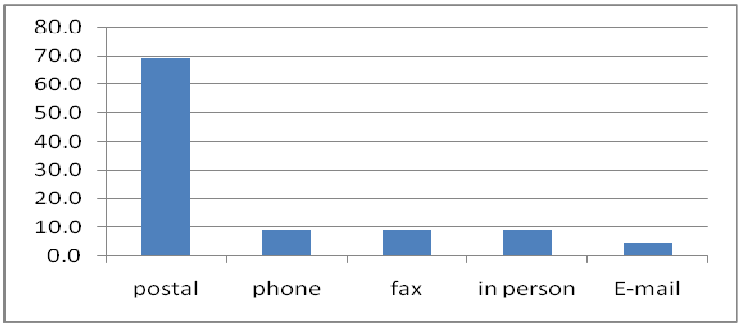


Figure 4-5 Percentage of data reporting method used

Table 4-7 Challenges in the reporting system and recommended mechanisms

Challenges	***Frequency***	***Percentages***
Delay (not timely)	10	55.6
loss or missing of information	7	38.92
lack of human resource and management	1	5.56
Total	18	100
Recommended mechanisms		
computerized system with internet	16	80
Fax	7	35
Phone	1	5
Total	20	100

As show in the Figure 4-6 below, 90.2% receive feedback on their performance and 9.8% did not have received. Table 4-8 describes the feedback mechanism status, the timing, currently used and challenges of the current system. From the one who received feedback, 59.46% they received feedback frequently and 37.8% sometimes. In 72.79% it is not timely feedback and 27.03% timely. The mechanism of feedback they receive were postal 78.38%, in person 27.03% and phone 5.41%. The challenges they are facing in the current system were delay of feedback, loss of information and shortage of transportation.

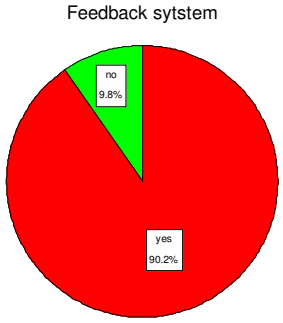


Figure 4-6 Percentage of feedback received

Table 4-8 Feedback mechanism status, timing, currently used and challenges

Status of receiving	*Frequency*	*percentage*
Frequently	22	59.46
sometimes	15	40.54
Total	37	100
Timely feedback		
Yes	10	27.03
No	27	72.97
Total	37	100
Feedback mechanism used currently		
Postal	29	78.38
In person	10	27.03
Phone	2	5.41
E-mail	1	2.7
Fax	1	2.7
Total	37	100
Challenges		
Delay	14	73.68
Loss	3	15.79
Transportation	2	10.53
Total	19	100

There is access to computer at the laboratory in 36.4%. As shown in the Figure 4-7 below, from those that have access for computer the percentages of usage of computer for different purpose have been indicated, 12(46.2%) of them are using it for word processing, 5 (19.2%) of them for statistical analysis, 7 (26.9%) for record management and 2 (7.7%) of them for financial consolidation.

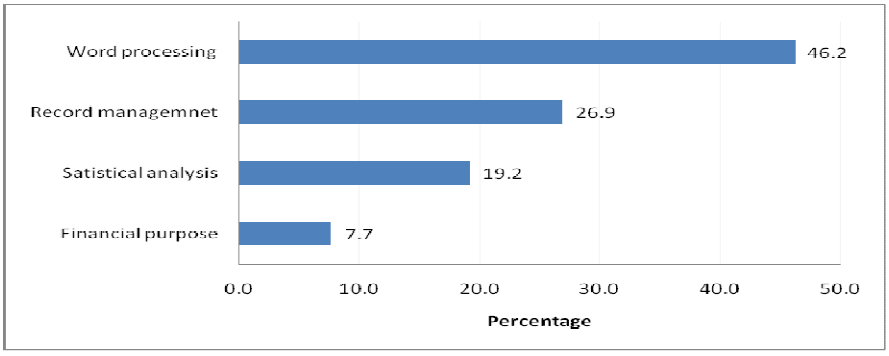


Figure 4-7 Purpose of using the computer in the laboratory

Figure 4-8 a and b shows the percentages of access to internet in the laboratory and in the institutes respectively, Only 9(22.5%) have access of internet in their laboratory and it is restricted to the federal hospitals like ALERT, St. peters TB specialized hospital, Bella defense referral hospital and Black loin general specialized hospital. The access of internet in their institute is 51.2%. 15(40.5%) of them are using the internet for educational purpose, 10(27%) for e-mail, 5(13.5%) for news and 4(10.8%)for sport.

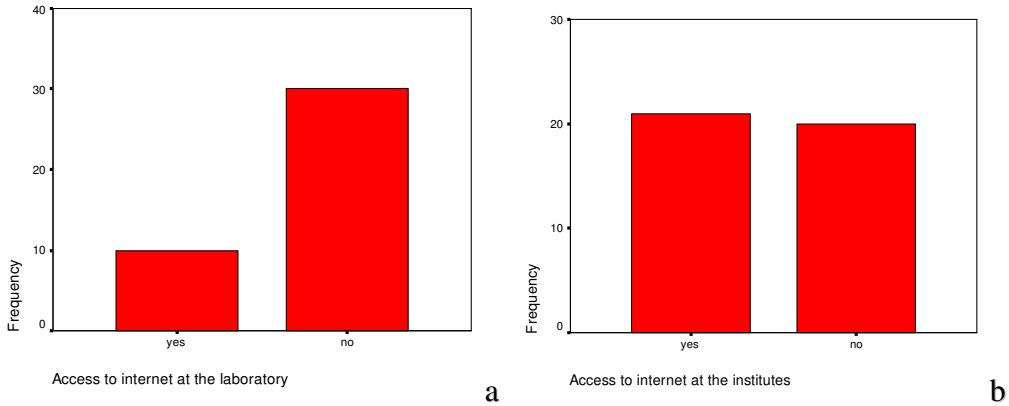


Figure 4-8 Access of internet at the laboratory and institutes

The Table 4-9 below describes the general information related problem in the area of external quality assessment. The lack of computer and internet access is the most common one reported accounting 62.5%. Also delay of information 16.67% and poor recording system, lack of commitment from higher officials and lack of training in computer were reported 8.33%. They suggested as improvement mechanism the use of automation system (networking of computers and internet access) reported 84.62% and good management, cooperativeness and developing of knowledge (training) reported 7.69% as improvement mechanism.

Table 4-9 General problem and suggested improvement mechanism

General Problems	*Frequency*	*Percentages*
Lack of internet access	15	62.5
Delay of information	4	16.67
Lack of commitment from higher officials	2	8.33
Lack of training in computer	2	8.33
Total	24	100
Suggested improvement mechanisms		
computerized system with internet	22	84.62
good management	2	7.69
Cooperativeness	2	7.69
developing of knowledge	2	7.69
Total	26	100

Table 4-10 below describes the barriers the respondent point out in the application of ICT in their setup. These were cost, absence of network and Internet, lack of well trained personnel in IT, bureaucratic problems, not understanding the value of ICT, negligees, poor financial system, lack of infrastructure, lack of knowledge of administrator, lack of willingness, EQA not organized well, management gap with laboratory, poor advocacy, lack of resource and proper maintenance system.

Table 4-10 Barriers indicated for the application of ICT

Barriers	*Frequency*	*Percentages*
Cost	7	25.9
lack of well trained in IT	6	22.2
absence of network and internet	5	18.5
Bureaucratic problems in the office once	1	3.7
poor financial system	1	3.7
lack of infrastructure	1	3.7
lack of knowledge of administrator	1	3.7
lack of willingness	1	3.7
EQA not organized well	1	3.7
poor advocacy	1	3.7
Lack of resource and proper maintenance system	1	3.7
not understanding the value of ICT	1	3.7
Total	27	100

4.2 Qualitative result

A total of 13 Laboratorian (the head of laboratory/quality officer) were interviewed. 11 of them were Bsc. Laboratory technologist, one biochemist and one Msc. in Infectious disease. As an entry question, discussants' knowledge concerning the objective of the center in general was raised. The participants from the regional/federal hospitals expressed that their objective is to give a quality service to their customer (patients) and to meet their satisfaction by providing quality service to them. The regional and national laboratories, their major objectives were to perform routine analysis of laboratory test and the one beyond the capacity of hospitals. And also to perform quality system, quality control, basic and applied research, training of professionals and supervision in clinical laboratory aspect. In the public health laboratory aspect, they perform different type of analysis like physical, chemical, toxicology and bacteriology of water, food etc.

To accomplish these objectives they have develop/adapt standard operation procedure and introduce quality system (QS) that touches all the steps from pre-analytical stage to post analytic stages.

The financial support to their activity in the regional and federal hospital is derived mainly from the government. For the regional and national laboratory even thought the budget is derived from the government also donors support the system.

Information related activities all the laboratories engaged are the generation of EQA result and the different documentation developed for the facilitating their work. The method they use to store and process data is the manual system but only in Paulo's hospital they use also a computerized system to store EQA information. All laboratories said that the frequency of EQA data collection was dependent on the EQA offering institution but it's mainly in quarterly base.

The frequency of report generation, most said that they make a report on monthly, quarterly and annual base. The information flow from one level to another is through a written paper.

Problem related to collection of data in all the laboratories is the same and these are problems like hand writing, not well organized recording system and staff attitude toward the value of information. They pointed out that lack of ICT has contributed to these problems. They receive feedback infrequently and in most of the case the feedback is delayed with the average time of response 1 month and even in some laboratories they did not receive until now.

All the interviewed responded that the storage system of EQA information is a manual system with the exception of Paulo's hospital used both the systems. It has been indicated that the manual system need more space which the institutes lacks.

Most of the laboratories said that they are not aware of the indexing system. Simply they make a copy of the report (the EQA data) and place them in a folder. Since EQA has short life time, the laboratories have small amount of EQA information. Because of this reason they say that they can retrieve information in short period of time but they admitted that it is highly prone to loss in the laboratory.

The service they provide depends on the level of the laboratory, it range from a simple routine sample analysis (federal and regional hospitals) to an advanced one (basic research, supervisory, etc at the regional and national laboratories). The major users of them are the patients which came for help and make they query through test request forms, researchers which came for information and make their query through official letters and different institution (health centers).

None of the laboratories publicized any document and they don't have in house publication.

Problems they are facing in handling the collection and providing service to the user are lack of data clerk, administrator willingness, financial constraint and lack of skill manpower. All the respondent believed that automated system will solve all the problems they mentioned and they have a plan in feature to make an automation system. The benefit they expect if automated system were implemented are reduction in time, reduce workload, fast, easy, simple to use and accurate.

4.3 System development

4.3.1 Analysis of the existing system

This section provides the analysis of the current information system in the Ethiopian EQA. The analysis is based on the survey described in the above section 4.1 and 4.2.

4.3.1.1 Collection type and size

The EQA's collection constitutes specimens and result reports on HIV RT, tuberculosis, hematology, chemistry and CD4. Other types of collection like onsite assessment information, maintenance information and trainings information. The lack of organized information system has contributed to the unorganized collection of data especially for the EQA activities and during the assessment this problem lack of organized information system was one of the limitations.

4.3.2 Function and services

The functions of the EQA are similar to that of the function outlined in the Chapter 1 of sections 1.1.2.2. Thus a brief account of the practices exercised in the center concerning function and services are described as follow:

4.3.2.1 Acquisitions

The specimens in the EQA are acquired through different ways for different specimens. Specimens for HIV and tuberculosis are prepared in the national and regional reference laboratory. For malaria the sample are prepared in the national laboratory and for the panel testing of CD4, hematology and clinical chemistry are supplied by the external agents out side Ethiopia.

4.3.2.2 Documentation

Documentation activities that are carried out in the EQA are of two types: collection management- specimen detail and report (result), site information and training detail. And different guideline used the EQA activities like reference materials. The major document activities are discussed below.

Specimen detail and report: specimen detail and report (result) are recorded in a form prepared for this purpose. The specimen detail and reports are made between the N/REQAS and the participating facilities with a defined period of time.

Site detail: site detail is recorded in the form prepared for this purpose prior to site visit (up on request to participate in EQA) or during the site visit.

Training detail: training details are record in a form prepared for this purpose.

Guidelines: information describing the test method, principles, procedure (SOP)…, instruction forms, and training reference manual, module & protocol.

4.3.2.3 EQA users and information needs

Users are the beginning and ending of all information system. Due to this reason information service providers give much emphasis on analyzing the information need of their users.

The users of the national and regional external quality assurance are

- Data clerk: which receives EQA results (data) and report to coordinator
- Laboratorian: which are the technologist/technicians that prepare sample for the panels test and serve the customers
- Trainees: those people form the facilities which register and take training
- Trainer: those that train and evaluate their performance of training participant before and after training.
- Coordinator: which plan and schedule training and prepare training document.
- Supervisors(QO):which assess sites, panel testing and blind rechecking

4.3.2.4 Use case of the existing system

This part describes the use case of the existing external quality assurance system

Use case name	Use case description	Participating actors
Register facility	This use cases describes the event of potential member facilities request to join the EQA program. The data clerk fills fields on from.	Data clerk
Register sample	This use cases describes the event of recording details of sample by Laboratorian that is going to be used for panel testing.	Laboratorian
Assess site	This use cases describes the event of filling the site assessment checklist form on paper and store it for later use.	Data clerk Supervisor
Panel testing	This use cases describes the event of data clerk or supervisor receiving panel result of the facility and stores it for later use.	supervisor Data clerk
Blind recheck	This use cases describes the event of supervisor filling blind recheck result and stores the data for later use	Supervisor
Generate feedback	This use case describes the event of Supervisor and Laboratorian to produce feedback to facility from the panel result received.	Supervisor Laboratorian
Plan and Schedule training	This use case describes the event of coordinator to enter fields on a form and stored for later use	Coordinator
Register trainees	This use case describes the event of a potential trainee requesting to join training and data clerk, trainer or trainee records the fields on the form.	Trainees Trainer Data clerk
Evaluate trainees	This use case describes the event of trainer record participant pre and post test and the trainer make evaluation report.	Trainer

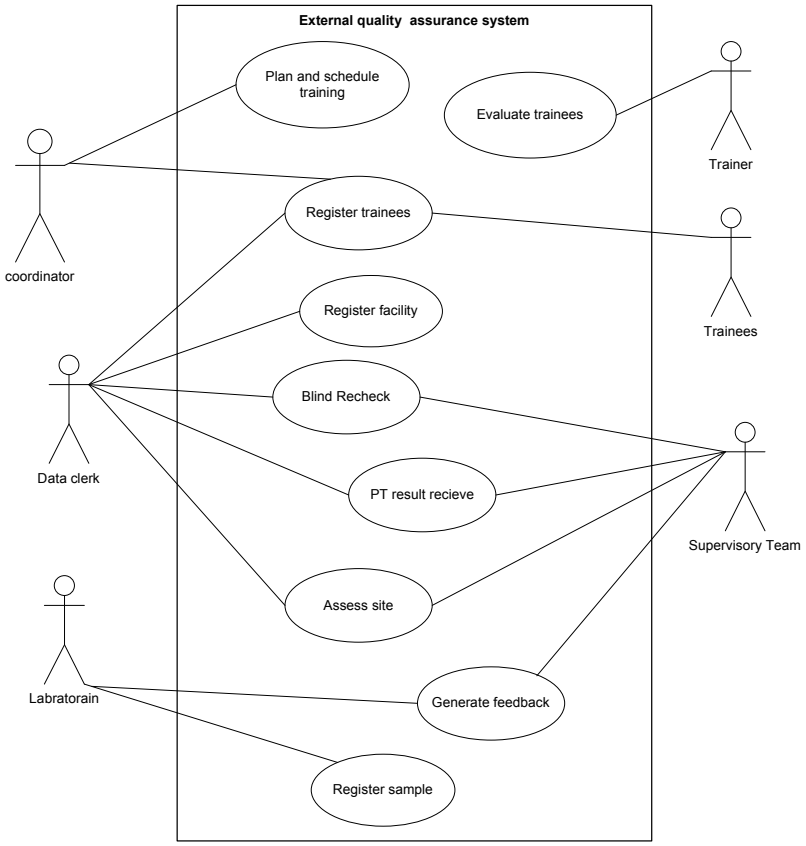


Figure 4-9 Use case diagram of the existing EQA

4.3.2.5 Computing facilities at EQA

The EQA has 15 computers; all are Pentium IV, 2.8 GHz, 8 laptops and 5 printers. The institute has a full hour internet connection. The software available in the EQA are packages like Ms office 2007 and Ms office 2003. This software is used for the purpose of communication, editing and secretarial office purpose.

4.3.3 Summary of problems and requirement

From the survey and analysis the following problems and requirement have been identified as a limiting factor on the information system of the EQA service.

- There is no consistency between the laboratories on how to document the EQA information

- The way the information is being collected is not attractive to the professionals because of its manual nature, which is high prone to error like incomplete data, delay (time consuming), loss of information, need larger space, tedious (challenging) and no proper recording system.
- The documentation system does not facilitate the retrieval of information when required by other parties because of absence of finding aids like use of indexing system.
- There is no access policies in their laboratories
- Lack of easy of access to the information services and resources, timely information and reliable information.
- The reporting system is not timely and prone to loss.
- The feedback system used is not timely and prone to loss.
- No organized information on the training events (who participate, from where, who were the facilitator etc.)

4.4 DESIGN OF THE SYSTEM

4.4.1 System requirement

The survey and analysis identified the following system requirement for the national and regional external quality assessment scheme of Ethiopia.

4.4.1.1 Collection related

- Database that facilitate the maintenance of collection of information for their specimen (type, result, storage condition, transport packaging etc)
- Database that facilitate the maintenance of report collection from the site (Onsite evaluation report, panel testing report, blind rechecking report)
- Databases that facilitate the maintenance of training information collection (Training plan detail, training schedule, training program, participant, venues, facilitator…)
- Database that facilitate the maintenance of participant facilities information (place, employees, contacts, address)

- Database that facilitate the maintenance of documentation (instruction format, procedures, training manuals, etc)

4.4.1.2 Report related

The web based system should support feedback system to the facilities

- Web that facilitate generation of report(feedback)

4.4.1.3 Search facilities

Search facilities required to access the database would include:

- Interactive database access
- Access to documentation of EQA
- Access to integrated information for a specific specimen, training, test, etc

4.4.1.4 General requirement

In addition to the access there is a need to conform to global standards. Some of the general requirements indentified include:

- Setting up internet connection. Access to internet would facilitate: collaborative research, communication with similar institutions, easy information exchange, and advertising.

4.4.2 Use case of EQA system

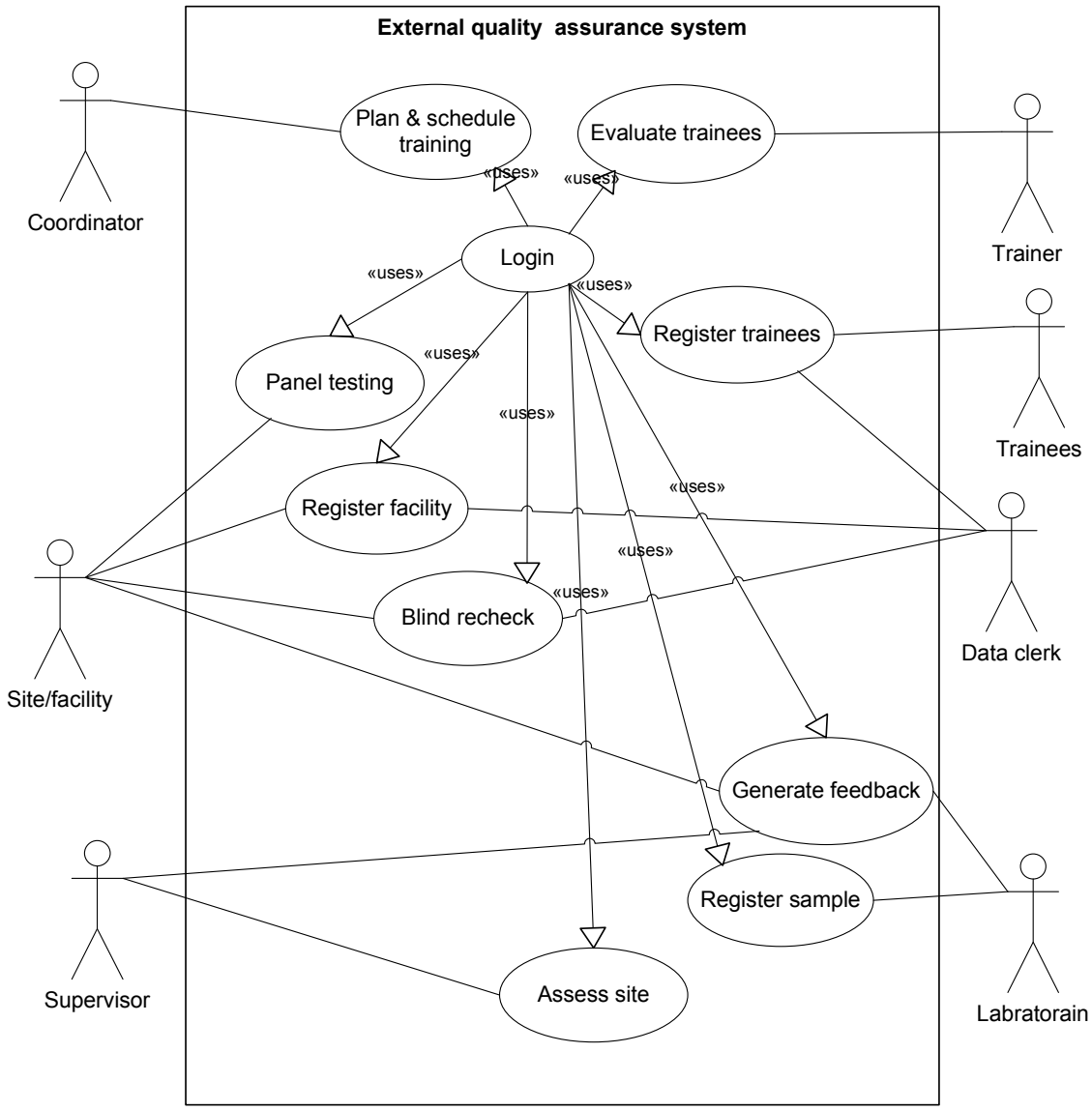


Figure 4-10 use case diagram of new EQA system

Here the use case of the new external quality assurance system is described in detail

External quality assurance system use case

USE CASE NAME:	**Log in**	
USE CASE ID:	UC#01	
ACTORS:	Facility, supervisor, Laboratorian, coordinator, trainer, Data clerk	
DESCRIPTION:	This use cases describes the event of validating the users of the system.	
PRE-CONDITION:	The user has user name and password	
TYPICAL COURSE OF EVENTS:	**Actor Action**	**System Response**
	Step 1: The user activates the login page	**Step 2**: System displays "login page"
	Step 3: The user enters user name and password.	**Step 4**: The system determines the user entered correct user name and password.
		Step 5: system displays the right page.
	The end of use case	
ALTERNATE COURSES:	**A4:** The user entered incorrect user name and password **A5:** The system determines the user is not authored to access the system.	
POST-CONDITION:	The user authorized	

USE CASE NAME:	**Register facility**	
USE CASE ID:	UC#02	
ACTORS:	Supervisor, Data clerk	
DESCRIPTION:	This use cases describes the event of potential member facilities request to join the EQA program. The data clerk fills fields on from and the system stores facility details to the database.	
PRE-CONDITION:	Fulfill EQA conditions	
TYPICAL COURSE OF EVENTS:	**Actor Action**	**System Response**
	Step 1: The user activates the administrator login page the registration screen	**Step 2**: System displays "login page"
	Step 3: the user enters username and password	**Step 4:** System displays "administrator page"
	Step 5: The user select and enters the required field on the registration page	**Step 6**: The system stores data on to the database and displays successful registration
	The end of use case	
ALTERNATE COURSES:	**A5:** the inserted data's are not as per the system validation the system display error confirmation. **A6:** go to step 5	
POST-CONDITION:	Registered facility	

USE CASE NAME:	**Register sample**	
USE CASE ID:	UC#03	
ACTORS:	Laboratory technologist/technician	
DESCRIPTION:	This use cases describes the event of recording details of sample to the database by Laboratorian.	
TYPICAL COURSE OF EVENTS:	**Actor Action**	**System Response**
	Step 1: the user activates login screen.	**Step 2**: the system displays login page
	Step 3: the user enters username and password	**Step 4:** the system verify the user and displays the main page
	Step 5: The user activates sample registration page.	**Step 6**: System displays sample registration page.
	Step 7: The users insert data to the fields on the sample registration page.	**Step 8**: The system stores the data on to the data base and displays successful entry.
	The Use case end	
ALTERNATE COURSES:	**A7:** if the inserted data's are not as per the system validation the system display error confirmation. **A8:** go to step 7	
POST-CONDITION:	Sample registered	

USE CASE NAME:	**Panel testing**	
USE CASE ID:	UC#04	
ACTORS:	Data clerk Facility	
DESCRIPTION:	This use case describes the event of entering PT result on the required field and the system stores the input on to a database.	
PRE-CONDITION:	Registered facility	
TYPICAL COURSE OF EVENTS:	**Actor Action**	**System Response**
	Step 1: the user activates login screen.	**Step 2**: the system displays login page
	Step 3: the user enters username and password	**Step 4:** the system verify the user and displays the main page
	Step 5: the user activates specific panel testing (PT) result submission page.	**Step 6**: the system displays the page
	Step 7: The users insert data to the fields on the PT result page.	**Step 8:** The system stores the data onto the database and displays successful entry.
	The Use case end	

ALTERNATE COURSES:	**A7:** the inserted data's are not as per the system validation the system display error confirmation. **A8:** go to step 7
POST-CONDITION:	Recorded panel result entry

USE CASE NAME:	**Assess site**	
USE CASE ID:	UC#06	
ACTORS:	Data clerk	
DESCRIPTION:	This use cases describes the event of entering site assessment data on the field and the system store the data on to the database.	
PRE-CONDITION:	Registered facility	
TYPICAL COURSE OF EVENTS:	**Actor Action**	**System Response**
	Step 1: the user activates login screen.	**Step 2**: the system displays the login page
	Step 3: the user enters username and password	**Step 4:** the system verify the user and displays the main page
	Step 5: The user activates site assessment page.	**Step 6**: System displays site assessment page.
	Step 7: The users insert data to the fields on the site assessment page.	**Step 8** The system stores the data on to the data base and displays successful entry.
	The Use case end	
ALTERNATE COURSES:	**A7:** if the inserted data's are not as per the system validation the system display error confirmation. **A8:** go to step 7	
POST-CONDITION:	Site assessed	

USE CASE NAME:	**Blind recheck**	
USE CASE ID:	UC#07	
ACTORS:	Facility Data clerk	
DESCRIPTION:	This use cases describes the event of facility or data clerk filling blind recheck result and the system stores the data on to the database.	
PRE-CONDITION:	Registered facility	
TYPICAL COURSE OF EVENTS:	**Actor Action**	**System Response**
	Step 1: the user activates login screen.	**Step 2**: the system displays the login page
	Step 3: the user enters username and password	**Step 4:** the system verify the user and displays the main page

	Step 3: The user activates site assessment page.	**Step 4**: System displays site assessment page.
	Step 5: The user activates blind recheck page.	**Step 6**: System displays blind recheck page.
	Step 7: The user inserts data to the required fields.	**Step 8**: The system stores the data on to the data base and displays successful entry.
	The Use case end	
ALTERNATE COURSES:	**A7:** if the inserted data's are not as per the system validation the system display error confirmation. **A8:** go to step 7	
POST-CONDITION:	Entry recorded	

USE CASE NAME:	**Generate feedback**	
USE CASE ID:	UC#08	
ACTORS:	Supervisor Laboratorian Facility	
DESCRIPTION:	This use case describes the event of user choosing the right report and the system generates the report.	
PRE-CONDITION:	Registered facility	
TYPICAL COURSE OF EVENTS:	**Actor Action**	**System Response**
	Step 1: the user activates login screen.	**Step 2**: the system activates the main page
	Step 3: the user enters username and password	**Step 4:** the system verify the user and displays the main page
	Step 5: the user activates the report page	**Step 6** the system displays feedback page.
	Step 7: The users selects the right feedback type	**Step 8**: The system generates the chosen feedback type
		Step 9: the system asks the user if he want a printed copy of the feedback.
	Step 10: the user indicates that he wants a printed copy.	**Step 11:** the system prints the feedback.
	The end of use case	
ALTERNATE COURSES:		
POST-CONDITION:	Feedback generated	

USE CASE NAME:	**Plan and schedule training**	
USE CASE ID:	UC#09	
ACTORS:	Coordinator	
DESCRIPTION:	This use case describes the event of coordinator to enter fields on a form and the system stores it on the database.	
PRE-CONDITION:	Login	
TYPICAL COURSE OF EVENTS:	**Actor Action**	**System Response**
	Step 1: the user activates login screen.	**Step 2**: the system activates the main page
	Step 3: the user activates training plan and schedule page	**Step 4**: the system displays training plan and schedule page.
	Step 5: the user fills in the data to the required fields in the page	**Step 6**: the system stores the data on to the database and displays successful entry.
	The Use case end	
ALTERNATE COURSES:	**A5:** the inserted data's are not as per the system validation the system display error confirmation. **A6:** go to step 2	
POST-CONDITION:	Training registered	

USE CASE NAME:	**Register trainees**	
USE CASE ID:	UC#10	
ACTORS:	Login	
DESCRIPTION:	This use case describes the event of a potential trainee selected to join training and data clerk/trainee enters the fields on the form. The system stores it on the database.	
PRE-CONDITION:	Selected by the coordinator	
TYPICAL COURSE OF EVENTS:	**Actor Action**	**System Response**
	Step 1: the user activates participant registration page	**Step 2**: the system displays participant registration page
	Step 3: the user fills fields in the page	**Step 4**: the system stores the data on to the database
	The Use case end	
ALTERNATE COURSES:	**A3:** If the inserted data's are not as per the system validation the system display error confirmation. **A4:** Go to step two.	
POST-CONDITION:	Trainee registered	

4.4.3 Classes of EQA system

In the Ethiopian external quality assurance there have been identified different objects that organizes the system and these are:

Classes that are related to collection of data of EQA which are Tuberculosis, HIV, malaria, CD4, chemistry and hematology panel testing report, TB onsite evaluation report and onsite evaluation checklist. These classes store information which has been sent by different facilities participating in EQA program from all over Ethiopia. Classes that are related to training are plan, schedule and programs of training and venue and trainees registration. Other classes like staff profile and contact also store information. Their interaction with each other and their relationship are shown in the figure below.

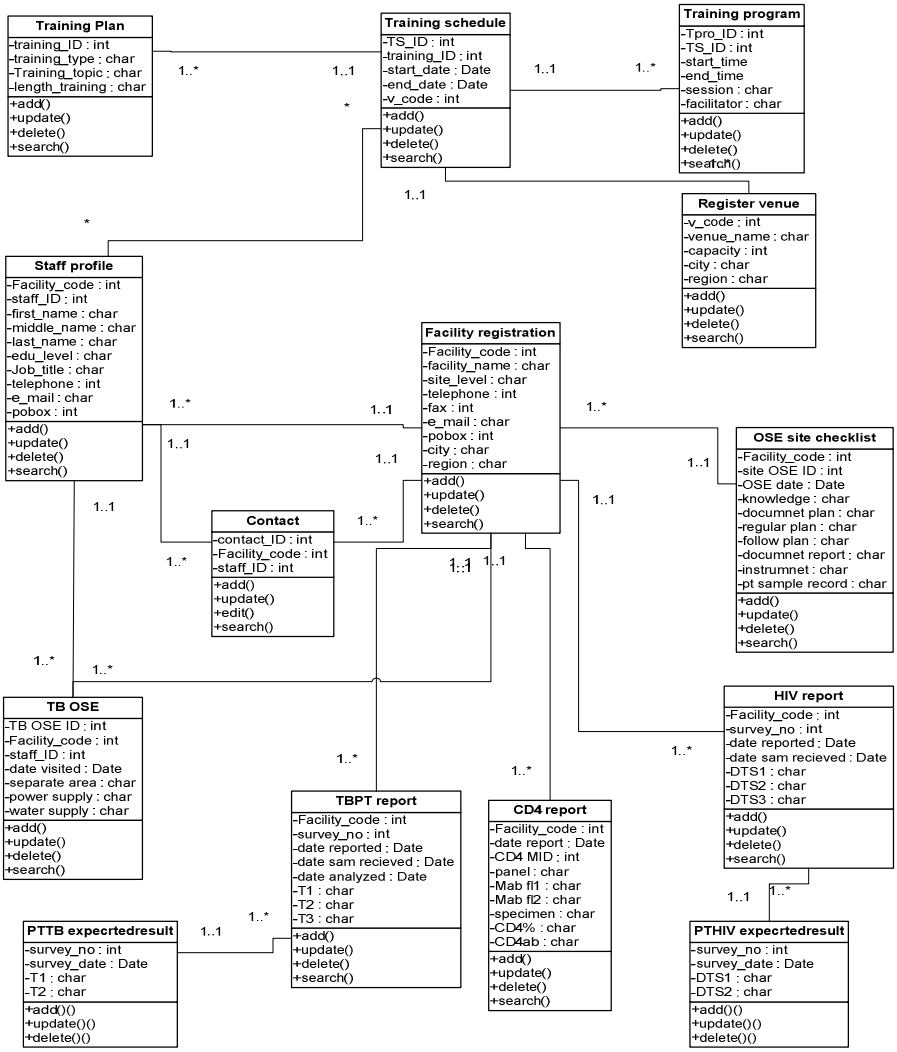


Figure 4-11 EQA class diagram

4.4.4 Sequence diagrams of EQA

Here is a description of the External quality assurance system sequence diagram which depicts how the EQA objects interact with each other via messages in the execution a use case or an operation. They illustrate how messages are sent and received between objects and in what sequence.

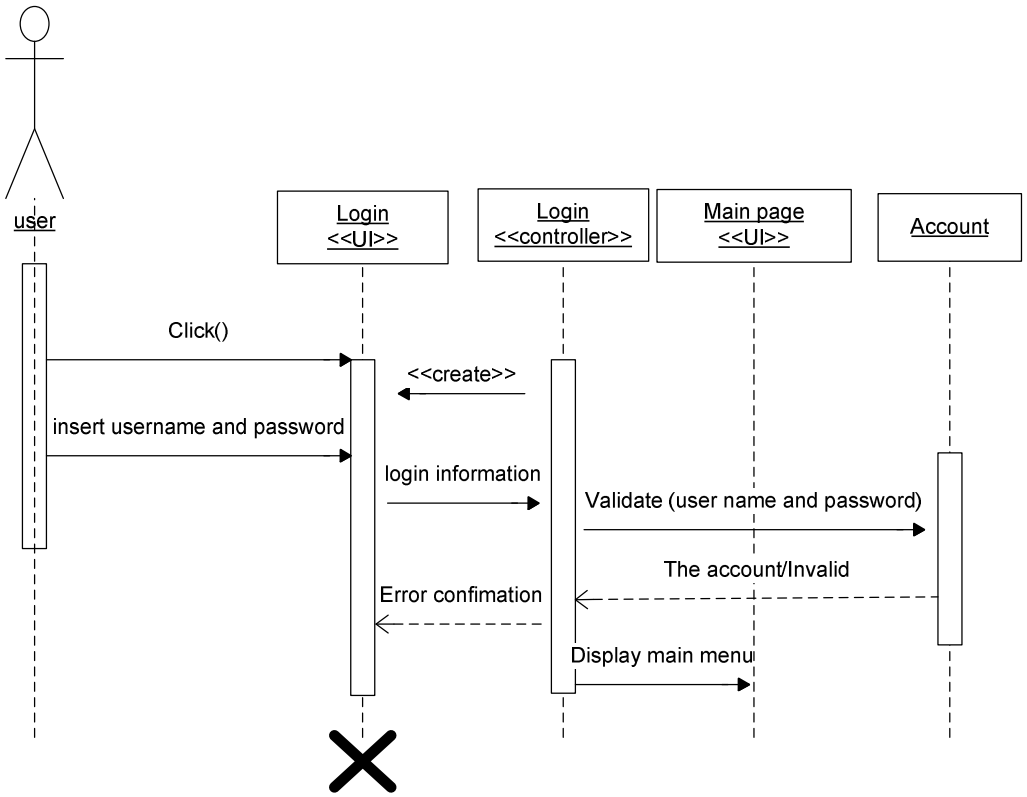


Figure 4-12 Login sequence diagram

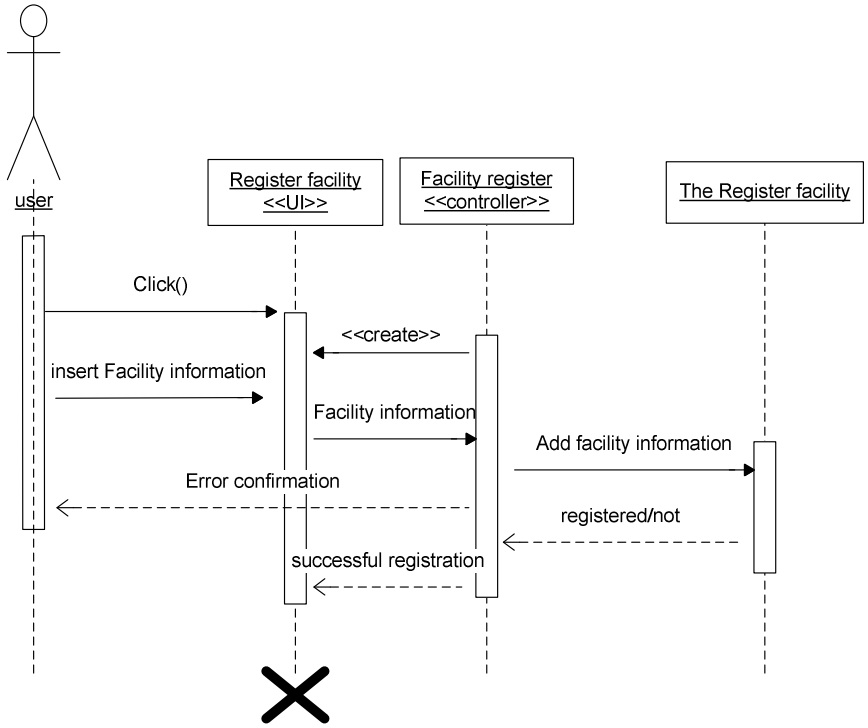


Figure 4-13 Facility registration sequence diagram

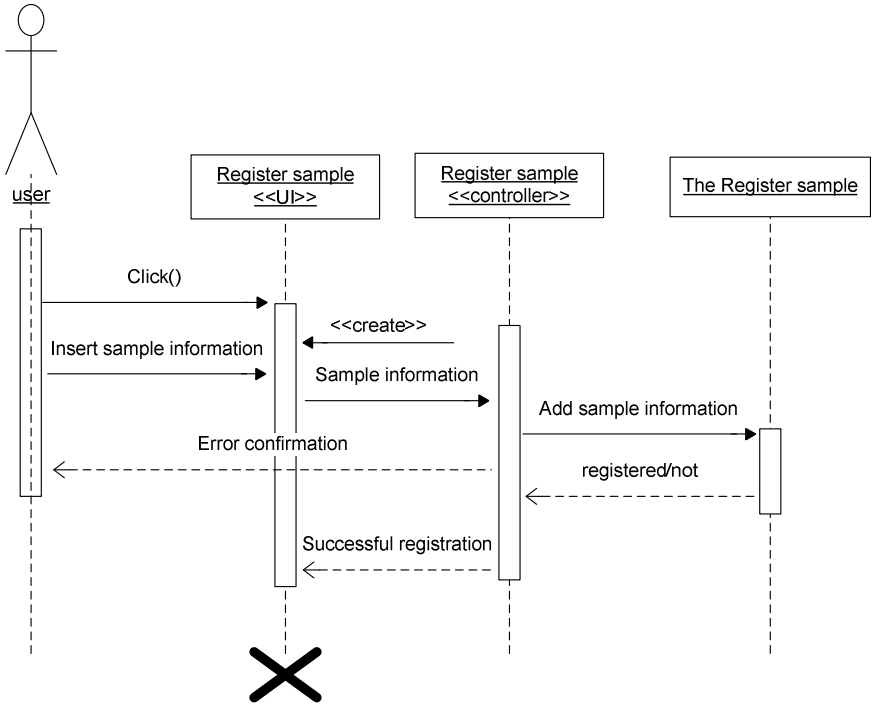


Figure 4-14 Sample registration sequence diagram

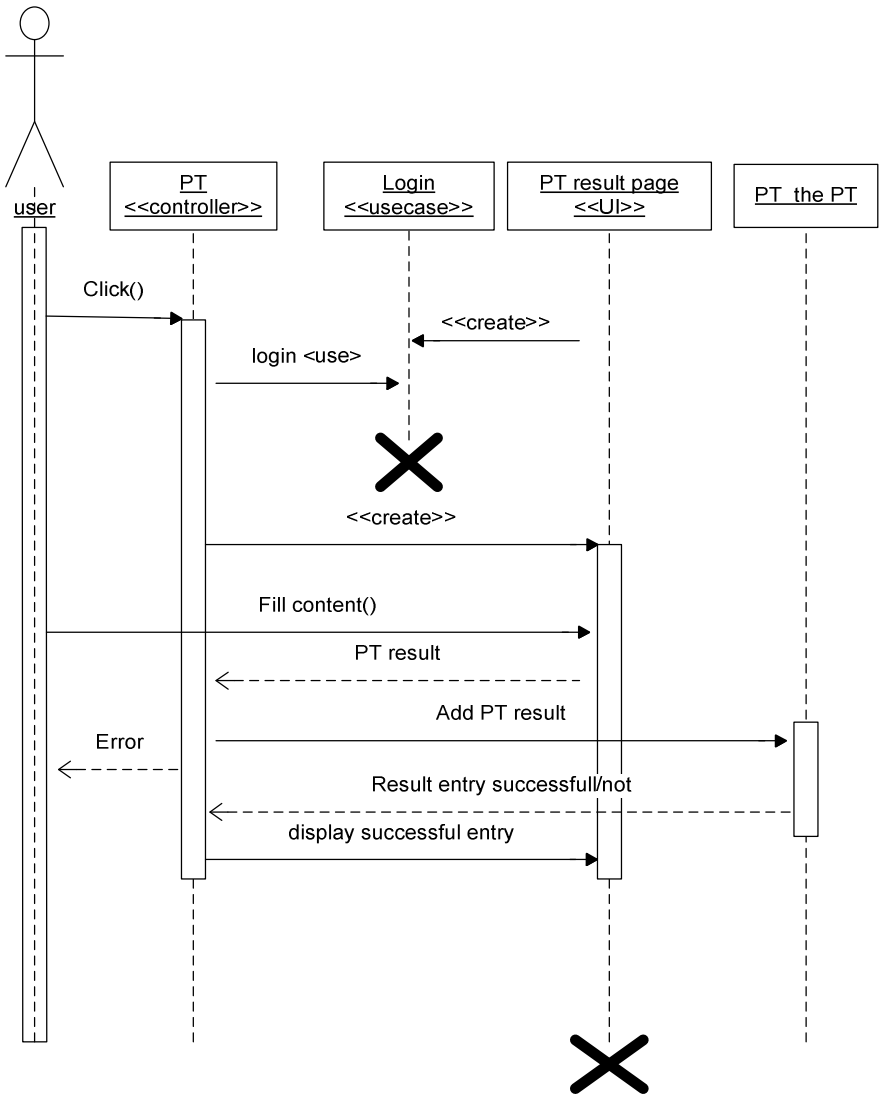


Figure 4-15 Panel testing sequence diagram

Note: Here each type of panel testing that the system stores data is not described on the sequence diagram, instead a user interface named simple as "panel testing" is described. (HIV, TB, malaria, CD4, chemistry, and hematology)

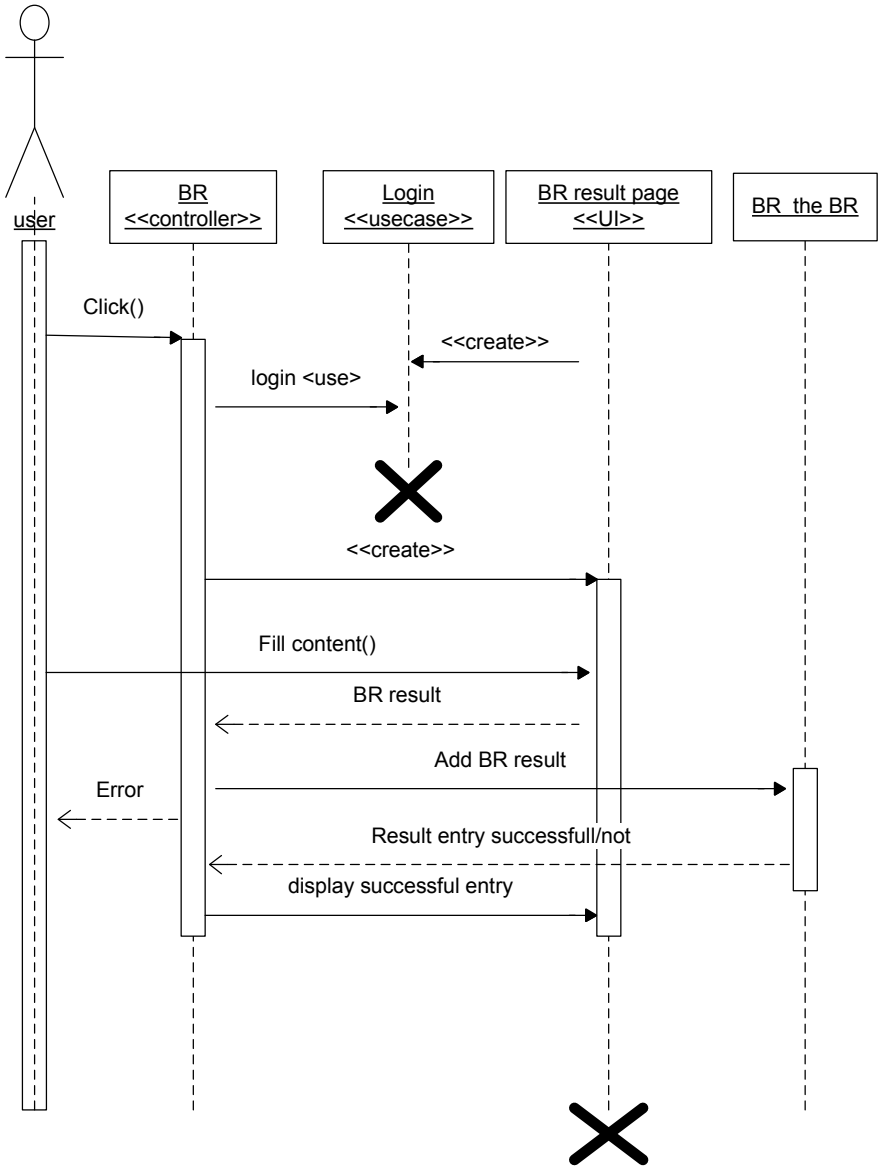


Figure 4-16 Blind rechecking sequence diagram

Note: Here each type of blind recheck that the system stores a data is not described on the sequence diagram, instead a user interface named simple as “blind recheck” is described. (TB and malaria)

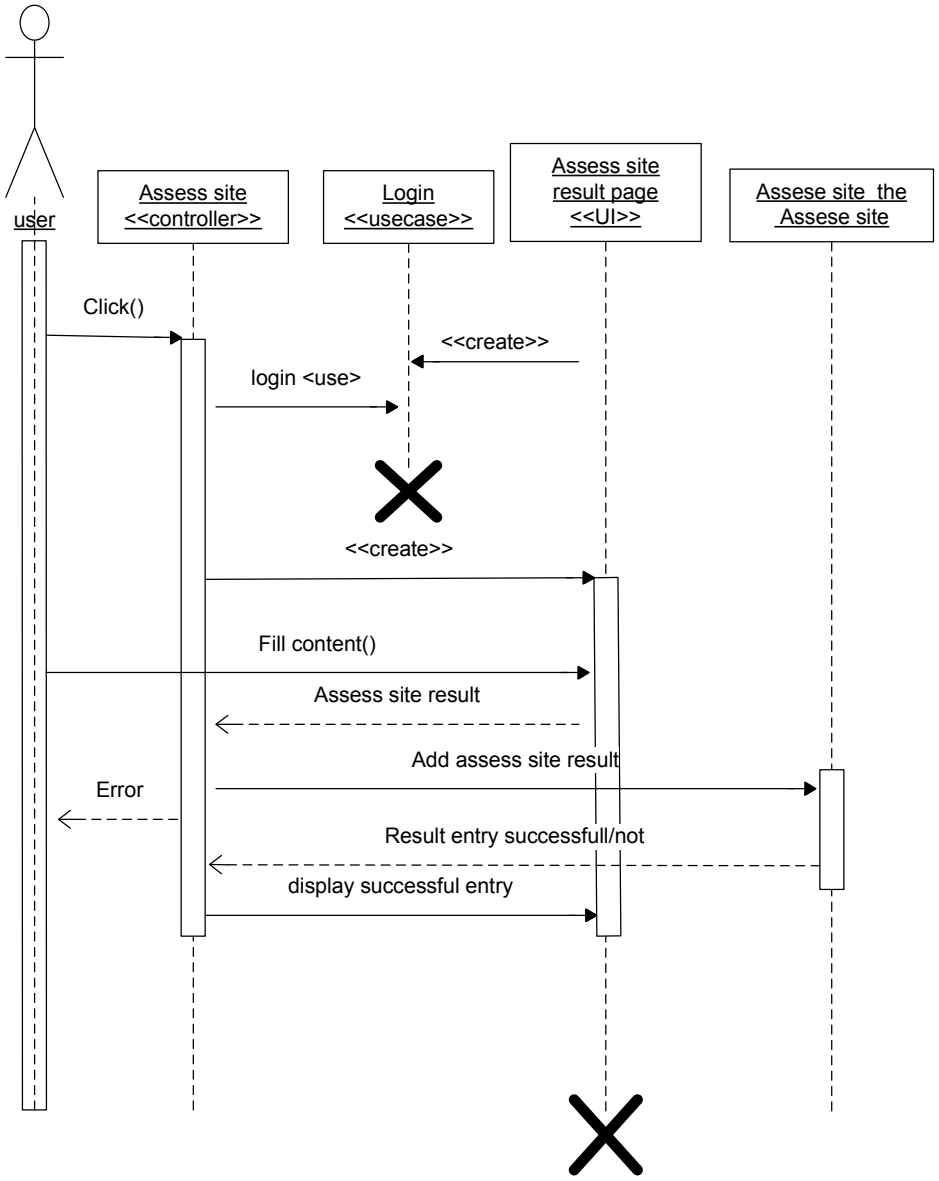


Figure 4-17 Site assessment sequence diagram

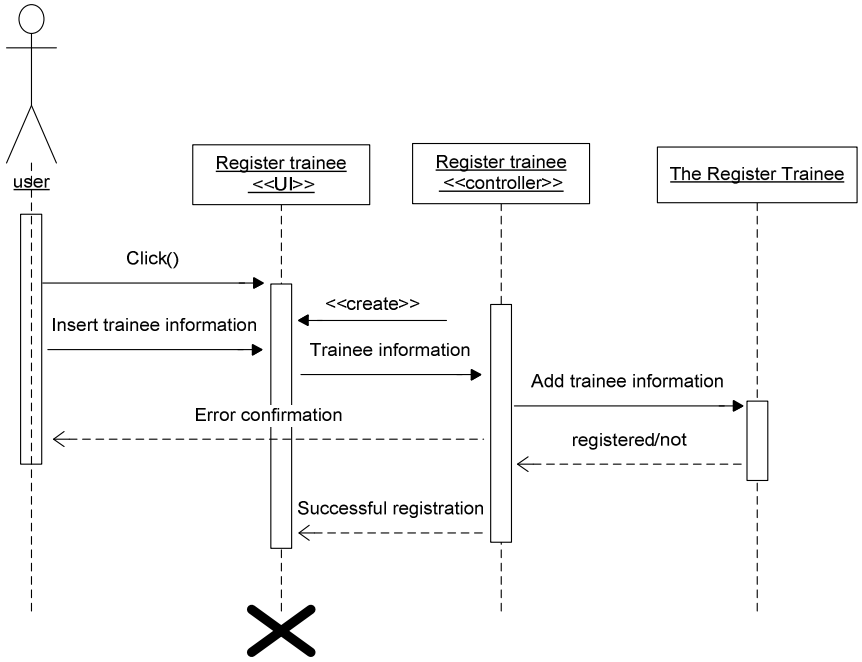


Figure 4-18 Trainee registration sequence diagram

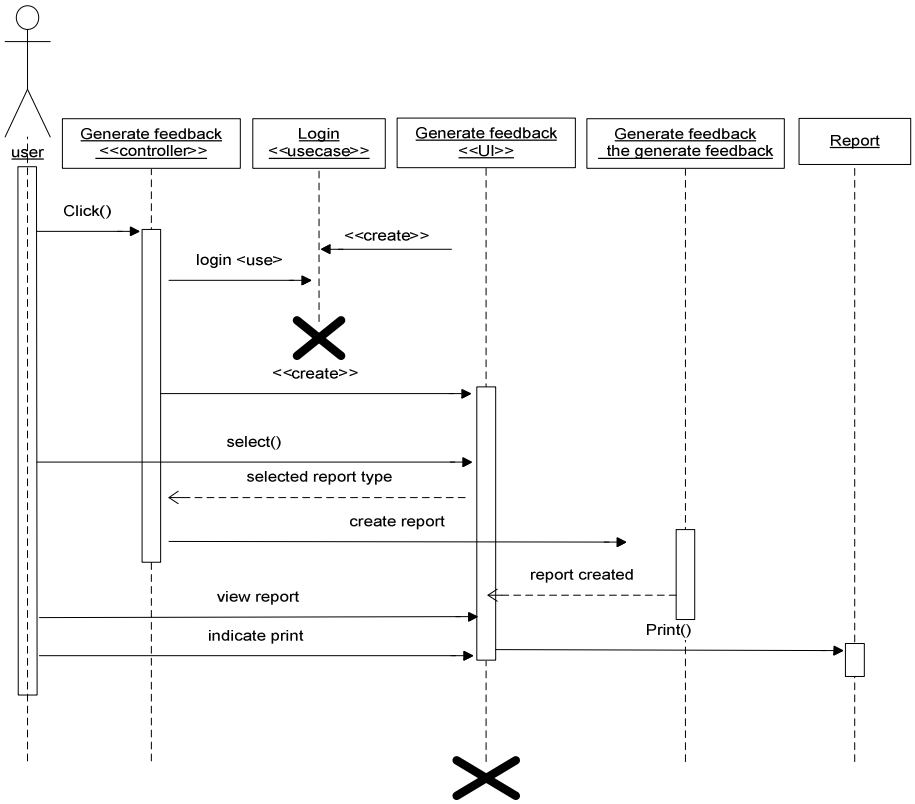


Figure 4-19 Report sequence diagram

Note: Here each type of report that the system generate is not described on the sequence diagram, instead a user interface named simple as report is described.(e.g. HIV, TB, malaria, etc)

4.4.5 Deployment diagram of EQA

The physical architecture that has been used was three tier client/server architecture. The database server is MySQL v5.051a which used to store information on EQA activities like storing of data collected from the facilities (panel testing, blind rechecking and on site evaluation), a server side scripting language of PHP v5.2.9 at the application layer is used to manipulate the data and a web browsers at presentation layer where users of the EQA come in contact with the system to upload result, view feedback etc.

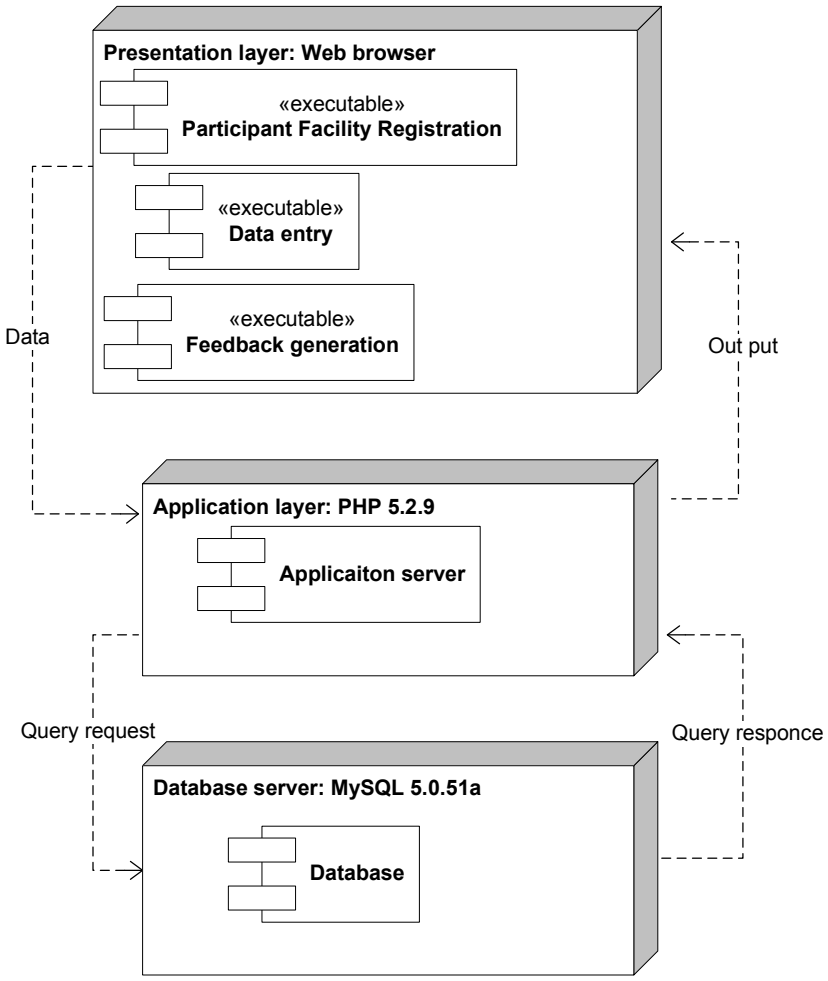


Figure 4-20 Deployment diagram of EQA system

4.4.6 Persistent object model

The classes of EQA system has been mapped to their respective tables as shown in the figure below. The classes have been normalized to avoid data redundancy and anomalies (insert, update, deletion). By using a mapping rule persistent object model is developed. For those tables with a many to many relationship their primary key is taken to create a new table. That new table having a composite primary key and its specific attribute. For those classes with a one to many relationship, the primary key from one table side is take to the many table side as foreign key. Their constraints have also been indicated on the figure.

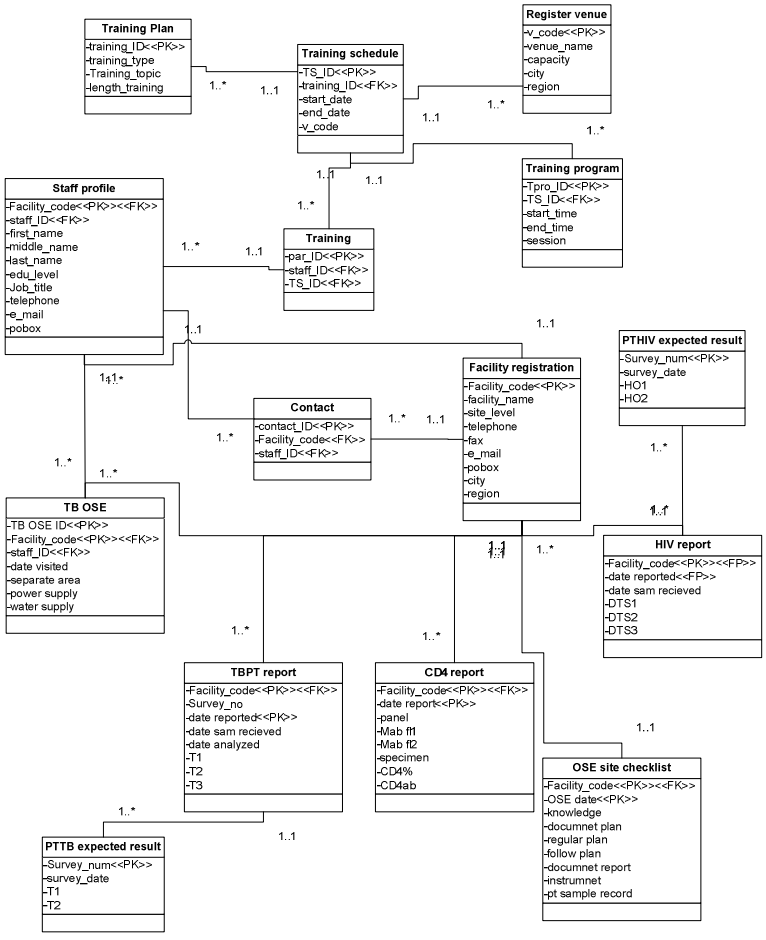


Figure 4-21 EQA persistent object modeling

4.4.7 Implementation and testing

The database system that has been designed was developed for the national and regional EQA panel testing of HIV, Tuberculosis and Malaria and training.

The system has a capability of introducing an overview of the quality system of Ethiopian laboratory services, external quality assurance and training. It supports facilities to upload their result and get feedback report from the N/REQAS about their performance on the specific test that they are participating. It also allow the EQA administrator to manage and seen the result reported, register facilities, registration of sample etc… and training coordinator to manage the planning, scheduling and programming of a training.

4.4.7.1 Verification test

The system has been tested using a simulated data. The response time of the system to generate the feedback report on the simulated data is fast and it takes few seconds and it gives a correct feedback report in about 95.55% of the cases. The system was failed to give the error type that the facility have to the result they submitted but it gives a correct score.

4.4.7.2 Testing

The developed system modules (TB report, HIV report, feedback report, training plan, training schedule,…) have been tested using simulated data to Checks for errors and omissions regarding end-use and design specifications. There were some errors on the coding and design specification and these errors have been corrected. The system was also tested in the Ethiopians health and nutrition research institutes (EHNRI) of NEQAS department, the referral laboratory in the EHNRI and training department on a LAN setup.

The NEQAS department after going through the system they have responded that the system is acceptable and up to their requirement. The department is every much interested and happy with the result submission and feed back generating capability of the system. They have appreciated specially the response time of EQA result submission and feedback generation. During the testing phase the submission and generation of

feedback takes only second. They have also appreciated the quality of data they have received because the quality of data that they were receiving in the manual system was very poor.

The training department has also appreciated the training database and the friendliness of the web for developing their plan, schedule and program of the training. They are also happy with the training yearly calendar and a detail of each training's which is posted for the public dynamically to be viewed.

Testing of the system in at the referral laboratory, the laboratory uploaded their AFB microscopy panel testing result. The system response on submission of the result was immediate with in seconds. The staffs were expecting that the feedback will take some weeks to get but at the moment the result is submitted, the feedback is read to be viewed. The staffs at the center generate the feedback dynamically which takes few second to generate the feedback. They have especially stressed in the feedback generation because the moment they have uploaded their result, they can generate feedback dynamically.

Chapter 5 Discussion

The use of a web based information system in the health system is now a day is an important step in the improvement of the health service to the community.[1] Web-based reporting systems are one example of how information technology may be used to improve patient safety and quality of care initiatives, while at the same time improving operational efficiency.[32] Knowing the status of the different laboratories in terms of their capability and capacity at all level is very crucial for the benefit of the help seeking patient and the development of Ethiopian health service delivery.

The laboratories use manual data collection means in about 90% of the cases. In a study done in Slovenia, there has been shown that electronic data collection reduces in about 55% the cost of data collection as compared to the paper based data collection.[33] If an automation system has been implemented in the EQA program the facilities could have saved the cost they spent in the postal mail or personal.

The national and regional EQA scheme uses mainly paper, postal mail and phone for the exchange of information with the facilities. This also identified in this study 92.5 percent indicated that they are using paper and postal mail for receiving information about the sample. This type of information exchange is highly subjected to loss and delay.

As compared to the previous method of data reporting and feedback generation, the newly developed web-based EQA has improved the performances by reducing the response time and loss of information. In pervious method, the participating laboratories will send their result through postal mail or personal delivery (77.8%) this is high subjected to loss, delay etc. This also affects the timing needed to reaches to the center. WHO indicated that providing timely and accurate information for use in patient management and disease surveillance by the laboratories continue to play a critical role in all disease control and prevention programmers. [34]

The NEQAS staffs are expected to examining the result sent by the facilities and making individual feedback, the system reduce the work load of staffs through its capable of generating a feedback by making comparison of the facility result with the standard expected result.

Only 27 % receive feedback timely, this is due to the fact that the result submission system used and the time staffs needed to make comparison have greater impact on the timing the facilities receive feedback. It takes an average of one month for the facility to receive its feedback on their performance on the pervious method. In the newly developed web based system it will take only few second to get the feedback with the reservation of internet access and its speed.

Access for computer and internet in Ethiopia is 0.9 PC's per 1000 people and 0.01 internet host per 10,000 people, respectively.[35] This also observed in this study that access to computers is 36.4% and internet (22.5%) in the laboratory. Internet access in the facility is a little higher but still in shortage (51.2%) and restricted to federal hospitals.

In most of the cases the automated system have been recommend to be used in the facility for their organized handling of information related activities and also they have indicated that this system will make their work easy, reduce workload, it an accurate method, fast, time saving etc. It is also supported by a study in Peru were the use of automated system improved the time and the cost that is spent by the staff in checking the status of their sample.[20]

In general, the use of automated system in the external quality assurance is beneficial with the different reason indicated by the respondents like time saving; easy, simple, fast, accurate, etc other studies also strengths this finding. [23,25,27] The fear is that access to technology is limited in African and also in Ethiopia.[35] and peoples perception toward the technology will be a challenge[31] task for the policy makers.

Chapter 6 Conclusion and Recommendation

6.1 Conclusion

The constantly increasing volume of data collected from different laboratories is creating difficulties in manipulation of all available information. An integrated approach to discover useful information, organize the layout of the information, and assist user navigation is particularly important.

From the this study, it is concluded that

- Most of the laboratories uses manual system to handle EQA information
- There is a delay in result reporting and feedback generation
- A web based database was developed for panel testing of HIV, TB, and malaria and for training
- the system was developed using an object oriented system development methodology
- Time for the submission of result to the N/REQAS reduced with accuracy.
- The response time of feedback given by N/REQAS to the facilities has reduced.
- The workload on the N/REQAS staff reduced.
- The facilities on the storage of their EQA data improved.

Therefore, the use of automated system in the EQA has great potential in the improvement of the program of EQA. If it has been implemented effectively the facilities as well as the EQA will get the great benefit of the automation system which indirectly improves the health care service delivery.

6.2 Recommendation

From the finding I recommend that

- EQA to implement an automation system for their activities to get the benefit of automation system. This can be accomplished by allocating budget/requesting from donors already supporting the program, training of the staffs and by developing an information technology infrastructure.

- Further study should be done on this area to have a clear idea of the EQA program and automation because this study is conducted only in Addis Ababa and can serves as a baseline.
- Studies should be done to assess whether it is possible to integrating an ICT to the health sector of Ethiopia to different context like capacity, profession readiness etc

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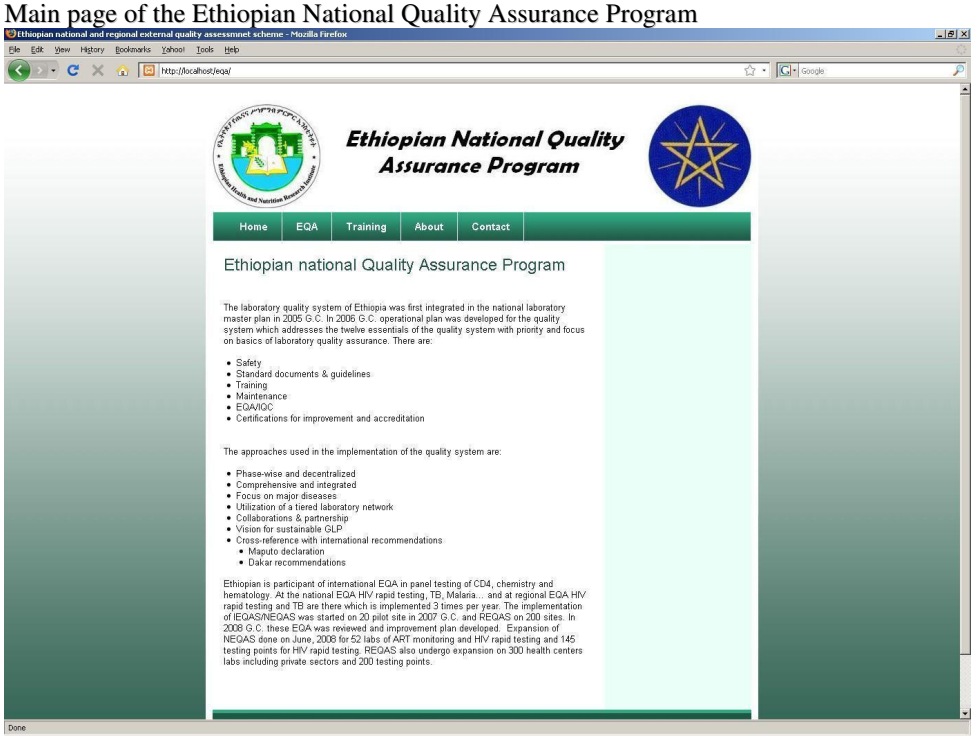
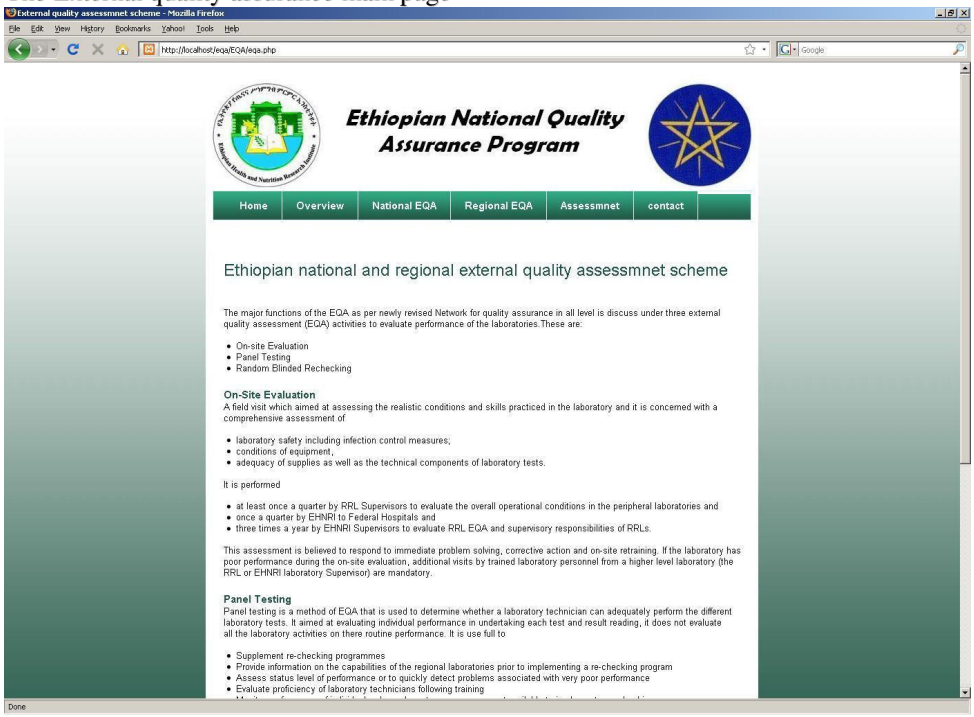
ANNEXES

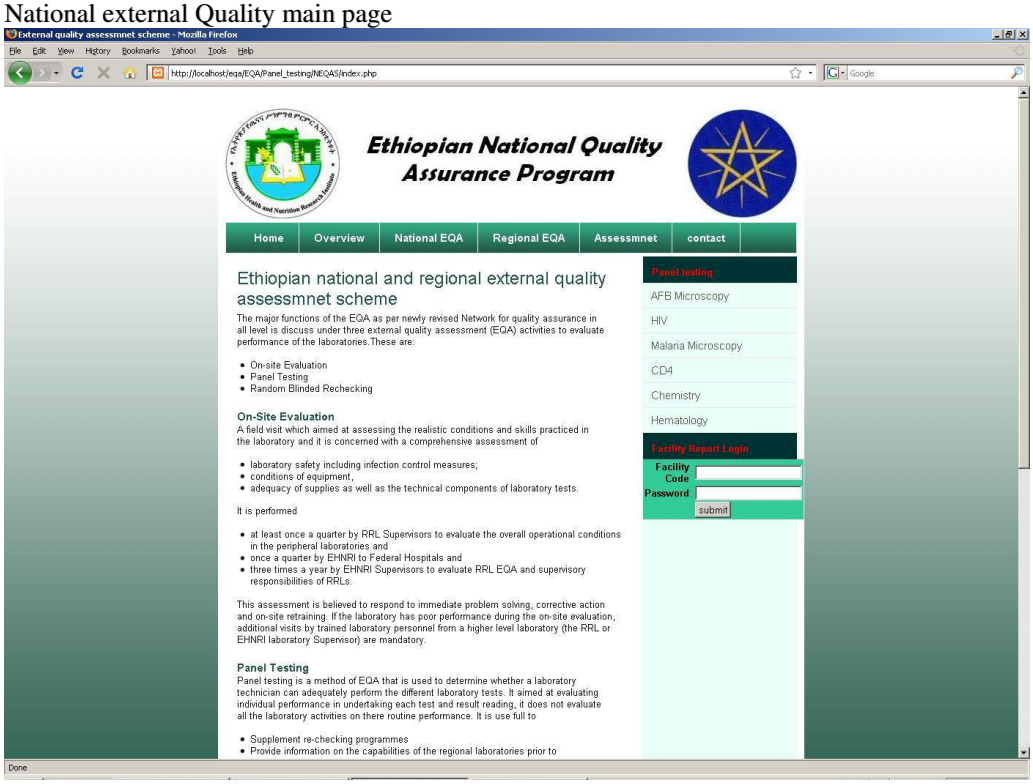
Main page of the Ethiopian National Quality Assurance Program



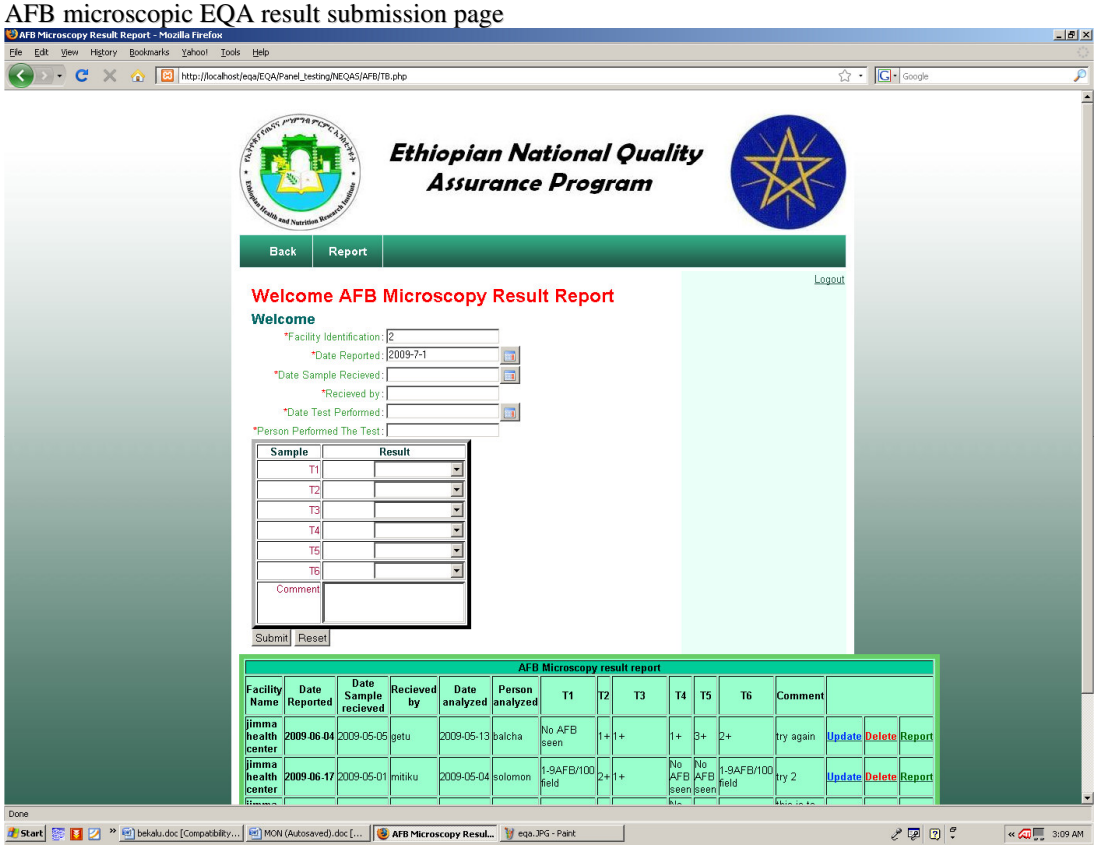
The External quality assurance main page



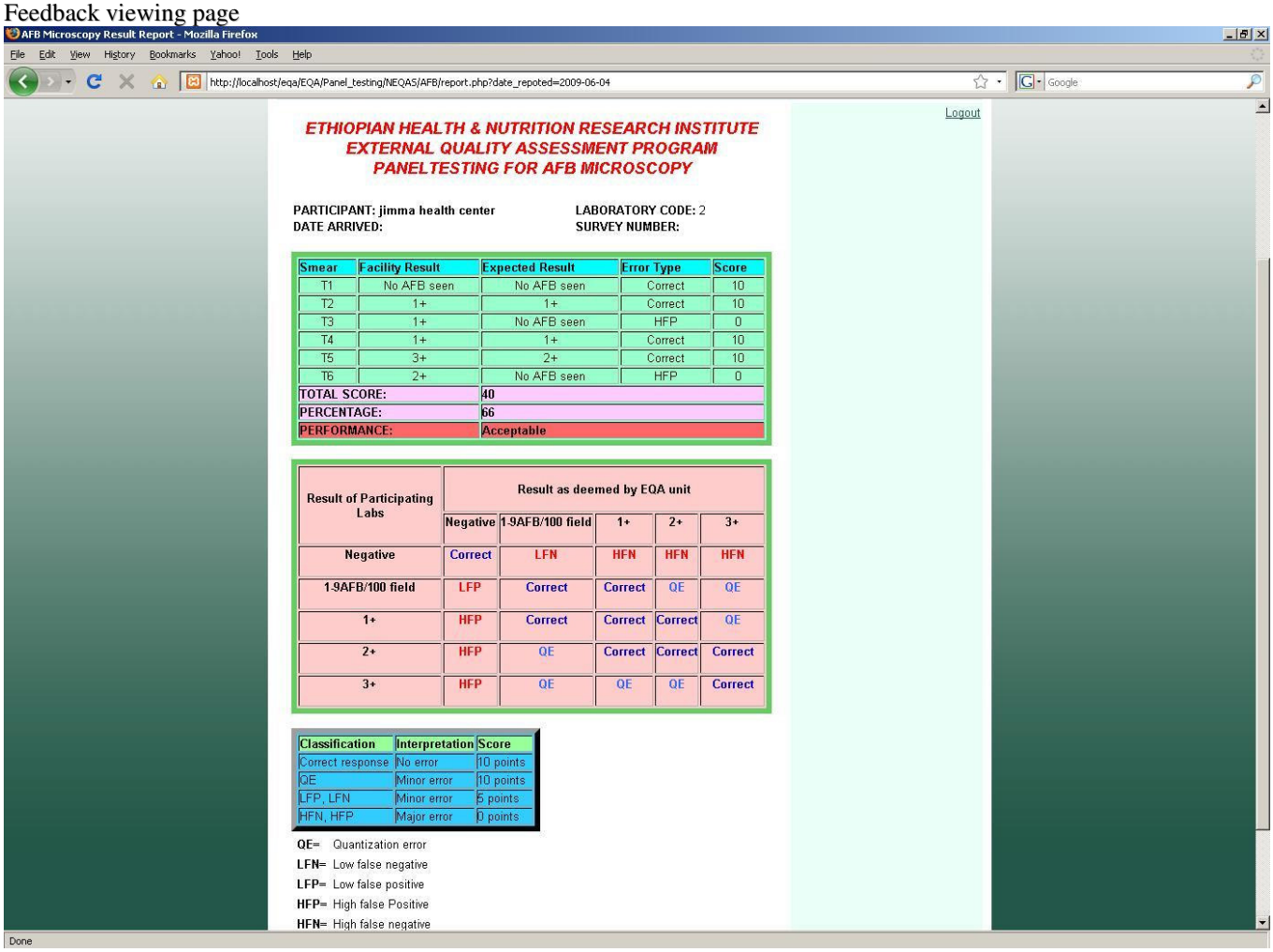
National external Quality main page



AFB microscopic EQA result submission page



Feedback viewing page



Information sheet

This study is conduct to assess the information and information utilization of national and regional quality assurance system and to develop web based database system for the national and regional external quality of the laboratory medicine. The Ethiopian ministry of health (MOH) in its study on the health information system of the country, there has been found that the information system to be poor (less data management, less information use and dissemination, less human resource …) therefore this paper will have its contribution to the information flow and handling system of the national and regional external quality assurance for better collection, management and reporting of the health data. These will contribute to the improvement of patient management.

Annex III

Consent form

Greetings

Hello! My name is Bekalu Assamnew, I am working on thesis research project at Addis Ababa University informatics Faculty, Department of Health informatics. This study is to be conducted with the aim of assessing the current information and decision support system of the national and regional external quality assurance scheme and to produce a user friendly web based database system that help in improving patient care. Your institute is one of the selected to participate in this study, therefore you are kingly requested to participate in this study and provide us with the information required from you.

We would like to inform you that the responses that you provide the questions are very essential, not only, for the successful accomplishment of the study but also for producing relevant information which will be helpful in improving the external quality assurance scheme that can improve the patient care. I would appreciate if you would take few moment of your valuable time to answer this questionnaire. Thank you in advance in anticipation of your cooperation.

Questionnaires

General direction

Please, put " √ " mark on the space provided to indicate your response where applicable. In cases where the responses other than mark are required, please write your response in the space provided. You may use additional paper where the space provided is not enough.

1. Identification
   Institute _____
   Department _____
   Profession_____
   Position _____
2. What are the specific activities you are currently engaged?
   _____
   _____
   _____
3. In which type of lab test your laboratory is participating in External Quality Assessment (EQA)? (Tick as many as the institute involved)
   ___a. HIV
   ___b. Clinical chemistry
   ___c. CD4
   ___d. Hematology
   ___e. Others(specify)_____
4. In what way do you receive the information about the sample?
   ___a. Written Paper
   ___b. E-mail
   ___c. Fax
   ___d. Postal
   ___e. Other (please specify) _____
5. What types of information are included with the sample?
   _____
   _____
   _____
6. Does the EQA sample arrive to your laboratory with enough information?
   ___a. Yes
   ___b. No

   4.1 If No, what are the most common missed information and in your opinion do you think the reason could be?

_____
_____
_____
_____

7. How do you rate the consistency of information you receiving?
   - ___a. Consistent
   - ___b. Moderately consistent
   - ___c. Poorly consistent
   - ___d. Inconsistent
8. If your response for Q6 is poorly consistent or inconsistent what do you think the reason could be?
   - ___a. Absence of organized/integrated information technology
   - ___b. Low level of application of information technology
   - ___c. Duplicated external information source
   - ___d. Loss of records
   - ___e. Other, please specify_____
9. How do you rate the accuracy of information you receiving?
   - ___a. Accurate
   - ___b. Moderately Accurate
   - ___c. Poorly Accurate
   - ___d. Inaccurate
10. If your response for Q8 is poorly accurate or inaccurate what do you think the reason could be?
    - ___a. Absence of organized/integrated information technology
    - ___b. Low level of application of information technology
    - ___c. unreliable external information source
    - ___d. Loss of records
    - ___e. Other, please specify_____
11. Do you keep photograph documentation other than specimens?
    - ___a. Yes
    - ___b. No
12. What additional information's are collected other than the EQA sample result during external quality assessment?

    _____
    _____
    _____

13. Do the documentation system facilitate for conservation (protection, storing and maintenance) and research purpose?
    - ___a. Yes
    - ___b. No
14. What type of data collection method is used to collect information for EQA participation?
    - ___a. Paper based
    - ___b. Automated (computers)

15. Which methods do your recommend for proper data collection? And why did you recommend?

_____

_____

16. What were the challenges of using the previous method of data collection for EQA activities?

_____

_____

_____

17. Do you maintain indexes?
    - ___a. Yes
    - ___b. No

    12.1 If yes, how are the indexes organized?
    - ___a. By accession number
    - ___b. Alphabetic name
    - ___c. Other (please specify)_____

18. Does the indexing system provide sufficient cross-reference to related information?
    - a. Yes
    - b. No

19. Does the index contain complete and up-to-date information?
    - ___a. Yes
    - ___b. No

20. How fast do you get the EQA information when you are asked for them from the recordings for some purpose like research, crosschecking etc?
    - ___a. Very fast (Less than five munities)
    - ___b. Fairly fast (5-20 minutes)
    - ___c. Not fast at all
    - ___d. Other, please specify_____

21. If your response for Q21 is "Not fast at all" what in your opinion is/are the possible cause(s)?
    - ___a. Misfiling
    - ___b. Storage system is use
    - ___c. Loss of records
    - ___d. Mistakes in initial registration
    - ___e. Improper tracking system
    - ___f. Absence of finding aids such as lists, indexes and other guides
    - ___g. Lack of proper matching of finding aids with the physical location of the files
    - ___h. Volume of file and large number of users
    - ___i. Other, please specify_____

22. Is there any standard operating procedure (SOP) at your laboratory?
    - ___a. Yes
    - ___b. No

_____

23.1 If yes, how did the SOP organized?

_____

_____

_____

23.2 If yes, how do you rate its accessibility?

___a. Accessible
___b. Moderately accessible
___c. Poorly accessible
___d. inaccessible

23. Is there any access policy for documented information?

___a. Yes
___b. No

24. How do you rate the availability of information at your work place?

___a. Very good
___b. Good
___c. Fair
___d. poor

25. If your response for Q25 is fair or poor what do you think the reason could be?

___a. Absence of center database service and poor manual system
___b. Low level of utilization of information technology
___c. Lack of efficient retrieval system
___d. Poor information exchange with government offices (Long bureaucratic procedure)
___e. Low level of recognition for the role of information
___f. Absence of finding aids such as lists, indexes and other guides
___g. Lack of proper trained manpower in the area of information services
___h. Other, please specify_____

26. What aspect of information do you consider as the most important factor to your information requirement?

___a. Timely information
___b. Pertinent and relevant information to the immediate need
___c. Reliable information
___d. Information presented in simple and direct form
___e. Ease of access to the information service and resource
___f. Other, please specify_____

27. Form the above stated aspect which ones are lacking in the EQA documentation center?

___a. Timely information
___b. Pertinent and relevant information to the immediate need
___c. Reliable information
___d. Information presented in simple and direct form
___e. Ease of access to the information service and resource
___f. Other, please specify_____

28. What types of data reporting system are used?

___a. postal

___b. phone call
___c. fax
___d. E-mail
___e. Other (please specify)_____

29. Do you think the mechanisms you mentioned are appropriate for exchange of information?
___a. Yes
___b. No

28.1 If no, what where the challenges of using the previous method of data reporting system for EQA activities?

_____
_____
_____
_____

28.1 If no, what do you recommend on the type of reporting system?

_____
_____
_____
_____

30. Do you receive feedback after reporting the results?
___a. Yes
___b. No

29.1 If yes, how often?
___a. Frequently
___b. Sometimes

29.2 Is the feedback timely?
___a. Yes
___b. No

29.3 What type of feedback mechanism is used?
___a. Postal mail
___b. phone call
___c. fax
___d. E-mail
___e. Other (please specify) _____

31. What are the challenges of using the method you mentioned for feedback mechanism?

_____
_____
_____

31.1 Is there access of computer in the laboratory?
___a. Yes
___b. No

31.2 If yes, for what purpose do you use the computer?
___a. Word processing

___b. Consolidating financial report
___c. Statistical analysis
___d. Records management
___e. Other, please specify _____

32. Is there access to internet at your laboratory?
___a. Yes
___b. No

33. Is there access to internet at your institute?
___a. Yes
___b. No

34. If your responses are "Yes" for Q32 and Q33 for what purpose do you use the internet?
___a. Educational purpose
___b. E-mail
___c. News
___d. Sport
___e. Other, please specify_____

35. What are the information related provisions problems your are currently facing in your work?

_____
_____
_____
_____
_____
_____

36. What improvements do you suggest to improve the provision of information?

_____
_____
_____
_____
_____
_____

37. What are the barriers and enablers can you point out on the application of ICT at your situation?

_____
_____
_____
_____
_____
_____
_____

Interview guideline

Identification

1. What is your responsibility, education and work?

Organization and relationship

1. What is the objective of the center?(major tasks and document)
2. How is the center structured (organization) managed and financed?
3. What steps are or procedures are carried out to accomplish your major tasks?
4. Please describe the flow of work and document involved?
5. What are the information related activities of the center?
    a. What Data are generated and stored on completion of each task
    b. What method do you use store and process data
6. Is there any information flow between you and other department?
    a. Describe the name of the department or institute from which you receive source document
    b. Work relation ship
7. Are there any collaboration programs with other institutes?

Collection

1. What types of collection does the center has (computer based or manual (paper based)) and in what formant and language?
2. How frequently is the information collected?
3. What is the size of the collection across each type?
4. What sort of record is maintained?
5. Please state the various reports you prepare on daily, monthly quarterly or annually basis.
6. How is the information flowing form one unit to another? (in what format)
7. What problems are there related to collection?

Storage

1. How did you keep (store) information collected?
    a. Is there enough space to storage?

b. Are the facilities suitable for the collection?
c. Is the environment conductive

Access

1. What types of finding aids do you use when you are requested for information?
    a. Id
    b. Indexing
    c. etc
2. How are the types of these finding aids organized?
3. Do these finding aids contain complete and up-to-date information about the collection?
4. Is there any access policy or rules?
5. How fast can be retrieve an information form any one of the finding aids?

Service and users

1. What types of services the center provides?
2. Who are the major users of the center?
    a. What is there level of access
3. How do users usually make their queries? Is there any query form?
4. Do you publicize (advertise) the holding of the center? How?
5. Do you have any in-house publication used to disseminate in published from information on your collection? What is the frequency of issue and can you do it at the required frequency?

General

1. What problems is the center facing in reaction to handle information on the collection and providing service to users?
2. What are the major causes of there problems?
3. Do you think that automation can solve the problems\? Is there any intended plan to automate the service and function?
4. What benefits do you expect form automation

What is your reaction to new technologies like Internet?

DECLARATION

This thesis is my original, has not been presented for a degree in any other university and that all sources of material used for the thesis have been duly acknowledged.

_____

Bekalu Assamnew

June 2009

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

_____

Ato Henok Luleseged

June 2009