Addis Ababa University School of Information Science and School of Public Health MSc. in Health Informatics Program

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Development of Malaria Prevention and Control Information System for Harari Regional Health Bureau

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Acronyms

DHIS	District Health Information Software
DSS	Decision Support System
EPC	Epidemic Prevention and Control
FMOH	Federal Ministry of Health
GIS	Geographical Information System
GoE	Government of Ethiopia
HEWs	Health Extension Workers
HIS	Health Information System
HRHBMPCIS	Harari Regional Health Bureau Malaria Prevention and Control Information System
HSDP	Health Sector Development Program
IDSR	Integrated Disease Surveillance And Reporting
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Nets
LRR	Logarithm of Relative Risk
MIS	Malaria Information System
MPFT	Mass Presumptive Fever Treatment
NF	Non Falciparum
OOAD	Object Oriented Analysis and Design
PF	Plasmodium Falciparum
RHB	Regional Health Bureau
RDTs	Malaria Rapid Diagnostic Test
SMS	Short Message Sending
SBCC	Social Behavior Change Communication
SDSS	Spatial Decision Support System
SMS	Short Message Sending
RHB	Regional Health Bureau
TB	Tuberculoses
UML	Unified Modeling Language

Abstract

Background: Information is a powerful tool for controlling infectious diseases. The use of information systems to understand the dynamics of malaria and its prevention and control proved valuable. Development of information system supporting timely and accurate decisions has been slow for many resource poor environments. In Harari Region the malaria burden is very high and all woredas within the region are malarious, where every health institution within the Region report large number of cases weekly for the Regional Health Bureau. Although information usage for prevention and control of malaria is very low, the region has enough computers and communication infrastructure to replace manual data handling system with computer based one.

Objective: The aim of this project was to design an information system for prevention and control of malaria for Harari Regional Health Bureau.

Methodology: The project employed Object Oriented System Analysis and Design Methodology. For data collection techniques like interview, survey, observation and relevant document review were used. For sufficient analysis and design, the Unified Modeling Language (UML) tools selectively used were use case diagram, sequence diagram, activity diagram, state chart diagram and class diagram. System architecture design, database design, system flow design and user interface prototype were developed by using Microsoft Office Visio and Access 2007 for further illustration.

Result: The designed information system incorporates: Malaria surveillance, registration of spray operation and ITNs distribution, searching, updating and report generation function. The system design also includes weekly epidemic registration with web based notification for personnel working on prevention and control department.

Conclusion and Recommendation: Different problems were found with existing manual system including inaccessibility to use reported and collected data for effective decision making. To address the above mentioned problems the new information system was designed. To bring the newly designed information system into problem solution, Harari Regional Health Bureau should work on implementation and coupling of the new system with existing smart care software.

1. INTRODUCTION

1.1. Background

Malaria is a disease that causes massive health problem throughout the developing countries especially those in sub-Saharan Africa. Highland and semi-arid regions are among environments where a particular challenge to confront the disease is present because of unsteady occurrences of out brakes (1). Prevention and control measures in these regions should be improved to timely predict and make early response.

As many nations across the developing world continue to make progress toward reducing malaria transmissions, the need for timely and accurate reporting of remaining cases of the disease is more important than ever. Since 2000, malaria-endemic countries across Africa have worked tirelessly to protect vulnerable populations with insecticide treated bed nets, indoor spraying of insecticides, effective medicines, and new diagnostics (2). This scaling up of malaria control efforts has led to dramatic drops in malaria illnesses and deaths in many countries, paving the way for these countries to begin to work on eliminating the disease altogether. As malaria cases diminish, using localized rapid reporting systems to track and treat the remaining cases of the disease is essential to maintain progress made to date and ensure that a resurgence of malaria does not occur.

According to (Mabaso, 2004) “Most malaria vector control strategies in Africa have focused on the use of insecticide-treated nets (ITNs) and indoor residual spraying (IRS) (3)” as a primary public health resource to prevent and control malaria. (Nchinda, 1998) and (Marsh, 1999) addressed that “Competition for ever-dwindling public health resources is a major challenge for malaria control program in sub-Saharan Africa and constant monitoring and evaluation of spraying activities is obligatory where indoor residual spraying is an important component of malaria control, to ensure effective application and prevent wastage(4)”.

Beyond use of indoor residual spraying and insecticide treated nets, the advancement in and improvement of surveillance systems with modern information technology lends itself to accommodate detection components to ensure quick response to outbreaks and prevention of epidemics (5). The availability of database development tools to verify and query data even before acceptance in the system, input masks for data entry, fixed drop down list and a more user friendly user interfaces improves data quality. Decentralization of services and surveillance offices lessen time from notification to collection and data entry. The improvement and availability of communication technology and specifically mobile technology for outbreak notification provides an additional option to improved response time.

Ethiopia National malaria guidelines address that “Communication skills are essential elements of malaria vector control. Spray operator, field coordinators and supervisors should have adequate skills to communicate with government officials at various levels, communities and

households. The main objectives of communication in malaria vector control are to gain the acceptance and cooperation of stakeholders during and after Indoor Residual Spraying (IRS) as well as to influence behavior at the household level for proper and consistent use of Insecticide Treated Nets (ITN). Health Extension Workers play an important role by providing information about malaria in general and prevention methods in particular (6)".

Ethiopia has a policy to provide the main malaria prevention and control services free of charge. Hence, the malaria risky population has the right to get malaria diagnosis and treatment as well as mosquito nets free of charge. Localities targeted for Indoor residual spraying (IRS) of their houses also receive it free of charge. Currently, long-standing 'expert knowledge', based on classifying whether kebeles are malarious or not, is used to decide on the targeting of intervention strategies, including bed nets, indoor residual spraying (IRS) and drugs. This micro planning varies from region to region, and takes into account factors such as altitude, usual rainfall, expectation of malaria cases, proximity to breeding sites, and historical occurrence of outbreaks (7).

1.2. Statement of the Problem

The burden of malaria in Africa is very high compared to other continents where "Every year, 1-2 million African children less than five year die of malaria and if one adds to this the contribution of malaria to all-causes of infant mortality, then clearly the burden of the disease is catastrophic disaster quietly happening each and every year (8)".New tools are needed urgently to support those currently available for control of the disease.

Coming to the Ethiopian situation, "annually 4-5 million people suffer from a clinical episode of malaria (8)". For the prevention and control of malaria epidemic in Ethiopia, there is a great motivation toward application of computerized information systems. Similar projects have never been undertaken in Ethiopia but predictive systems called EASTWEB have been developed in the Amhara Regional State for early warning of malaria epidemics.

Although the development of software systems like EASTWeb can facilitate the application of remote sensing data for malaria early warning, the limited availability of malaria surveillance data still limits the development of effective forecasting models in many areas. Expanding the EASTWeb system to include tools for easily capturing and managing public health data in addition to remote sensing data could thus greatly expand the utility of the system (9).

Harari Regional State Health Bureau has computers and other communication infrastructures, but Malaria prevention and control activities remain paper-based making the provision of comprehensive, reliable, relevant and timely malaria surveillance data usage challenging. Malaria indicator data reported throughout the region are kept using paper based record system which is prone to error, difficult for easy access, leading to lack of timely reliable and relevant information (10). Therefore, this project aims at creating a solution to these problems by

analyzing and designing a new computer application for data entry, data base management, data analysis and report generation to enhance malaria prevention and control activities.

1.3. Objectives

1.3.1. General Objective

The general objective of this project was to analyze and design an information system for prevention and control of malaria for Harari Regional Health Bureau.

1.3.2. Specific Objectives

1. To understand existing system and collect data requirement for the development of malaria prevention and control information system.
2. To analyze the malaria prevention and control information system.
3. To design the malaria prevention and control information system.
4. To develop user interface prototype of the malaria prevention and control information system.

1.4. Significance of the Project

The information system for prevention and control of malaria reduce workload of manual malaria information management system and create possibilities for risk prediction. The Harari Regional Health Office has the necessary infrastructures, but still malaria prevention and control remain manual and paper based, hindering the potential problem. The proposed project is important and relevant in that it will be a base for further project completion (coding and implementation) in order to come up with decision that can direct effective malaria prevention, control and eradication creating potential benefits for

- ✓ A wider public by allowing them to gate timely services
- ✓ Health professional by allowing them to improve their knowledge of malaria prevention and control
- ✓ Policy makers to get accurate and timely information necessary to make effective decision
- ✓ Funding agencies to direct their funds in transparent way and get accurate and timely feedback.
- ✓ Governments and Regional Health Bureau to reach their goal in control and eradication of malaria.

1.5. Scope of the Project

The project scope was to analyze and design computerized information system for prevention and control of malaria which after implementation provide online malaria case reporting, epidemic detection and notification of responsible health workers for immediate prevention and control. The system also provides a record database for spray operation and safety net distribution.

2. LITERATURE REVIEW

2.1. General Literature

2.1.1. Health Information System and Public Health Surveillance

Health information system record and report information on the health of a population from a variety of demographic, logistical, program management and health status indicators, the results are used for national health planning and policy setting. Public health surveillance is an essential component of the health information system with objectives and methods that inform action for public health (11). Developments in information and communication technologies provide opportunities for dramatically improving the way disease surveillance is conducted.

According to WHO, CDC 2006 “Disease surveillance systems are the product of a dynamic interaction between the generation of information and action to solve identified problems, and can be considered to be a component of the broader health information system (HIS) (12). Although other types of information are collected and reported to focal points in a national system, surveillance systems primarily look at data for defining trends in public health events, identifying personal characteristics (such as age, gender and location), and mapping the location of disease incidence. Using other health information (such as demographic or community information, or inventories of supplies or coverage data for insecticide-treated bed nets) may be necessary in analyzing a health event. Although surveillance systems do not necessarily need to be fully integrated into the health information system, they need to produce information for it (12)”.

Public health surveillance is the ongoing systematic collection, analysis and interpretation of outcome specific data, closely integrated with the timely dissemination of these data to those responsible for taking public health action to prevent and control disease or injury (13). In Ethiopia, IDSR activities have been subsumed under Epidemic Prevention and Control (EPC), in the Disease Prevention and Control Department (6).

The process and outputs from the surveillance system are measured by core indicators related to the system. The indicators include case detection, case registration, case confirmation, reporting, data analysis and interpretation, and public health response including reports and feedback from the Communicable disease surveillance and response systems. Data collected by surveillance should be analyzed routinely and the information interpreted for use in public health actions. Appropriate alert and epidemic threshold values for diseases with epidemic tendencies should be used by the surveillance staff. Capacity for routine data analysis and interpretation should be established and maintained for epidemiological as well as laboratory data (6).

Once malaria has been suspected or established as the cause of an epidemic or significant case build up, notification by telephone or short-message-sending (SMS) should occur as soon as possible to all higher levels of the health system, such as the HEW supervisor, health center,

district health office, zonal or regional health bureau (RHB). Each health care worker should have the contact number of his/her supervisors. Among the critical information needed is the number of malaria cases suspected or confirmed in the last week by species and number of days of remaining supply of ACTs, RDTs and chloroquine at current rate of consumption. A mass test and treatment strategy will be maintained in most situations and mass presumptive fever treatment (MPFT) with ACTs is appropriate when there are no RDTs for mass-screening or test positivity rate is $\geq$ 50% upon examination of at least 50 suspected cases. While the first priority in an epidemic is the prompt and effective diagnosis and treatment of malaria patients, the rapid assessment made by an investigating team may recommend additional vector control interventions to reduce the force of malaria transmission and prevent the resurgence of the epidemic in a community. Therefore, rapid epidemic assessments including entomological and suitability of environment for sustained transmission should inform decisions on the need for supplementary intervention requirements, mainly indoor residual spraying of households with insecticide (IRS) to effectively halt an ongoing epidemic (6).

2.1.2. Electronic Health Management Information System

The importance of electronic health information system management is well known by countries to improve service quality and solve the complexity within health sector. “An analysis of the health information landscape suggests that countries are moving from the established paper-based implementations of district health information to the “second generation” Health Information System (HIS), where health encounter data are used to not only inform policy, but also to improve care at the point of service(14)”.

Currently, Ethiopia has mostly a paper-based system of data collection at health facility level; however, little information is actually used for decision making and resource allocation at either the local, regional, or national level. Consequently, Ethiopia’s FMOH is in the process of revising the Health Management Information System (HMIS) (8). This revised HMIS, which includes a total of 108 indicators, may help the movements of the country toward electronic health management information system.

Depending on the number of indicators as well as the software used for data entry, migration from a paper-based to an electronic system does not necessarily reduce the burden on local health workers, but it does reduce errors associated with manual aggregation of the data at higher administrative levels. Electronic systems also make reporting potentially much more flexible and efficient, because information can be analyzed at the district level as well as above. Assuming the tasks required to optimize a paper based system are successfully completed, the challenges associated with moving to electronic storage and reporting are those related to support of the technology and system users (14).

Introduction of an electronic Health Management Information System (HMIS) will be an important breakthrough in administrative offices’ ability to monitor performance and pinpoint

constraints and bottlenecks. The electronic HMIS can provide the woreda, Region, and the Federal Ministry of Health (FMOH) with flexibility to create tables, graphs, and maps to present time trends and comparisons between locations, with an ease and speed that would simply not be possible if the analysis were done by hand, even if assisted by a spreadsheet. These various presentations will help in using the data to make astute decisions for performance improvement (8). Because the health information field is complex and multifaceted, a number of key issues have now been identified as central to the success of these efforts. One of these key issues is surveillance information system. Current project is designed to support malaria surveillance with further supporting function such as case registration, data analysis and interpretation, and public health response including prevention and control, reports and feedback within integrated disease surveillance and support system.

2.2. Related Works

Information is a powerful tool for controlling communicable diseases. It allows prevention and control person to make informed decisions regarding type of disease interventions, where they should be focused and what the extent of resource investment should be. Planning, implementation and evaluation of public health program is unlikely to be effective without quality information. To enable collection, collation, storing, analysis, interpretation and distribution of health related data for disease surveillance, an information system is usually required (15).

A study delivered in China in 2005 launched a web-based, case-based electronic reporting and recording system for tuberculosis (TB) information management system of the country. This study delivers the system with capability of holding TB patients detailed treatment data and treatment outcomes, including demographic information, clinical data and drug susceptibility testing results that are stored using Oracle database (16).

To support indoor residual spray monitoring in the Mpumalanga province of South Africa, the application of computerized management system was started during 2000. The information system helped the local spray operator's team as a guidance to monitor spray operation coverage, operators' performance, and insecticide consumption and application rates (17). The weakness of the system was it is standalone computer system that was not supported the communication between local supervisors and top level malaria prevention and control program managers.

Progressively, Malaria Information Systems have been set up in the malaria's provinces of South Africa following spray monitoring information system (18). This computerized system allows the input, management and output of malaria case information which is central to disease management, research and the regional evaluation of the Lubombo Spatial Development Initiative (LSDI). This Malaria information system (MIS) provided the ability to identify areas of risk and to assist decision makers in directing resources and strategies. The ready access of data, its rapid entry, analysis and output in the form of graphs, tables and maps, allows for stream-

lining of the data within the Region, and for rapid management and evaluation of the situation on an on-going basis, enabling cost effective use of resources (19).

In southern Mozambique, a computerized management system with a spatial decision support system (SDSS) component has been implemented to monitor vector control spraying operations (10). The number of structures sprayed was digitally recorded, insecticide spray application rates calculated and coverage by a spray team mapped over a large geographical area. This SDSS provided program mangers with an effective operational tool to actively monitor resource usage and spray progress, identify problems at the level of an individual spray operator, and implement remedial action when required to assure high coverage and program efficiency.

Following the success of stand-alone decision support system (DSS) in malarious provinces of South Africa, an integrated Malaria Information System (MIS) has been developed and implemented in Mpumalanga Region to facilitate pragmatic decision making (20, 10). Maps generated from the GIS-based MIS produced at a variety of administrative levels ranging from national to village level and have played an important role in formulating malaria insecticide and drug policies, providing appropriate information for tourists, evaluating changes in malaria transmission over time and allocating resources to control malaria (10).

In Ethiopia an action research was done to adapt the health statistical system, DHIS in Tigray Region (20). It has been adapted to the needs of Tigray Regional State so that they can produce quality health report from the primary health care data of the Region. The system is mainly used for reporting function instead of for transactional purpose.

To identify the potential causes for inter annual variability of malaria cases that is independent of seasonal trends and spatial variability in the population at risk, “The Anti-Malaria association created a historical surveillance database for the Amhara Region that included 19 districts with long-term data on malaria cases between 2001 and 2009. The data were used to compute logarithm of relative risk (LRR) indices that quantified inter annual variability in malaria cases while controlling for seasonal trends and spatial variability in the population at risk. LRR quantified inter annual variability during the peak season (September-December) when malaria case numbers are highest and epidemics typically occur (9)”.

The application of satellite remote sensing environmental data to early detect malaria epidemic introduced to Ethiopia following development of malaria historical data base for the Amhara Regional state. This integrated computerized information system was named as EASTWeb and according to (Wimberly, 2012)“The EASTWeb software application expedited the acquisition, processing, and management of historical remote sensing data and has continued to incorporate new data as it becomes available. The resulting database of environmental metrics was linked with a set of scripts for modeling malaria epidemic risk and a web atlas application for visualization and dissemination of malaria risk maps. Using the database generated with the software, the developers were able to develop statistical models that explained between 39% and

53% of the variability in historical malaria epidemic risk (9)". The investigator of the software recommends expansion of the scope of the system from climate to encompass other social and environmental determinants of malaria, and developing additional tools to better integrate disease surveillance with environmental monitoring.

At National level, outpatient malaria cases are manually reported through at least 3 reporting channels: the monthly report of all diseases, the monthly report on priority diseases for Epidemic Prevention and Control (previously called the Integrated Disease Surveillance and Response, or IDSR, report) and the malaria control program report (21). Health workers duplicate their work because they must fill the same information on several different forms. All the way along the reporting chain, several program officers duplicate each other's task to write the same data element on different forms.

The problem with malaria case reporting in Ethiopia is addressed by HMIS team 2008 as "Besides, unnecessary duplication, these multiple forms flow along separate reporting channels. This introduces another level of redundancy. Each reporting channel has an overhead associated with it, in terms of staff time for processing and material costs. Forms that flow along each channel contain some of the same information reporting location, date, etc; this information produces duplicate work simply for processing the form, even when the data elements are different. There is also duplication in stationery (when two or more forms could be combined into one), which incurs unnecessary costs for material and associated overheads for procurement, storage, transport, etc (21)". Hence, application of database systems with uniform data collection forms is necessary at Regional and National level to reduce unnecessary duplication and redundancy and improve the application of information for informed decision.

3. METHODOLOGY

Various methods can be used to develop computer based information system and this project was employed Object Oriented (OO) methodology to analyse and design information system for prevention and control of malaria. Object oriented methodology is popular because it is flexible, efficient and provides an easy transition to programming languages such as Visual Basics. Object oriented analysis describes an information system by identifying things called objects.

As interactive systems are increasingly promoted as a possible means of achieving system development goals, designers generally agree that participatory design approaches should be applied. In participatory development practice, there has been an emphasis on the importance and specifics of relationships, the interpersonal and social skills of practitioners. Main functions of participatory approaches are: accomplishing project goals with low cost and greater chances of sustainability (22).

During the development process of an information system for malaria prevention and control for Harari Regional Health Bureau participatory approach were used. This approach helps to include all the felt need of the users of the new system (22).

3.1. Study Setting

Institutional based cross sectional study was conducted using qualitative method in Harari Region eastern part of Ethiopia from March to May 2014 to investigate malaria prevention and control work. Government and private health institutions that report malaria related data for the Regional Health Bureau were assessed to see the reporting trends, horizontal communication (between health institutions) and vertical communication. Reporting was assessed through interview, observation and analysis of documents related to malaria prevention and control. Discussion was made with all existing health institutions about the necessity of software supporting the malaria prevention and control activities.

3.2. Study Area

Harari People's National Regional State is one of the nine ethnically based regional states of Ethiopia, covering the homeland of the Harari and surrounding Oromo people. Formerly named Region 13, its capital is Harar. The Region is located between 9011, 49 $^{(o)}$ and 9024, 24$^{(o)}$ northern longitude and 42003, 30$^{(o)}$ and 42016, 24$^{(o)}$ eastern longitude about 526 KM away from Addis Ababa. The Region also has smallest land area of the Ethiopian regional states (23).

Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), Harari has a total population of 183,415, of whom 92,316 were men and 91,099 women. This Region is the only one in Ethiopia where the majority of its population lives in urban areas: 99,368 or 54.18% of the population are urban inhabitants. With an estimated area of 311.25 square kilometers, this Region has an estimated density of 589.05 people per square kilometers.

The number of health facilities within the Region are, four government hospitals, two private hospitals, eight health centers of which two are only for diagnosis and treatment of malaria and twenty three health posts (24). Administratively, the Region subdivided in to 9 woreda, further divided in to 19 urban and 17 rural kebeles (5).

3.3. Source and Study Population

The source populations were health institutions and health professionals of the Harari Regional State in general. Study populations were existing systems, health professionals and other workers participating in malaria prevention and control activities in Harari Regional State health institutions.

3.4. Data Collection Tools and Variables

Appropriate interview and observation guide questionnaires were prepared by the principal investigator. The questionnaires were developed by English. The interview and observation were made by eight data collectors from third year HMIS students of Harar Health Science Collage. The data collection variables were malaria case capturing detail, reporting detail, processing, feedback detail, demographic data within the region related to malaria prevention and control.

3.5. Data Management and Analysis

The results were by summarizing the notes taken during the data collection. The responses first were categorized into different themes according to the type of existing system in use, and then Unified Modeling Language UML applied for the analysis of the requirement or collected data.

Data has been analyzed and designed by using systems design and development methodology and the proposed system analysis and design used object oriented methodology using UML and Ms Visio2003. This approach has been used since:

- ✓ It increases the reusability and modification
- ✓ It's easy and understandable.
- ✓ It is fast system developing approach that is ideal to be carried out.
- ✓ Allows developments of information system with complex interaction
- ✓ Allows to discover all objects of the new system by starting from visible and physical objects

3.5.1. Analysis Tools

The tools that used to analyze the requirement were: use case diagram, sequence diagram, state chart diagram and activity diagrams the input data elements also analyzed by using tables. The tools ware selected depending how much they illustrate the interaction of the system and user.

3.5.2. Design Tools

To design the proposed system the techniques used were system architecture design, detailed class diagram design, database design, system flow diagram and user interface prototype design.

3.6. Method of Dissemination of Results

The result of the project was disseminated by using non-formal report and formal report to the Harari Regional Health Bureau and the University of Addis Ababa School of Information science and School of Public Health, Health Informatics Program.

3.7. Ethical Consideration

The project has been carried out after getting ethical clearance from Institution Review Board (IRB) of the Addis Ababa University School of Medicine through the School of Public Health. Data collection permission was written from Harari Regional Health Bureau. Information sheet and consent forms were delivered along each interview and all interviewee were asked if they were willing to participate. During the data collection the importance of obtaining verbal consent and respecting their right to respond or not to respond to any part of the survey check list were considered, and ensuring the respondents privacy and confidentiality were emphasized.

3.8. Operational Definition

1. **IDSR** is an approach adapted to strengthen national disease surveillance systems by coordinating and streamlining all surveillance activities and ensuring timely provision of surveillance data to all disease prevention and control programs.
2. **Confirmed case** Patient who has a positive thin or thick blood film for Plasmodium parasite as examined by experienced laboratory technician.
3. **Epidemic Detection** Immediate notification of increase of cases number based on monitoring chart.
4. **Epidemic mitigation** is analysis for selection of epidemic prevention and control measures.
5. **IRS** is the application of long-acting chemical insecticides on the walls and roofs of all houses and domestic animal shelters in a given area, in order to kill adult vector mosquitoes that land and rest on these surfaces.
6. **Threshold** is previous year malaria case numbers by week and village code or name.
7. **Norm Chart** Malaria case monitoring chart.

8. **IDSR** reporter Health professionals who work on integrated disease surveillance and reporting at health institution.
9. **Case** A definition or an instance of a potential or confirmed malaria disease or illness.
10. **EASTWeb** is predictive systems developed in the Amhara Regional state for early warning of malaria epidemics.

4. DISCUSSION OF RESULTS

4.1. Existing Malaria Prevention and Control System

In Ethiopia, according to National Malaria Guidelines currently, malaria epidemic prevention and control includes; case reporting, epidemic forecasting and early warning, epidemic preparedness, epidemic prevention and epidemic detection and mitigation.

4.1.1. Reporting System

Regarding reporting formats, routine data generated from the services were reported to woreda health supervisors and Regional Health Bureau (RHB) by health centers and hospitals respectively using IDSR reporting form (14).

Within Harari Regional State, the reports are from health posts, health center, woreda health supervisor directly to RHB. The Regional Health Bureau, which is geographically about maximum radius of 10km of all health posts and health centers, serve as center for passive and active malaria surveillance report, epidemic detection and mitigation.

4.1.2. Epidemic Detection

Two methods of epidemic detections are described in the national malaria guidelines. “Method 1 is the classic method based on norm charts and thresholds. This is currently recommended. Method 2 (cluster mapping) will be tested and gradually introduced (14)”.

In strict sense, an epidemic of malaria is defined as a situation when the number of malaria cases is in excess of the normal number at specific period and time. Therefore the “normal” expected number has to be estimated. One way to do this is by using past weekly data of up to five previous years to construct a third quartile (second largest number) threshold line in an epidemic monitoring chart (14)”. In practice, health staff may not have this information for current or previous time and they simply collect data and report to the next highest level the evidence of case build up, the apparent population and areas affected and the status of remaining malaria treatment supplies.

“An epidemic starts when the number of cases in a given week is higher than the threshold number and continuous while the case numbers per week stay above the threshold for that week. An epidemic may last only one week or several weeks and there may be more than one epidemic in a year in the same place (14)”.

4.1.3. Indoor Residual Spraying (IRS)

According to Ethiopia National Malaria Guide line 2012, “IRS is the application of long acting chemical insecticides on the walls and roofs of all houses and domestic animal shelters in a given area, in order to kill adult vector mosquitoes that land and rest on these surfaces. IRS is one of the primary vector control interventions for reducing and interrupting malaria transmission, and one of the most effective methods for obtaining rapid large-scale impact on both vector populations and malaria morbidity/mortality (14)”

Within Harari Region Indoor Residual Spray operation uses DDT as long acting chemical insecticides in three rural woreda of the region Erer, Sofi and Dire Teyara. Most of the sprayable kebeles within the Region sprayed twice a year. The Regional Health Bureau malaria focal person is responsible for organizing and launching IRS operation.

4.1.4. Problems with the Current System

a. Invisibility of records

During the interview made, it was found that the registers and tally sheets have created problems because the hand write of some health providers was difficult to read and understand by other users of the data. This led to report incorrect information. According to the HMIS focal person of the Jugal Hospital the IDSR reporting forms have repeatable data content difficult to be filled by laboratory department. Unreadability of the hand write of the health workers using the manual recording and reporting system is creating a problem.

b. Producing incomplete and outdated data

The process of filling data takes time and health workers can get bored to complete the manual records and ISDR reporting form sheet. This problem was elaborated by the respondents from Regional Health Bureau as follows:

This situation also leads to incomplete and incorrect, prevention and control measures. The other challenge we are facing is delivering of outdated report since the health workers did not fill the IDSR report form timely.

4.2. Requirement Specification and Analysis

Requirement specification and analysis are the primary steps of Object Oriented Analysis Design (OOAD) system development which deals with investigation of the problem and the requirements or domain objects of the system. To describe the requirements one of the UML artifacts (Use Cases); that is, common models in OOAD were used. In this study requirement analysis/OOA is concerned with the creation of the domain from the perspective of objects. There is an identification of the concepts, attributes, and associations as well as modeling the noteworthy domain concepts or objects with and UML modeling diagram (26).

In any system, it is necessary to mention the systems behavior, functionality and constraints, and all these are referred to as requirements. The term requirement could be described as a user need or a necessary feature, function or attribute of a system that can be sensed from a position external to that system or as a statement of a system service or constraint (26).

Requirements include both the functional requirements and non-functional requirements. Functional requirements (behavioral requirements) define what the system does, namely, the functions (actions) of the system. They describe all the inputs and outputs to and from the system as well as information concerning how the inputs and outputs are interrelated (27). Non-functional requirements, on the other hand, define the quality of the system. They include the description of the system's usability, reliability, performance, security, maintainability, portability, implementation, interface, operations, packaging and legal obligations (28). Therefore, in this study the requirements used to determine the system were specified since computerized malaria prevention and control information system can be developed to address different goals and settings, and consequently emerge with different functions and capabilities.

4.2.1. Functional Requirements

A) Register basic demographic and parasitological/diagnostic test result of malaria case information.

This refers to patient-related information which includes patient identification information and diagnosis based on the indicators. The system is capable to: Collect, organize and display essential demographic and diagnostic malaria case information such as: age, gender, address including phone address and house number. Malaria case classification like: severe, complicated, non complicated parasitological diagnosis falciparum, vivax or mixed falciparum or others clinical data inpatient and outpatient, description of whether new or repeated case, sender data detail for confirmation purpose, treatment and treatment outcome. The user can also generate report, update, delete and search malaria case information.

Generate periodic and aggregate report as of national malaria prevention and control information need, like; weekly and monthly case report, spray coverage report, net distribution coverage

report and generate aggregate reports for submission to the Ministry of Health and other stakeholders.

B) Detect and register epidemic

One advantage of malaria prevention and control information system is to improve use of surveillance data for immediate action. To support this function, the system is required to: Analyze threshold from weekly received malaria surveillance data to support prevention and control actions.

C) Support ITNs monitoring by registering its distribution detail.
To document and then report ITNs Distribution data to Regional Health Bureau Woreda health supervisor records receivers detail like Name, house number, village code and family size along with ITNs identification information like serial number, produced date. The data recorded then help to drive information like ITNs coverage in terms of currently distributed, survived from previous year etc.

D) IRS Monitoring

To support this function the system should provide spray operations component as part of the malaria prevention and control information system to allow for routine monitoring and historical exploration of indoor residual spray activities.

4.2.2. Non Functional Requirement

Non functional requirement mean quality of the new system that are not directly related to the functionality of the new system and the following are the main non functional requirements of the system.

A, User Interface and Human Factor

Users are communicating with the system through the application interface which is easy to use by health workers. To user satisfaction and usability of the system, attractive user interface with data input mask, fixed drop dawn list should be used. This will minimize the time needed for users to adapt to use the system. There will be also interfaces and menus for each function provided by the system to easily navigate from one point to the other.

B, Performance characteristics

Nowadays, there is high need of timely quality malaria surveillance information within malaria prevention and control for information based action. The system data processing speed should be enough for this purpose. Since the system should be automated with taking into consideration these needs.

C, Security issues

To protect data from unauthorized access and use, the system should provide restriction in using the functionality and information right to use by user, i.e. the system should use role based authorization technique while user access the data.

D, Scalability

The malaria prevention and control involves activities that interact with different works in health care so the system should be scalable, to support the integration and deployment in large healthcare environments. It should be simple to add services or integrate with other systems. It should expose functionalities for user health worker, such as getting list of notifications and authentication as a web service so that they can use a system as part of another system.

4.2.3. Requirement Modeling

To model the requirements of the malaria prevention and control information system, use case diagram, sequence diagram, state chart diagram, activity diagram and domain model diagram ware used.

A) Actors of the System

Actors are the users of the system (who perform action using the system); in case of this study, they are four groups of Actors including system administrator. IDSR report owner at health institution level, malaria focal person at Regional Health Bureau level and health supervisor at Woreda Administration level use the system to add malaria cases on line, add spray and safety net distribution data, register epidemic and then send confirmation and epidemic notification through a web based malaria prevention and control information system.

Administrator is one type of user of the system and is basically set to administer the system and register the health workers and health institution (Hospitals, Health Centers and Health Posts) as a user of the system. System administrator at Regional Health Bureau could then be able to register health professionals working on malaria prevention and control as member of the users. The actual notification task is carried out between actors and other stake holders for confirmation and communication purposes.

Table 1: The HRHBMPCIS Actors and their description

S.N	Actor Name	Description
1	Administrator	Performs all administrative related tasks. It makes inactive, modify, delete, approve etc

2	Health institutions IDSR reporter	A health professional at health institution who is recognized by Regional Health Bureau as surveillance data reporter.
3	Malaria focal person	A Regional Health Bureau worker who is responsible to coordinate malaria prevention and control activities. Performs activities like detect and confirm epidemic, send epidemic notification. Add spray and safety net distribution to the record.
4	Health supervisor	A Health professional authorized by Regional Health Bureau at woreda level and woreda health supervisor or woreda health expert. Those responsible to receive notification and fill safety net distribution data?

B) Use Case Modeling

For better understanding of the requirements of the system, use case modeling is being used. This model represents the requirements in user-centric approach in order to describe all the tasks that the users (actors) will need to perform with the system (28). By definition use case is a description of sequences of actions or what the system does independent of how does it. Fig 1 shows use case diagram of HRHBMPCIS.

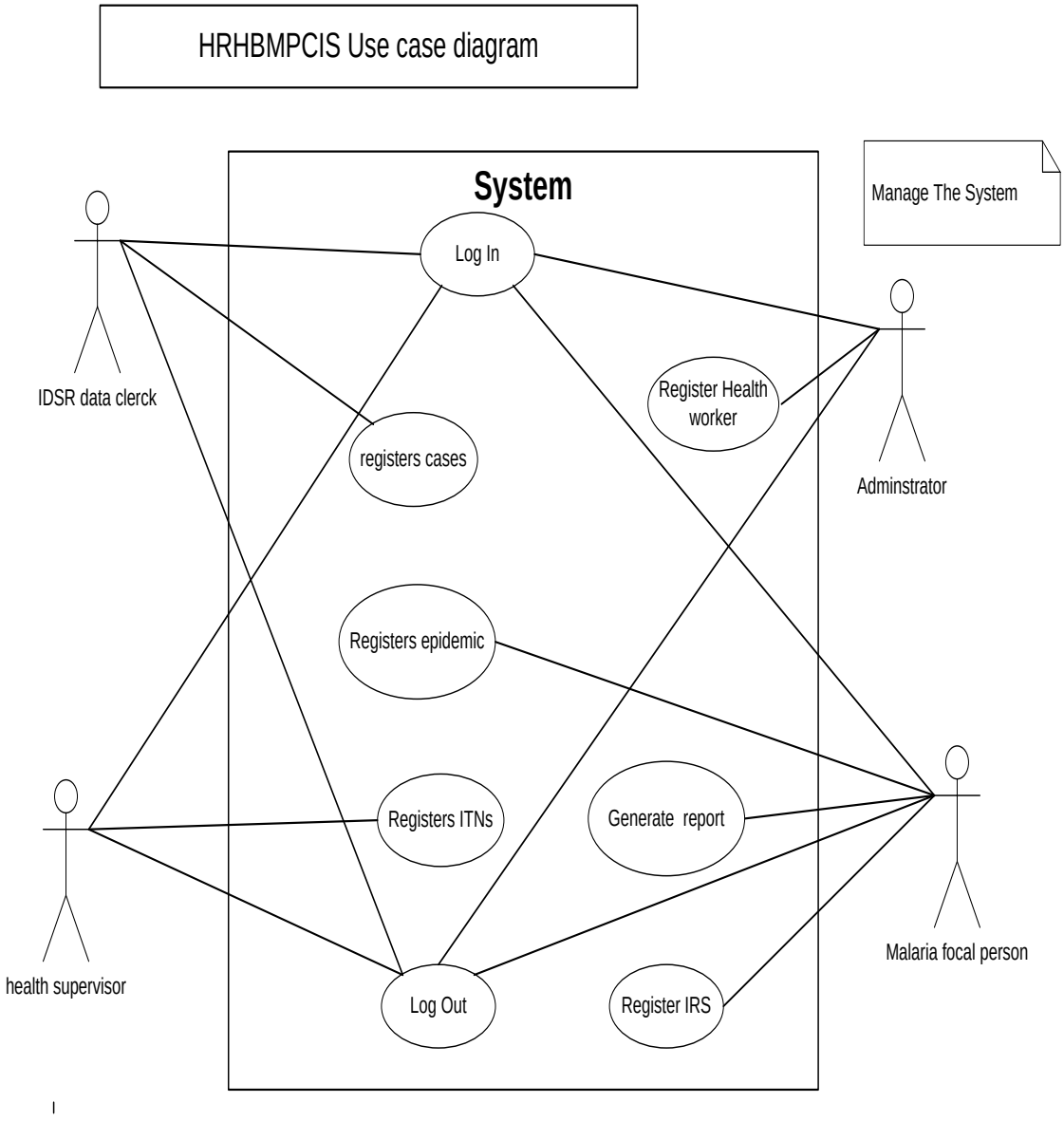

Fig 1 UML use case diagram of HRHBMPCIS

C) Use case detail description

While modeling a use case it is also important to describe the flow of actions represented by the use case diagram. Detail descriptions of each use case's name, actors, pre-conditions, flow of events and post conditions are presented below.

Table 2 Log in detail description of HRHBMPCIS

Use Case ID	UC01
Use Case Name	Authenticate and log in user
Use Case Description	Health worker having different responsibility login with respective user name and password
Primary Actor(s)	Users
Pre-Conditions	The users have authorized user name and password given by Regional Health Bureau.
Post-Conditions	The user logged in to the system
Basic Scenario	1. The use case starts when user clicks on log in button on start menu. 2. The system displays login user interface. 3. The user inters user name and password then click on log in 4. The system verifies username, password and his department (role). 5. The use case ends.
Frequency of Use	35
Special Conditions	None

Table 3 Register health worker use case detail description of HRHBMPCIS

Use Case ID	UC02
Use Case Name	Register Health worker
Use Case Description	Administrator register authorized health workers as system users
Primary Actor(s)	Administrator
Pre-Conditions	Administrator logged in
Post-Conditions	The health professional working on malaria prevention and control registered in the system as users.
Basic Scenario	5. Administrator click on user register role option user interface 6. The system display register user form 7. Administrator fill user detail and click save 8. The system display user account detail 9. The use case ends
Alternative Scenario	No
Frequency of Use	2-3 per week
Special Conditions	None

Table 4 Register malaria cases use case detail description of HRHBMPCIS

Use Case ID	UC03
Use Case Name	Register malaria cases
Use Case Description	IDSR report owner register malaria cases detail routinely at health institution
Primary Actor(s)	IDSR report owner
Pre-Conditions	Login to the system
Post-Conditions	Malaria cases detail registered in the database.
Basic Scenario	1. The use case starts when the IDSR report owner click on Register new case 2. The system displays case register main form 3. If the user clicks on Add button from the main form (Alt 3.1) 4. The system displays malaria case information detail form 5. The user fills: Facility identification number, Age, Address, clinical diagnosis, parasitological diagnosis, treatment approach and click add 6. The system checks if the case is not already registered 7. Use case end
Alternative Scenario	Update case 1. The use case starts when the IDSR report owner click on Register new case 2. The system displays case form 3. If the user clicks on update button from the main form 4. The system displays Update form 5. The user fills: Facility identification number, Age, Address, clinical diagnosis, parasitological diagnosis, treatment approach and click update. 6. The system checks if the case is not already registered (Alt 6.1) 7. Use case end
Frequency of Use	35 times per day
Special Conditions	Non

Table 5 Register epidemic use case detail description of HRHBMPCIS

Use Case ID	UC04
Use Case Name	Register Epidemic
Use Case Description	Malaria focal person record epidemic detection information
Primary Actor(s)	Malaria focal person
Pre-Conditions	Malaria focal person logged in
Post-Conditions	epidemic detection information is being registered in the system
Basic Scenario	1. The user clicks on detect epidemic from the main form 2. The system displays epidemic detection form/norm chart 3. The user click on Add button of the epidemic detection form 4. System displays epidemic detail form 5. User record cases facility/locality code, thresholds, case count and click add 6. Use case end
Alternative Scenario	No
Frequency of Use	10 times per day
Special Conditions	None

Table 6 Register IRS use case detail description of HRHBMPCIS

Use Case ID	UC05
Use Case Name	Register IRS
Use Case Description	Malaria focal person registers results of the spray campaigns
Primary Actor(s)	Malaria focal person
Pre-Conditions	Malaria focal person logged in
Post-Conditions	IRS operation data registered in the system
Basic Scenario	1. The user clicks on IRS monitoring 2. The system displays IRS monitoring form 3. The user add spray monitoring information and click add 4. The system request for confirmation 5. The user click on confirm 6. The system registers the spray information along with user personal description. 7. Use case end.
Alternative Scenario	No
Frequency of Use	20 times per day
Special Conditions	None

Table 7 Register ITNs use case detail description of HRHBMPCIS

Use Case ID	UC06
Use Case Name	Register ITNs
Use Case Description	Health supervisor registers ITNs distribution performed
Primary Actor(s)	Health supervisors
Pre-Conditions	Health supervisor logged in to the system
Post-Conditions	ITNs distribution data registered in the system
Basic Scenario	1. User click on ITNs distribution from the main form 2. The system displays the safety net distribution data 3. User clicks on add button 4. The system displays safety net distribution registering data detail form 5. User fill Bach number, locality name, village name, family owner name, date, shelf life and click add 6. The system requests the user for confirmation. 7. The user click on confirm 6. The system registers the information in the database along with user log in personal detail.
Alternative Scenario	No
Frequency of Use	400 per day
Special Conditions	None

Table 8 Generate report use case detail description of HRHBMPCIS

Use Case ID	UC07
Use Case Name	Generate Report
Use Case Description	The system generates report from the already available malaria prevention and control information in the database.
Primary Actor(s)	Malaria focal person
Pre-Conditions	Malaria focal person login to the system
Post-Conditions	Report printed or saved.
Basic Scenario	1. The user click on Report button from the MPCIS main form 2. The system display report list option form. 3. The user select from the report option. 2. System generates respective report. 3. User click on save or print 4. System saves or prints the report 5. Use case end
Alternative Scenario	No
Frequency of Use	3 per day
Special Conditions	None

Table 9 Logout use case detail description of HRHBMPCIS

Use Case ID	UC08
Use Case Name	Log out
Use Case Description	Lets users log out of the system
Primary Actor(s)	User health workers within malaria prevention and control
Pre-Conditions	A user is logged into the system
Post-Conditions	The user is logged out of the system.
Basic Scenario	1. The use case begins when user indicates s/he wants to log out by clicking on logout button. 2. The system displays log in menu.
Frequency of Use	50 times per day
Special Conditions	None

D) Sequence Diagram

UML sequence diagrams model the flow of logic within the information system being developed in a visual manner, enabling both to document and validate the system logic, and are commonly used for both analysis and design purposes. It is a common notation to illustrate collaborations among objects and shows the flow of messages between objects. The following section depicts system sequence diagram for malaria prevention and control information system.

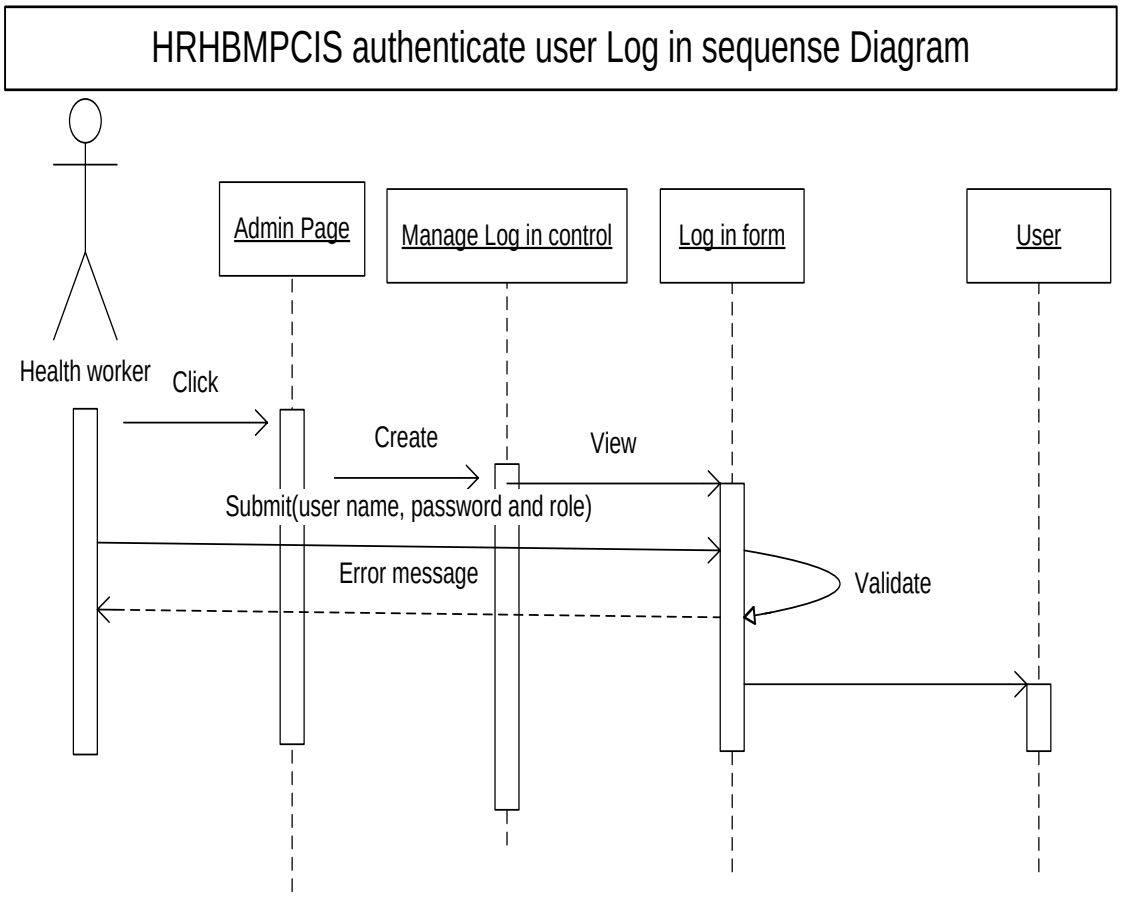

Fig 2: UML Sequence diagram for log in HRHBMPCIS

E) Data elements of the HRHBMPCIS

As mentioned in the requirement specification part of the system, it is responsible for four basic functions namely holding malaria case records, reporting data, epidemic detection and holding prevention and control activities spray and net distribution data. Depending on the observation and document analysis made on existing manual system the data elements shown as follows.

Table 10 Summary of data elements for malaria case registration, Harari Regional Health Bureau

Demographic/Identification Information							Case diagnosis				Rx
MRN	Name	Age	Sex	Woreda / kebele	Village	House Number	Clinical diagnosis		Parasitological diagnosis		
							Outpatient	Inpatient	Test	Parasite	

Table 11 Summary of data elements for weekly report forms for outpatient and inpatient malaria cases and deaths, Harari Regional Health Bureau

Identification information								Sender information		Malaria cases information															
H/facility	Region	Woreda	Village	Start and end of week date	name	telephone	E-mail	Inpatient								Out patient									
								<5 years				>5 years				<5 years				>5 years			
								case		Death		Case		Death		case		Death		Case		death	
								PF	NF	NF	NF	PF	NF	PF	NF	PF	NF	PF	NF	PF	NF	PF	NF	PF	NF

Table 12 Summary of data elements for spray monitoring, Harari Regional Health Bureau

Identification information			Spray operation information			Insect sides information	
Sp ID	Spray location	Village ID	Number of Operators	Operation duration start and end date	Structures to be sprayed	Name	Previous history

Table13. Summary of data elements for safety net distribution record, Harari Regional Health Bureau

Bach number	Locality name	Village name	Receiver name and house number	Shelf life	Given date

E. Domain /Conceptual Modeling

Domain model, also called conceptual models, is the integrated view of all data in an enterprise, and bridges the gap between the data organization as viewed by the DBMS (physical data model) and by individual user applications (logical data model) . To represent this model there are different available methodologies such as entity-relation diagramming, fact-oriented modeling, knowledge bases of logical rules, and object-oriented analysis (26). The object-oriented analysis was chosen as the methodology for creating the conceptual model for the HRHBMPCIS. This technique use domain classes which illustrates important concepts in a real world domain of the data handling system independent of software perspectives. The detail is presented in Figure bellow.

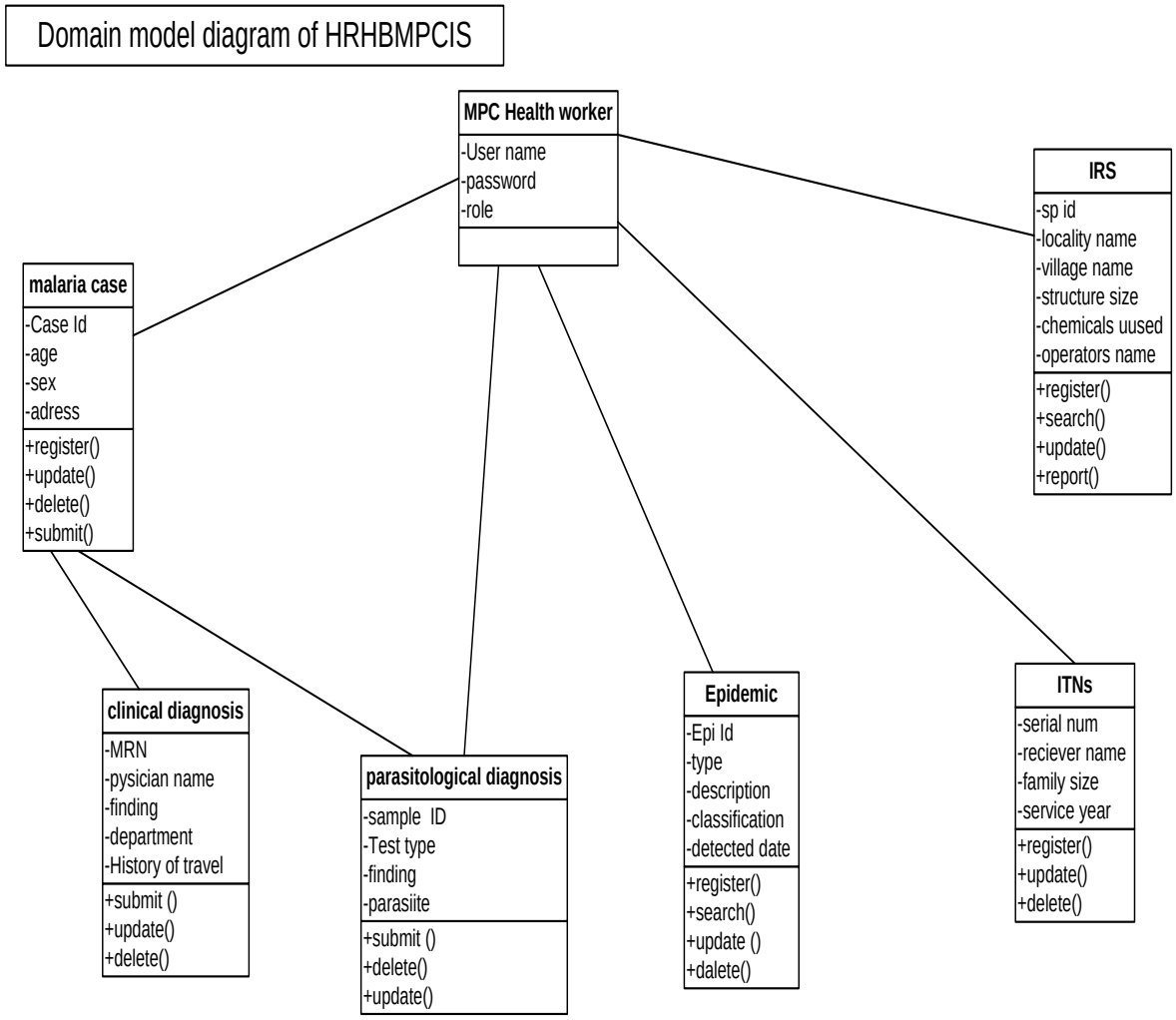

Fig 3 Domain model of HRHBMPCIS

As demonstrated in figure 3, the domain modeling shows the objects of the Malaria prevention and control information system of the Harari Regional Health Bureau. There are seven objects that are interacting in the HRB malaria prevention and control system, (i) to capture demographic and expresses information about the objects Malaria case, epidemic, ITNs, IRS and health workers, (ii) to capture parasitological diagnosis of cases, (iii) to capture clinical diagnosis where laboratory not available.

4.3. System Design

Once malaria prevention and control information system requirements are identified and analyzed, the next task was designing system architecture, detailed class diagram, database design and user interface prototype of the system.

A) System Architecture

In this project web based information system for prevention and control of malaria (MPCIS) was designed that said to facilitate data reporting, collection, acquisition, and access to information necessary for malaria prevention and control. An overall architecture of the system is shown in figure4.

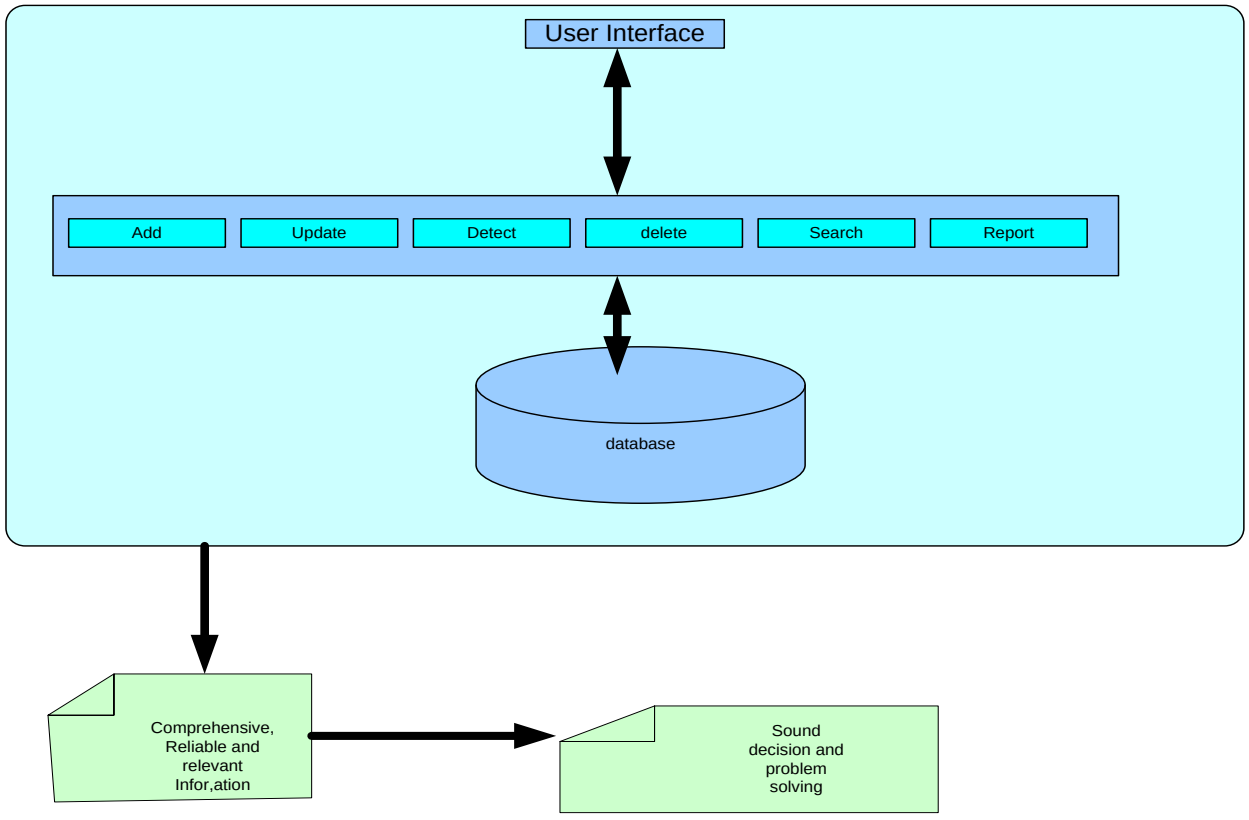

Fig 4: System Architecture of HRHBMPCIS

The user interface is the point where the user interacts with the system. It accepts queries from the database, the component that will record, store and manage malaria case, spray and safety net distribution data entered into the application through the user interface, generate report, send notification for health worker within malaria prevention and control and increase accuracy, time lines and accessibility of malaria related data within the region.

B) Class Diagram Design

The class diagram shows attributes and methods of the classes identified from the malaria prevention and control system. In contrast to the domain model that shows real-world classes, the design class diagram shows software classes. In this way, OO designs and languages can support a lower representational gap between the software components and our mental models of a domain that improves comprehension. As it is seen in figure 5 the class diagram represent clearly the classes and their attributes and methods.

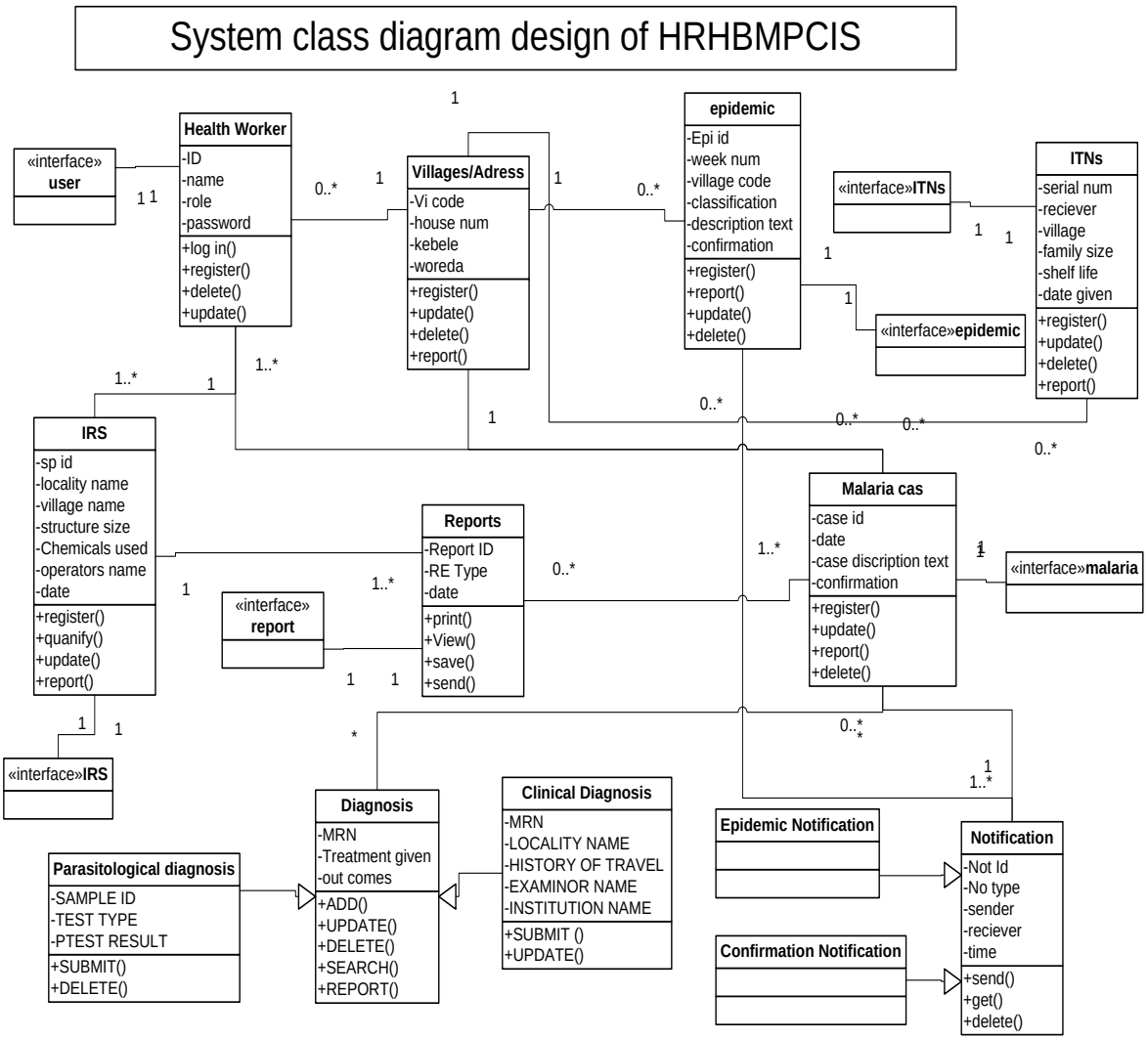

Fig 5 Class diagram design of HRHBMPCIS

C) Database Design

As in the relational database design, in object-oriented database design the physical database design or physical data model explores the internal schema of a database including data type with memory requirements specified, represent the data classes (tables), data attributes of those classes (fields), and the relationships between the classes in developing MPCIS for Harari Regional Health Bureau . The physical data model of HRHBMPCIS is depicted below.

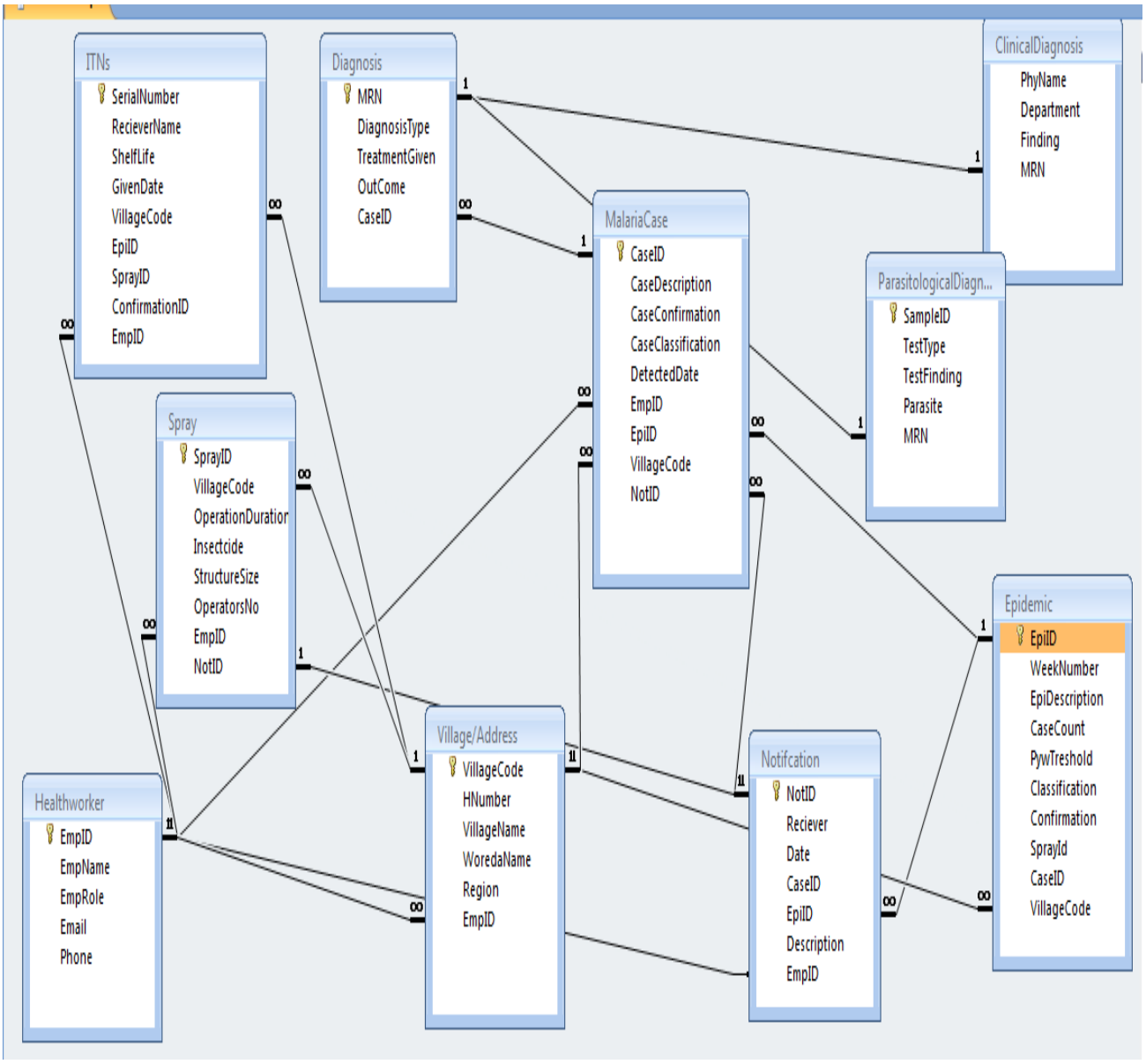

Fig 6 Database design of HRHBMPCIS

D) User Interface Design

User interface is part of the software that interacts with the user. It presents data and text on the screen and responds to the user keystrokes and mouse clicks (29). The design of the user interface is therefore critical to the success or failure of the system being implemented. In order to design effective user interface that match with the users, it is important to select appropriate user interface architecture. For such purpose there are two types of user interface architectures based on whether the application displays only a single window, a single document interface (SDI) or displays a primary window inside of which additional windows can be opened, a multiple document interface (MDI) (29). In this project SDI was employed to develop the HRHBMPCIS user interface prototype the flow of forms are displayed bellow by using system flow diagram.

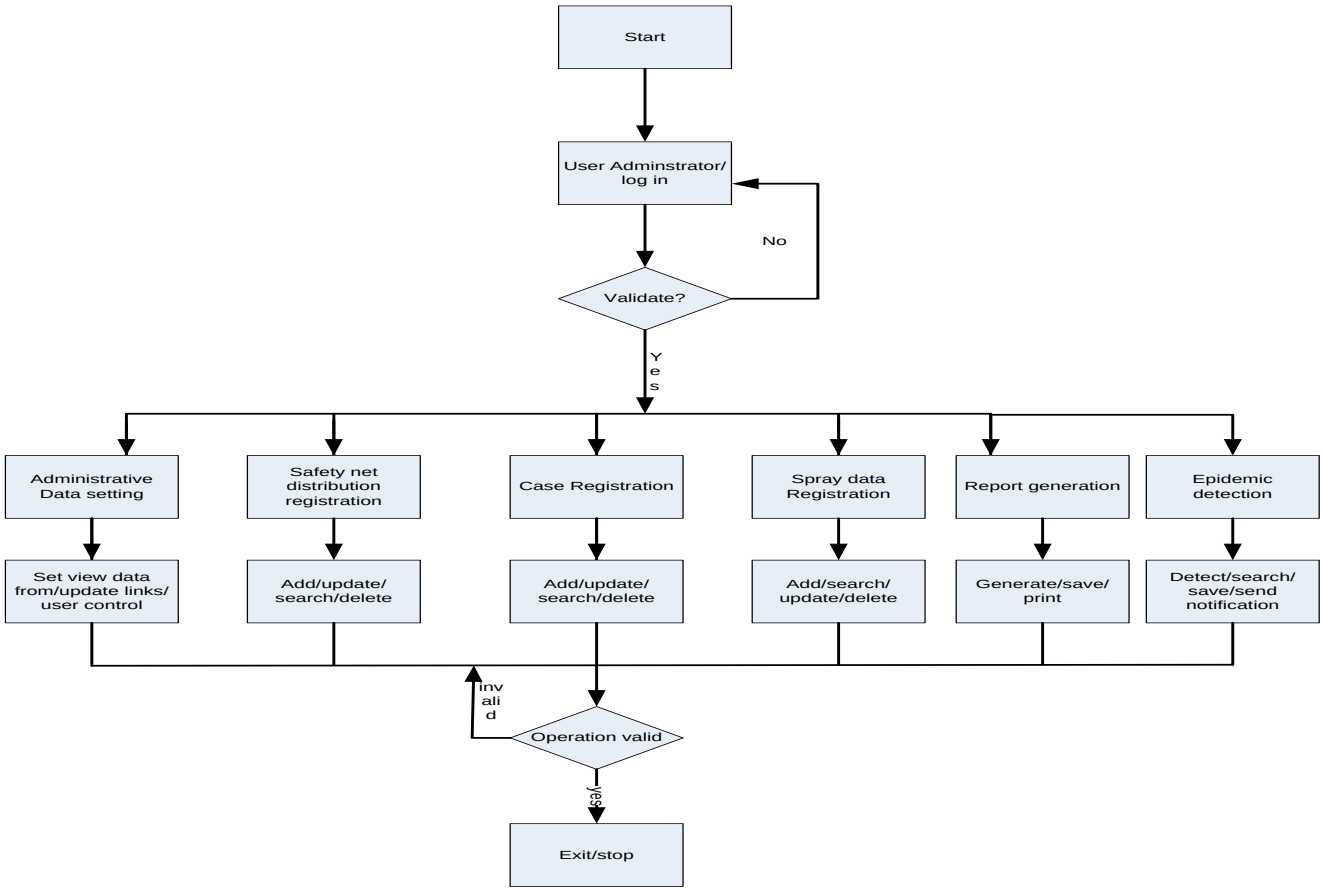

Fig 7 system flow diagram of HRHBMPCIS

5. CONCLUSION AND RECOMMENDATION

5.1. **Conclusion**

At National level including Harari Region malaria surveillance, prevention and control operational works are under manual procedures but, malaria passive surveillance (reporting from health institution), data storage, analysis, usage for epidemic detection and control can be computerized within application of information system developed based on national malaria prevention and control guidelines.

In the mean time information requirement of the malaria prevention and control was also identified. So Information related to the IDSR and malaria epidemic prevention and control like spray monitoring and net distribution was required. That is how the malaria prevention and control information system was analyzed and designed by using Object Oriented approach by focusing on the information needed by the malaria prevention and control unit of Harari Regional Health Bureau. It was also found that, to implement the functionality of generating aggregated report and notification the system should be networked.

5.2. **Recommendation**

As it was concluded, paper based malaria case reporting system from health institution and manual record handling at regional health bureau level (operation and action center) does not conform to malaria epidemic prevention and control. Different problem thought to exist with manual system, including invisibility of records, inaccessibility and difficulty to use reported and collected data for effective decision making. The following recommendation made for Harari Regional Health Bureau and future project implementers and researches in order to improve the current poor reporting, record handling and use practices.

- Addis Ababa University and Harari Regional Health Bureau should work on implementation phase of the project.
- Addis Ababa University should make proper arrangements for students to use this document as starting point for further study.
- Developers and students may use additional tools and techniques as well as other methods for the improvement and development of the system.
- Developers and students may use this document for further improvement and development of the system.

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ANNEXES

Annex 1

List of Sequence Diagrams

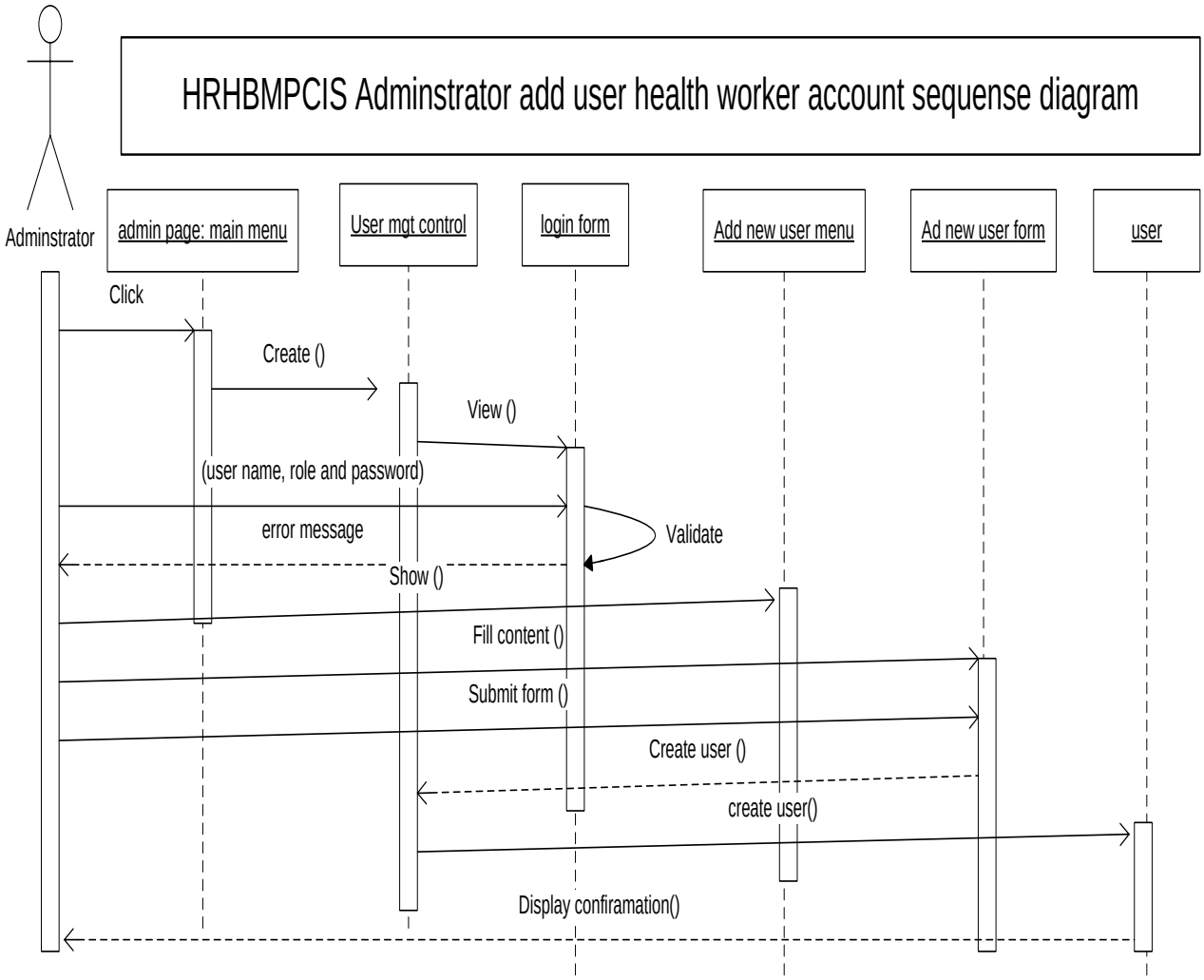


Fig1: sequence diagram for add user of HRHBMPCIS

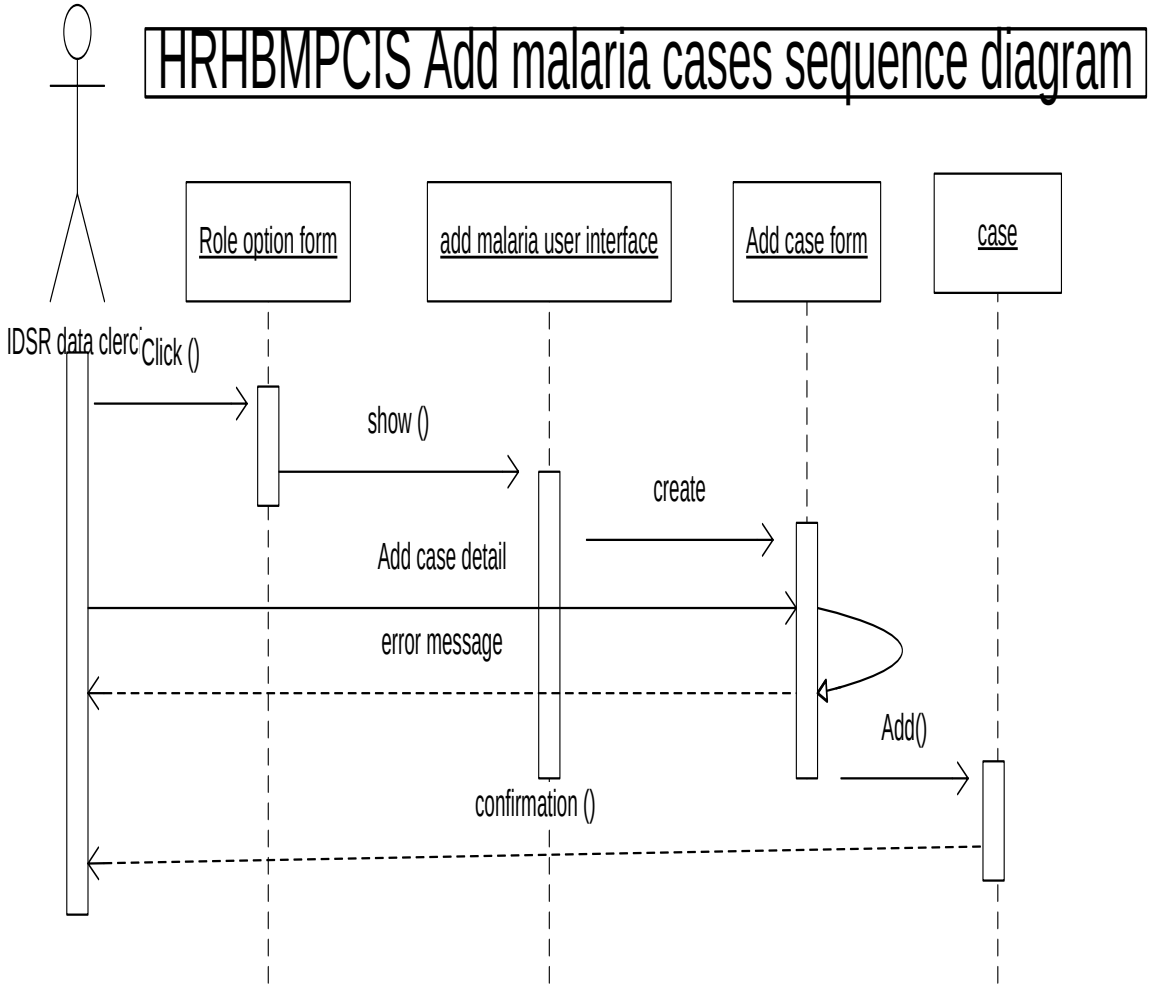


Fig 2: UML sequence diagram for Add malaria cases of HRHBMPCIS

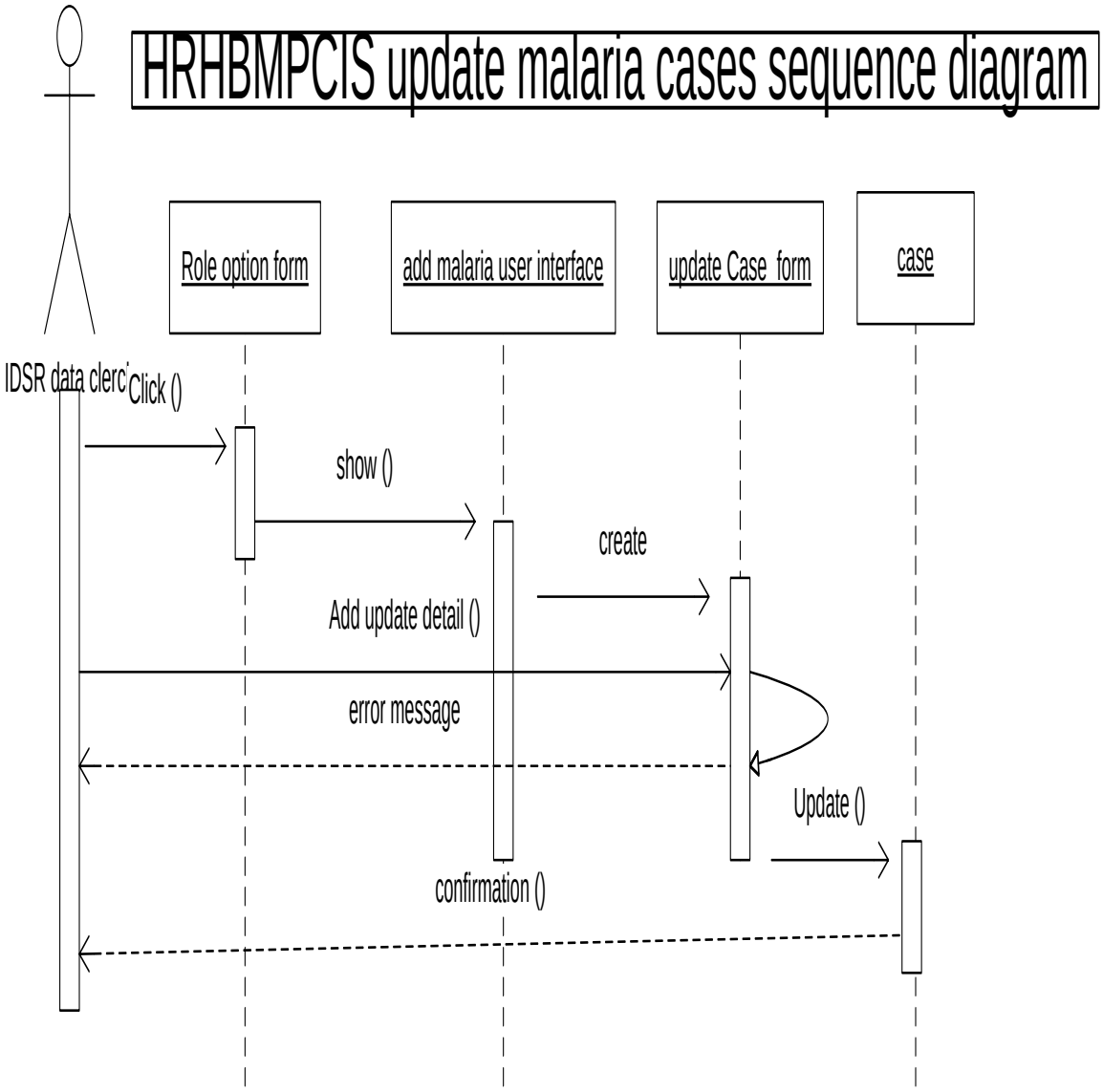


Fig 3: UML sequence diagram for update malaria cases of HRHBMPCIS

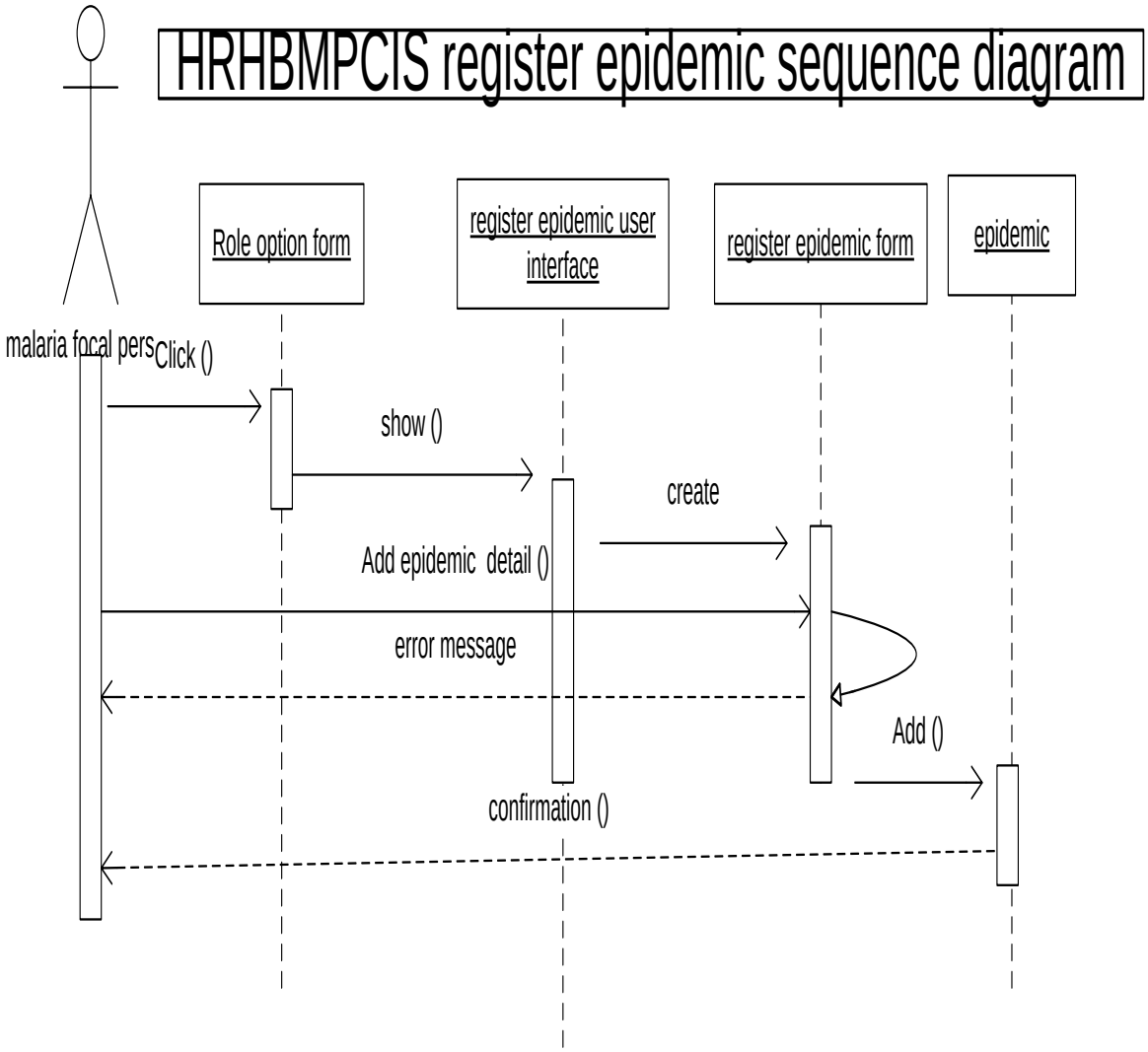


Fig 4: UML sequence diagram for register epidemic of HRHBMPCIS

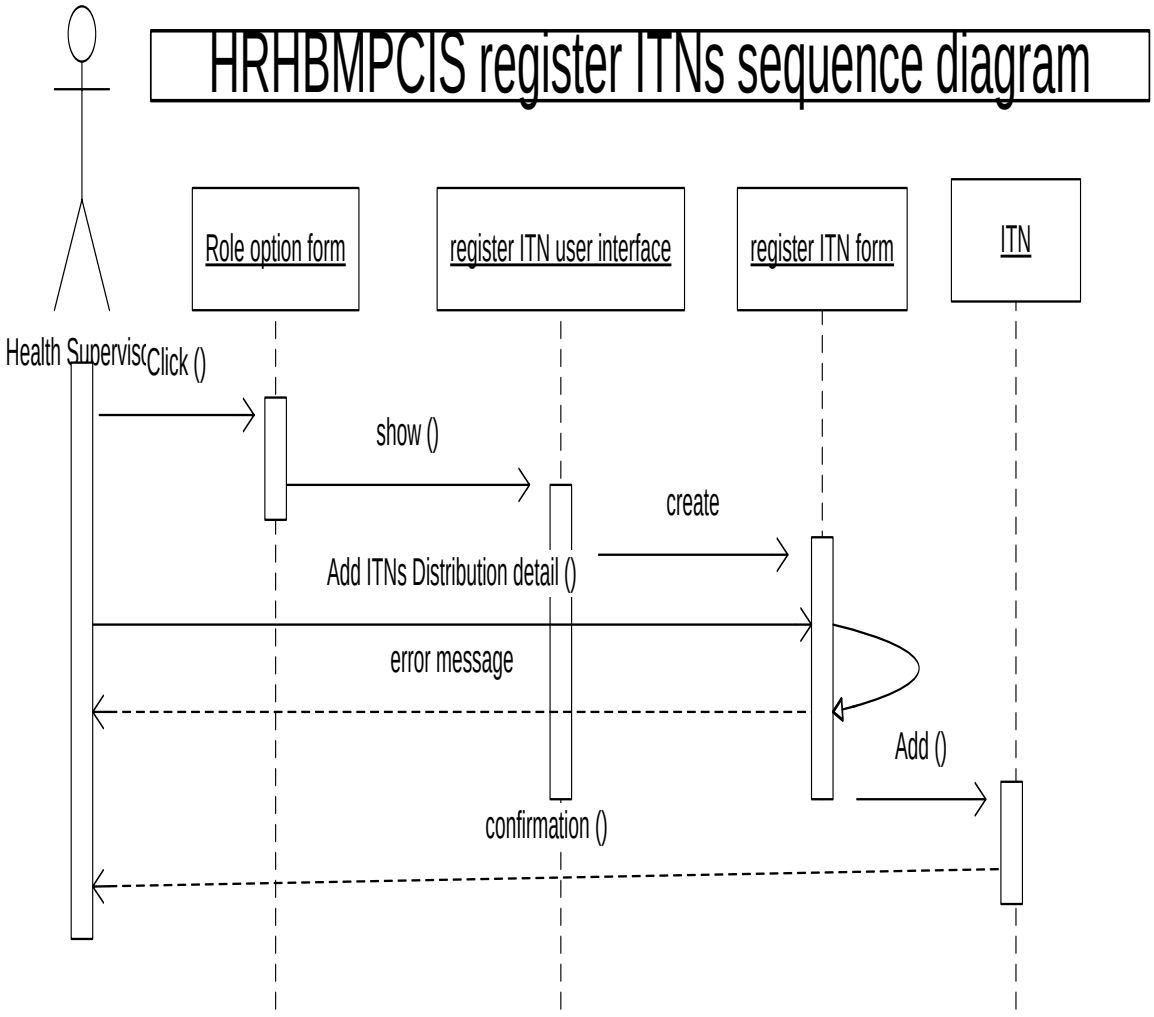


Fig 5: UML sequence diagram for register ITNs of HRHBMPCIS

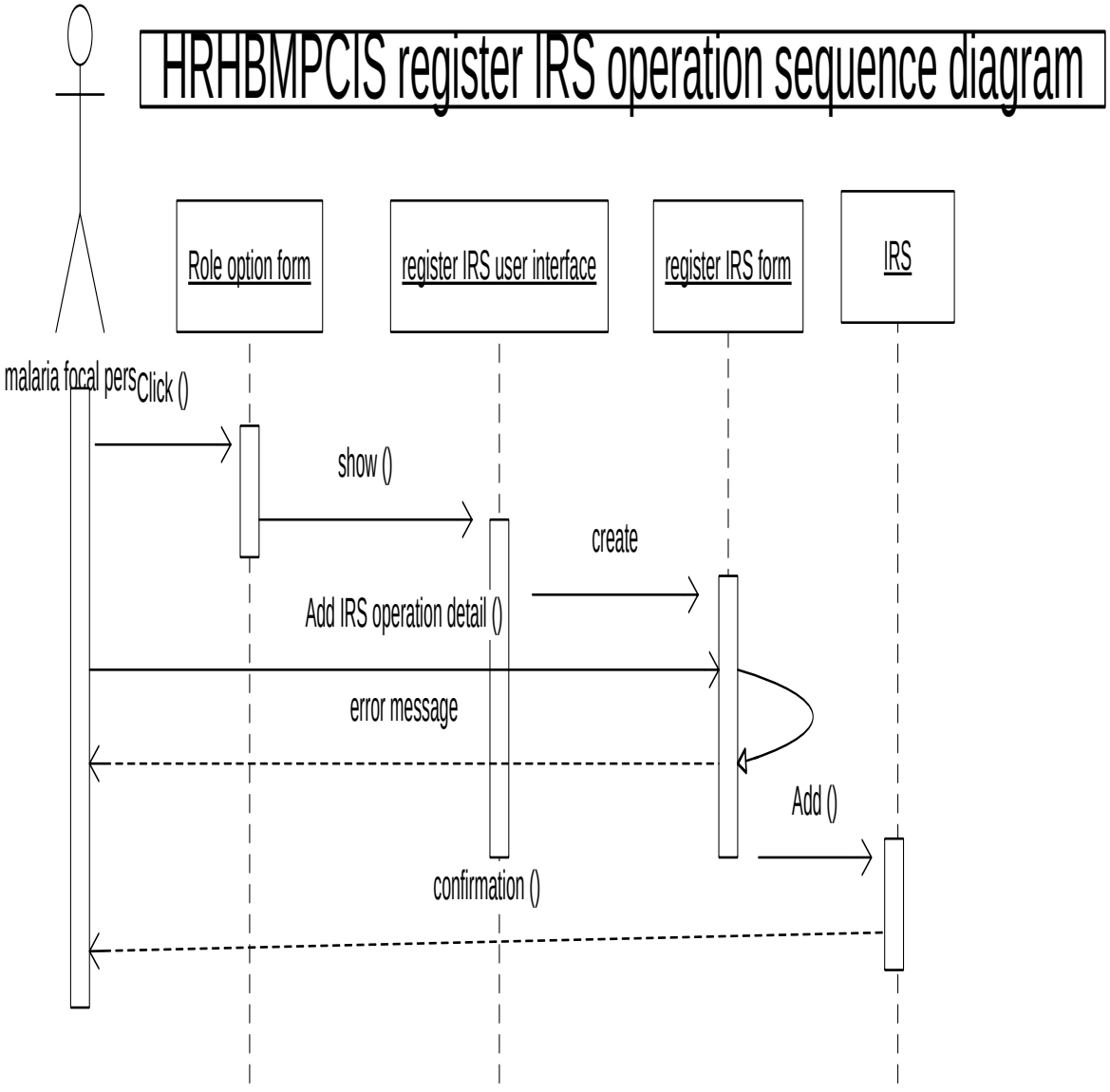


Fig 6: UML sequence diagram for register IRS data of HRHBMPCIS

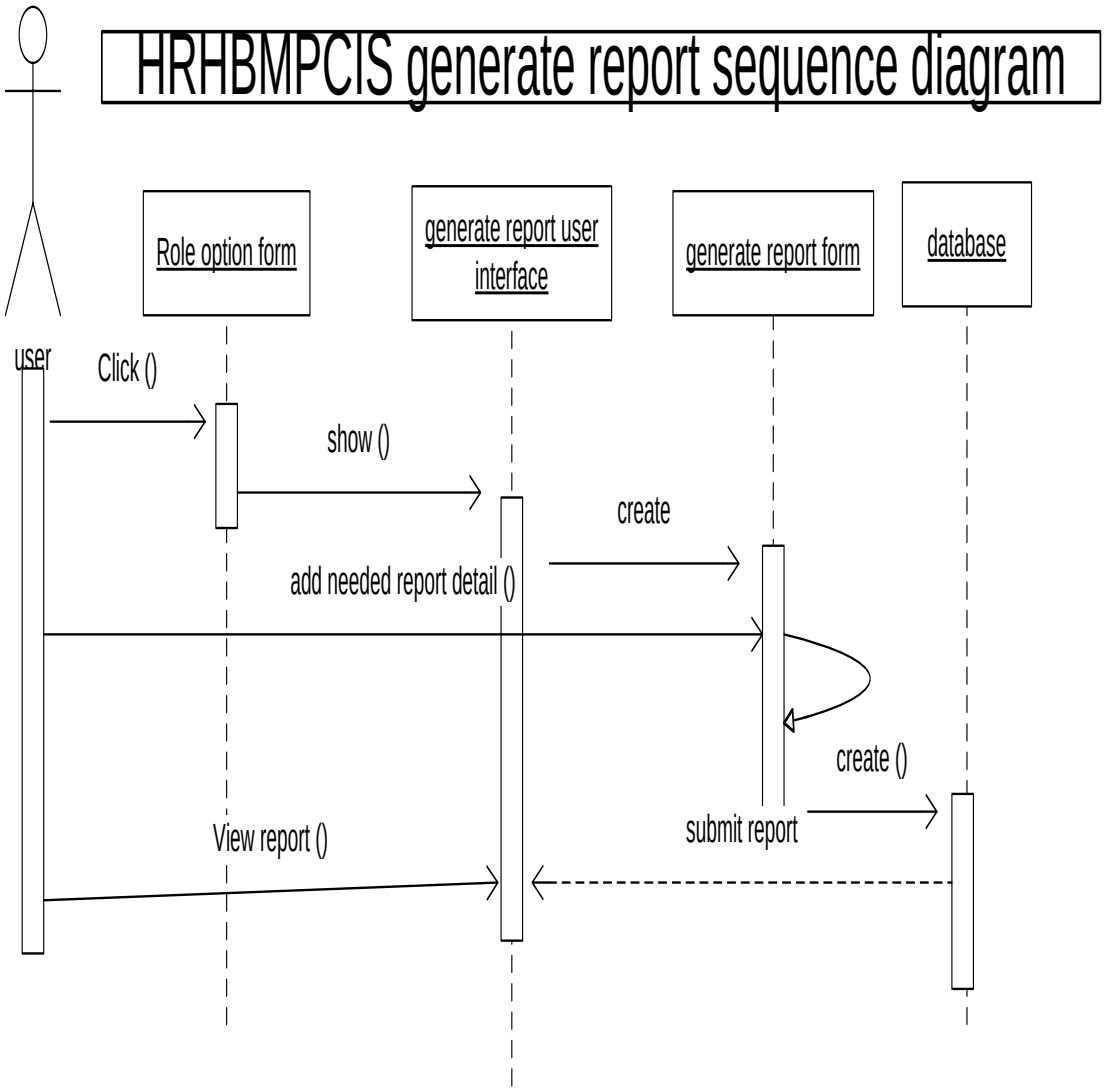


Fig 7: UML sequence diagram for generate report of HRHBMPCIS

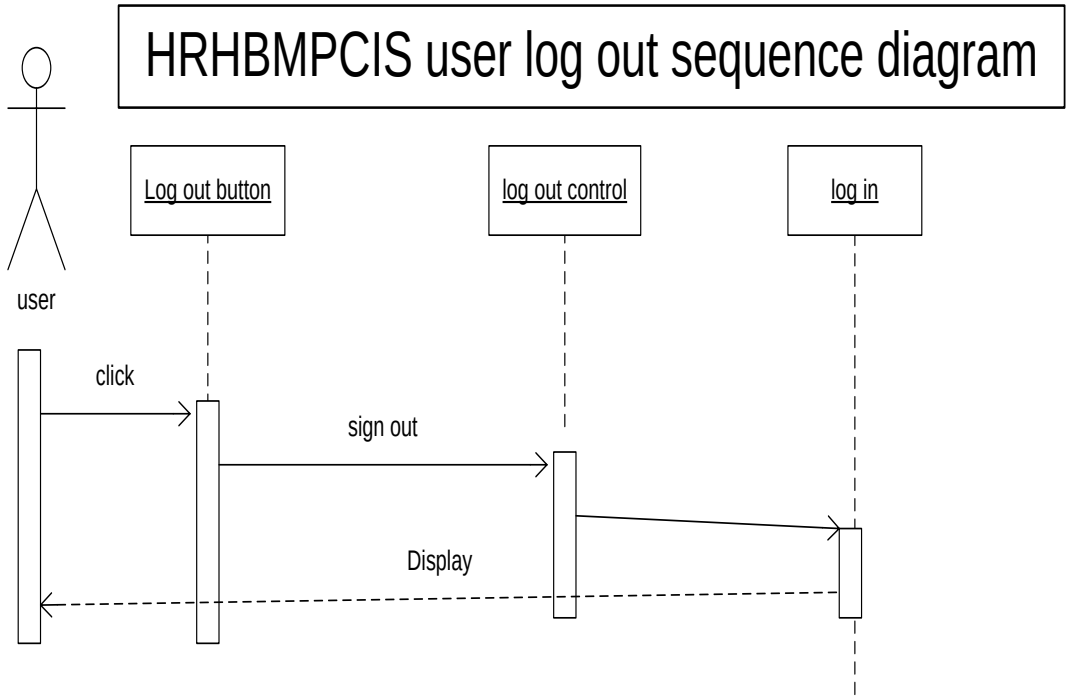
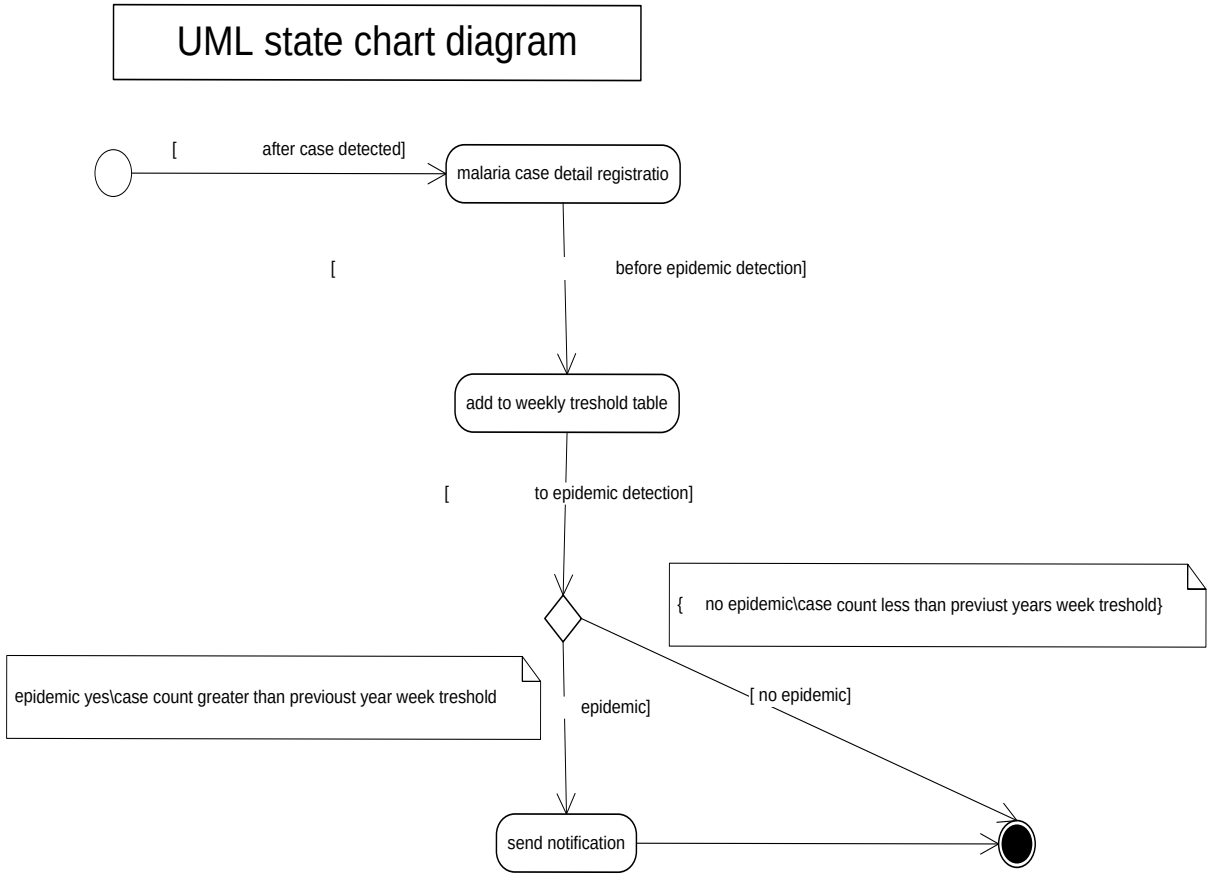


Fig 8: UML sequence diagram for user log out of HRHBMPCIS

Annex 2

UML State chart Diagram

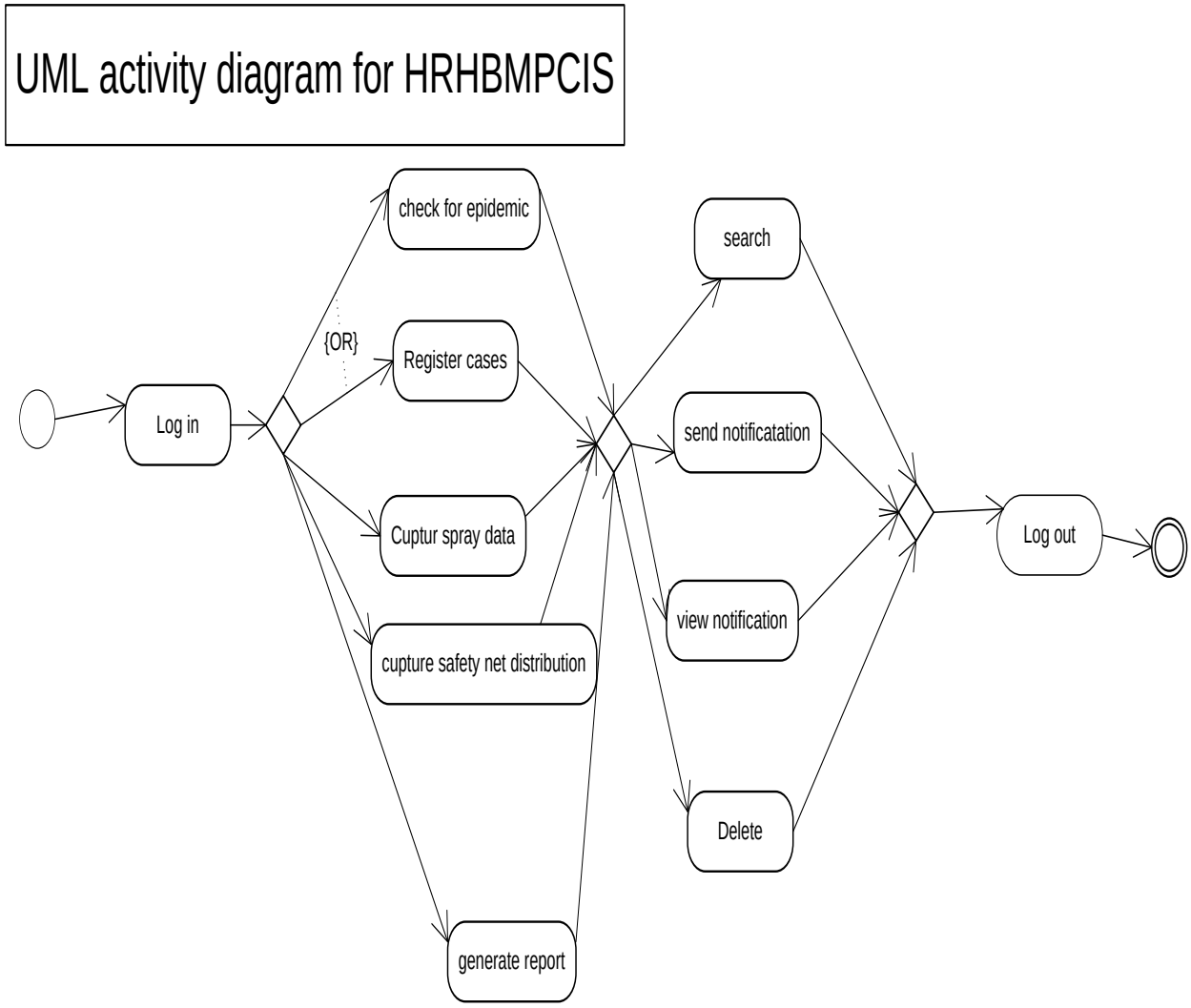
UML state chart diagram describes how an object changes its state that governs its behavior in response to stimuli from the environment.



Annex 3

UML Activity Diagram

UML Activity diagram shows the workflow using stepwise activities and actions which has beginning and ending events. It shows the interaction among business processes and a procedural flow of process which supports parallel behavior for multithreaded programming. It also used to model the flow of the system and convey what is happening inside a use case or inside a class through activity description.



Annex 4

List of Database Tables

Table 1: Village or Address table With its Attributes

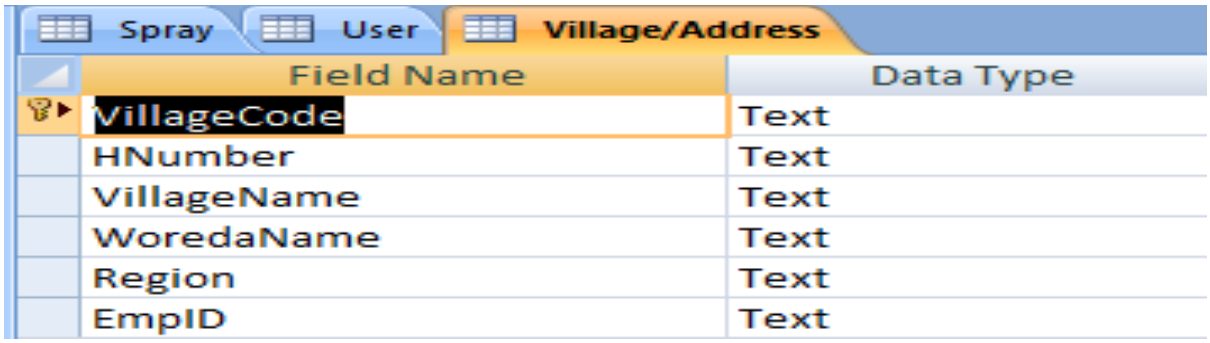


Table 2: Users table with its attributes

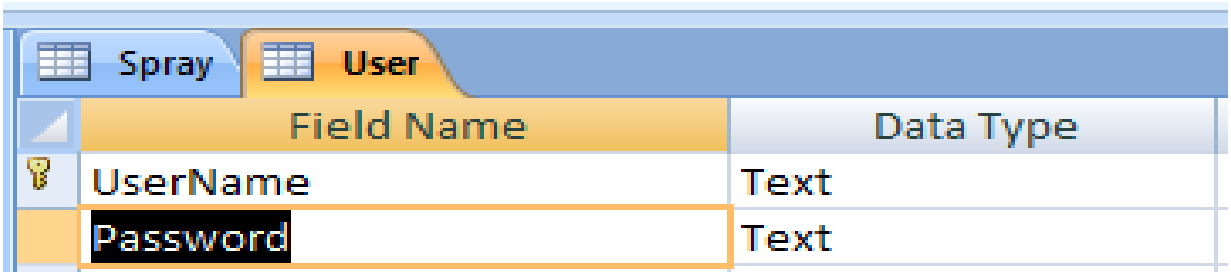
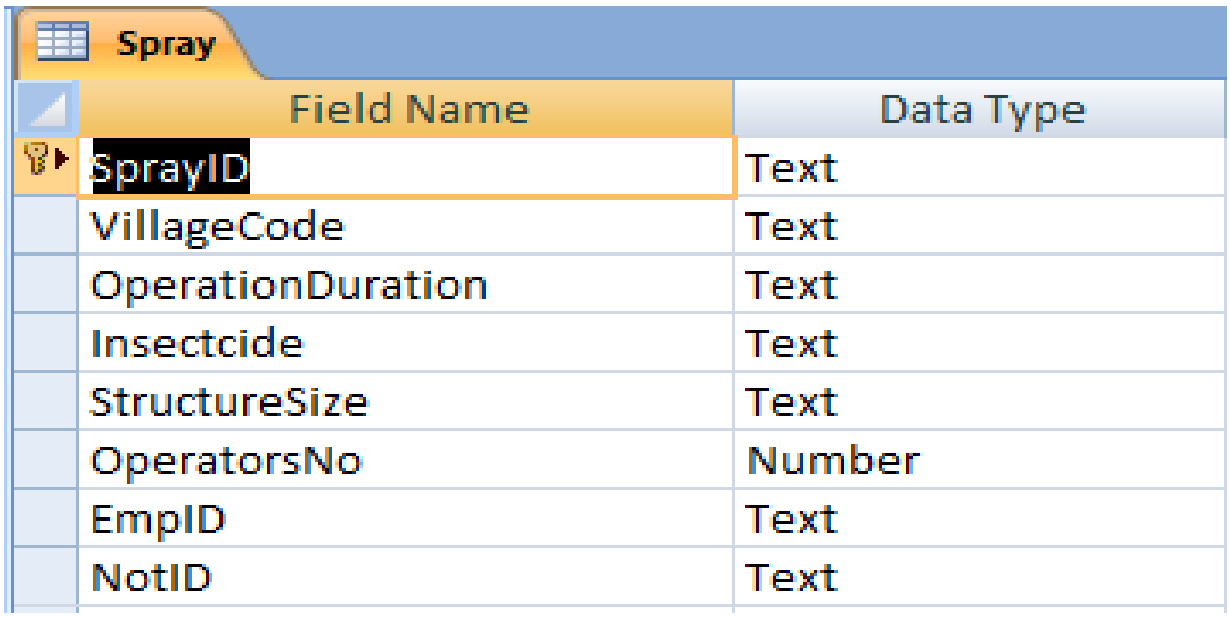


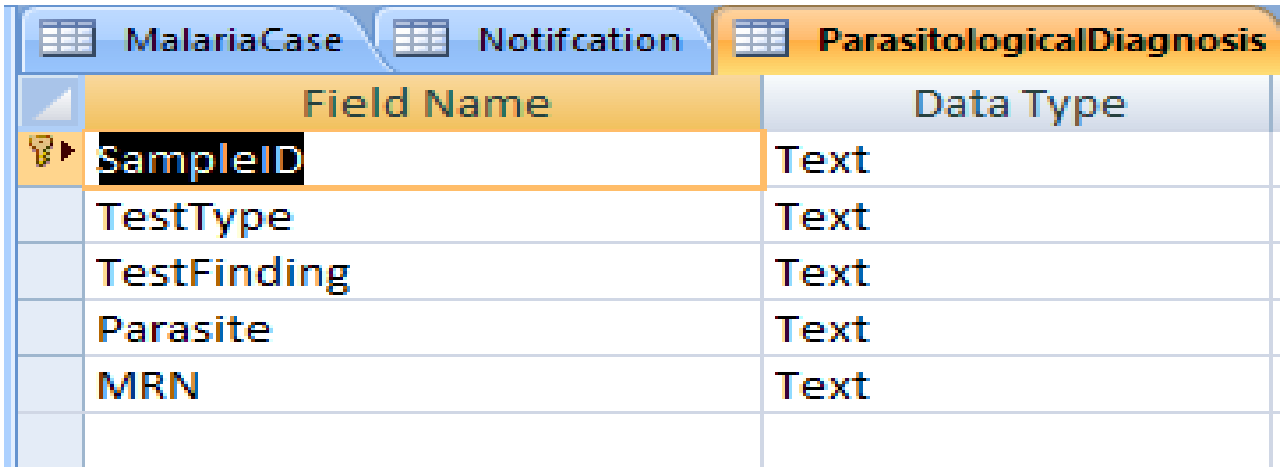
Table 3: Spray Tables with its attributes



Spray

Field Name	Data Type
SprayID	Text
VillageCode	Text
OperationDuration	Text
Insectcide	Text
StructureSize	Text
OperatorsNo	Number
EmpID	Text
NotID	Text

Table 4: parasitological diagnosis table with its attributes



MalariaCase | Notifcation | ParasitologicalDiagnosis

Field Name	Data Type
SampleID	Text
TestType	Text
TestFinding	Text
Parasite	Text
MRN	Text

Table 5: Notification table with its attributes

MalariaCase | Notifcation

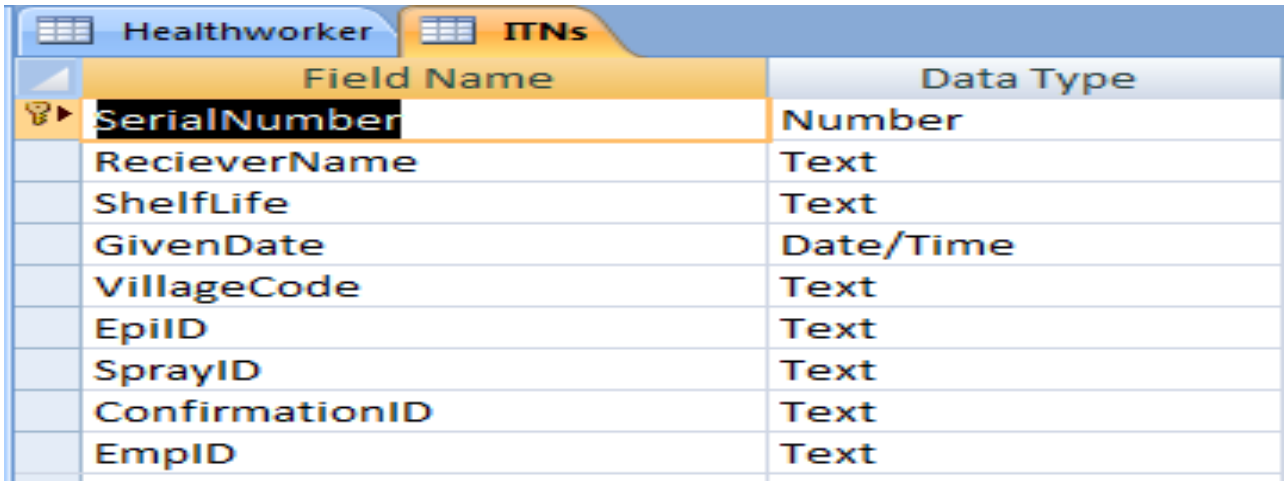
Field Name	Data Type
NotID	Text
Reciever	Text
Date	Date/Time
CaseID	Text
EpiID	Text
Description	Text
EmpID	Text

Table 6: malaria case table with its attributes

MalariaCase

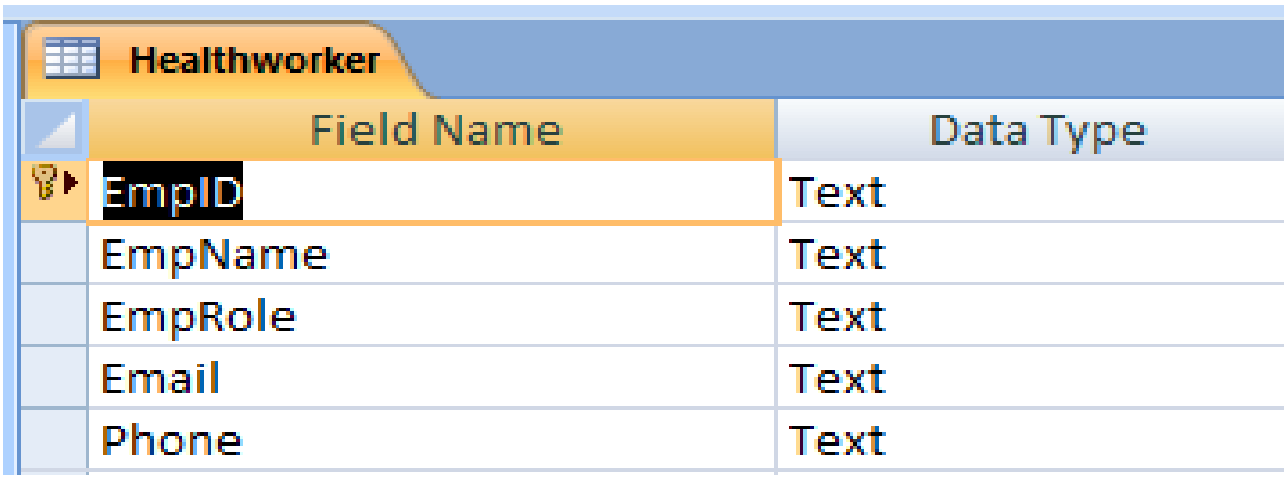
Field Name	Data Type
CaseID	Text
CaseDescription	Text
CaseConfirmation	Text
CaseClassification	Text
DetectedDate	Text
EmpID	Text
EpiID	Text
VillageCode	Text
NotID	Text

Table 7: ITNs table with its attributes



Healthworker	ITNs
Field Name	Data Type
SerialNumber	Number
RecieverName	Text
ShelfLife	Text
GivenDate	Date/Time
VillageCode	Text
EpiID	Text
SprayID	Text
ConfirmationID	Text
EmpID	Text

Table 8: Health worker table with its attributes



Healthworker	
Field Name	Data Type
EmpID	Text
EmpName	Text
EmpRole	Text
Email	Text
Phone	Text

Table 9: Epidemic notification table with its attributes

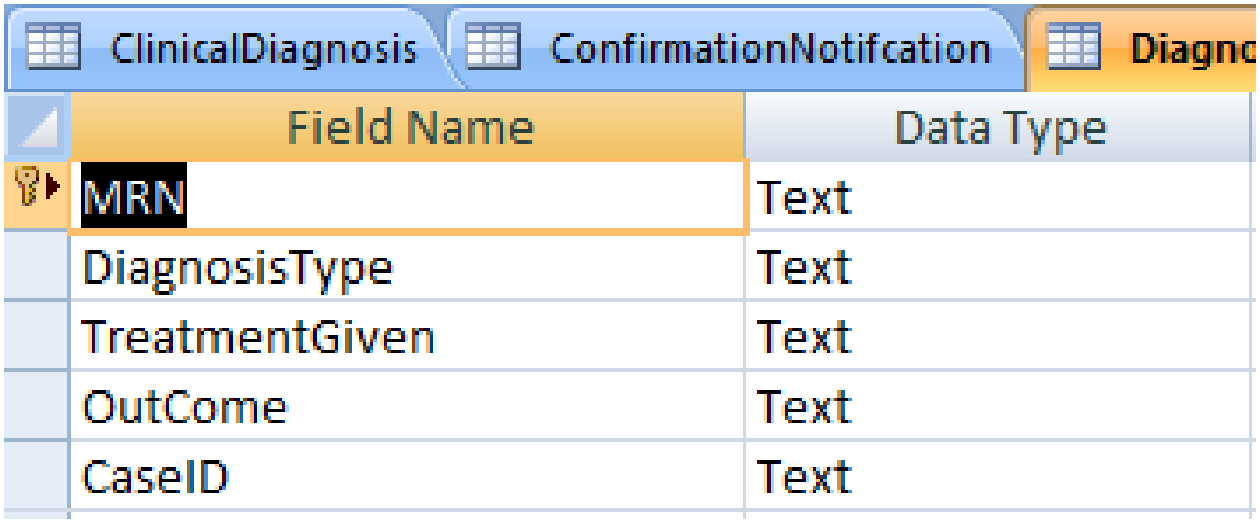
EpidemicNotification

Field Name	Data Type
NotID	AutoNumber
CaseID	Text
NotificationID	Text
DescriptionText	Text

Table 10: Epidemic table with its attributes

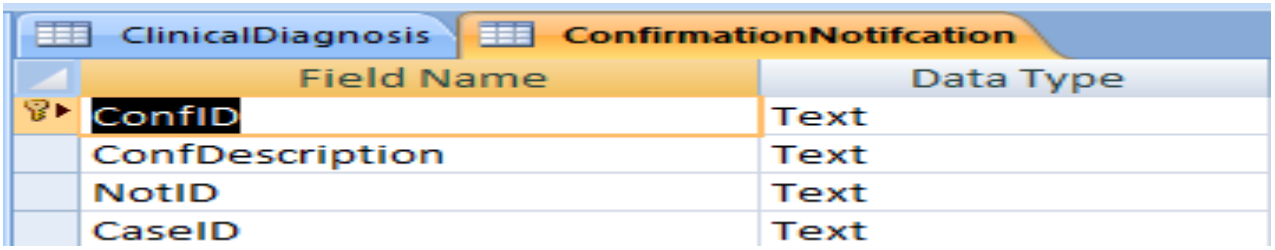
Field Name	Data Type
EpiID	Text
WeekNumber	Number
EpiDescription	Text
CaseCount	Number
PywTreshold	Number
Classification	Text
Confirmation	Text
SprayId	Text
CaseID	Text
VillageCode	Text

Table 11: Diagnosis table with its attributes



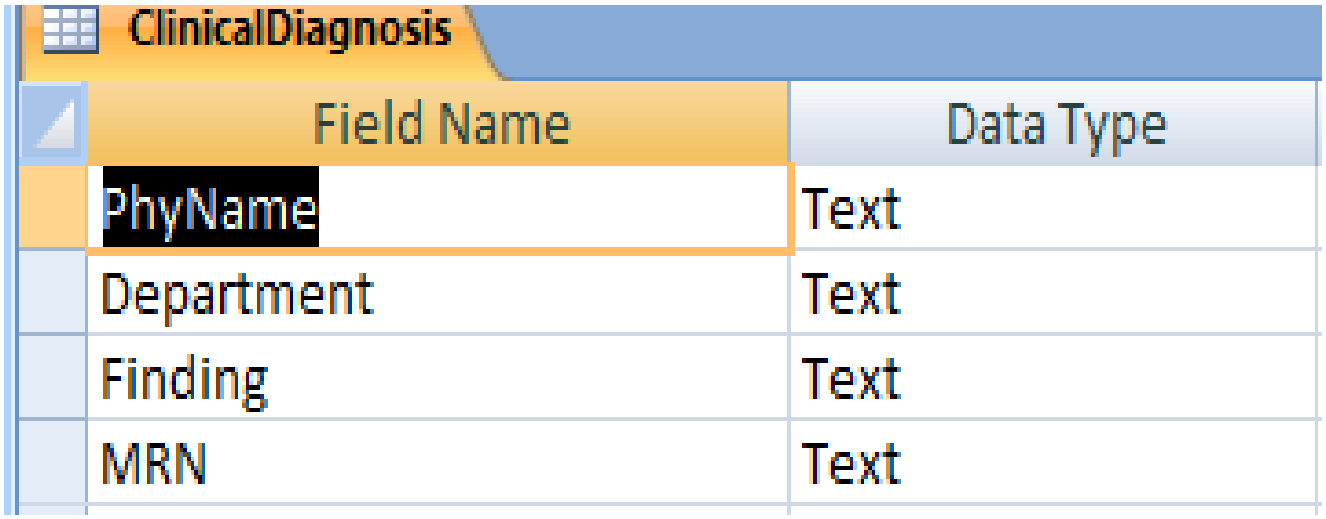
Field Name	Data Type
MRN	Text
DiagnosisType	Text
TreatmentGiven	Text
OutCome	Text
CaseID	Text

Table 4: confirmation notification table with its attributes



Field Name	Data Type
ConfID	Text
ConfDescription	Text
NotID	Text
CaseID	Text

Table 4: clinical diagnosis table with its attributes



Field Name	Data Type
PhyName	Text
Department	Text
Finding	Text
MRN	Text

Annex 5

List of User Interface Prototype

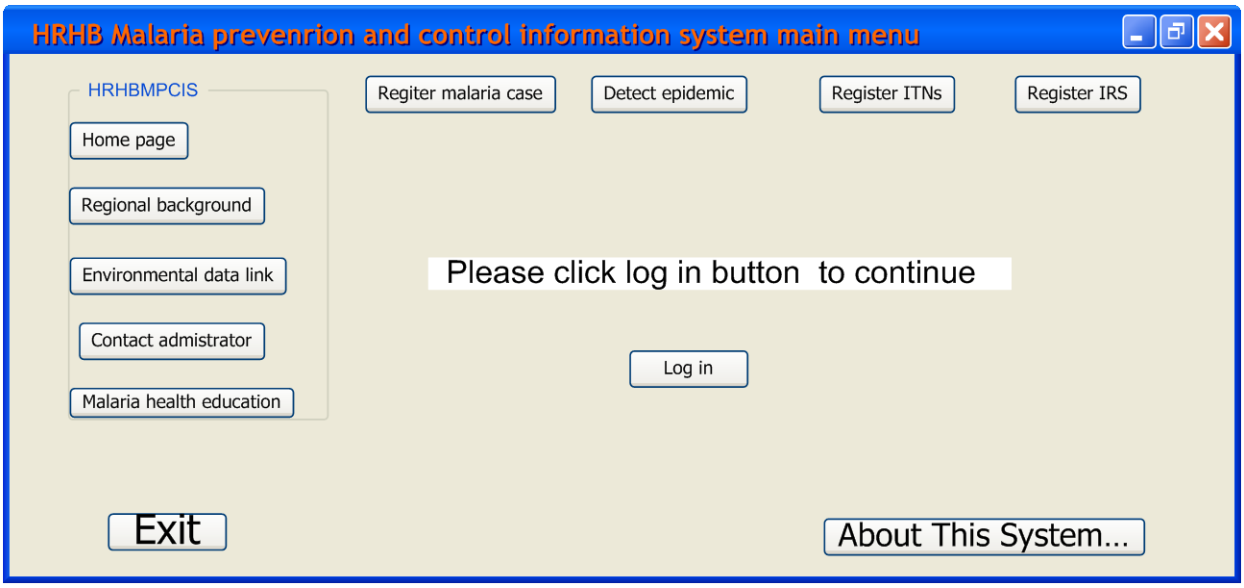


Fig 1 Main forms of HRHBMPCIS

After the system start the role option form (main menu displayed) which also include administrative option and user information link to open source software, to go farther the user select Log in button then user log in form displayed as follows.

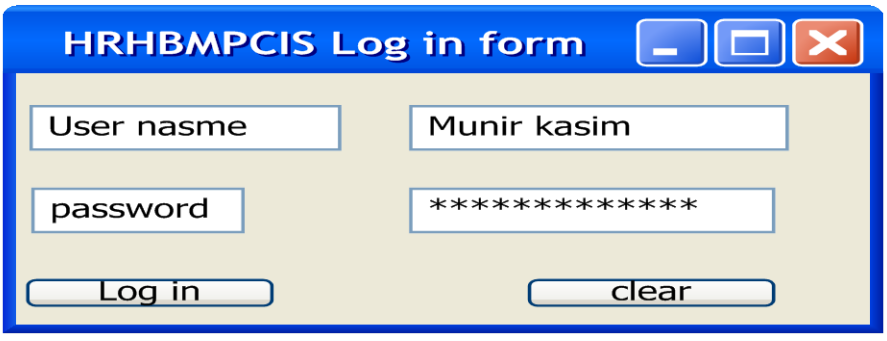


Fig 2 user log in form of HRHBMPCIS

Use inters user name and password he is authorized as account, if user name and password incorrect the system displays error message as follows.

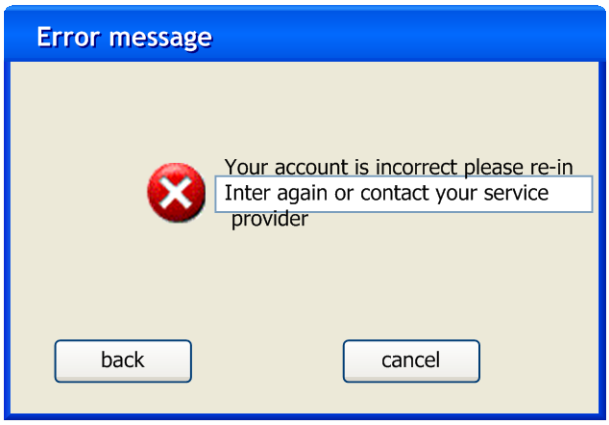


Fig 3 Error message display form of HRHBMPCIS

If the user name and password correct the user is allowed to role/option his authorized for in this case malaria case registration form.

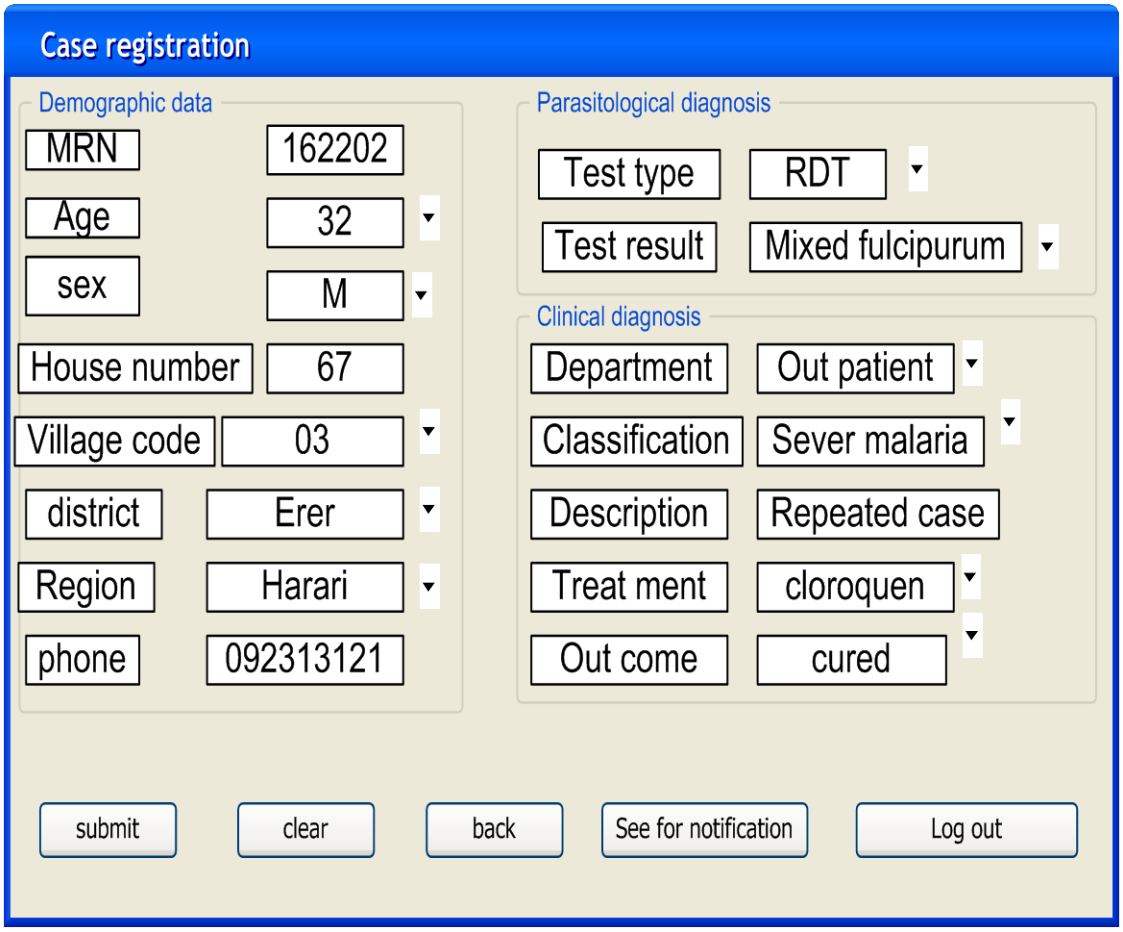


Fig 18 case registration option form of HRHBMPCIS

The case registration form holds the individuals malaria case demographic data, contact information, parasitological and clinical diagnosis information. The form allows the user to view received notification from administrator and submit confirmation. The form also allows the user to clear the filled data by clicking on clear button and back button to go back to role option form.

When Health worker register role is selected the system request for administrator username and password to display health worker register form. The health worker register form is displayed below.

Fig 4 Health Workers register form of HRHBMPCIS

This form allows the administrator to register and authorize all health workers working on the system by registering necessary data and offering them user name and password. The health workers data registered and saved will be recorded along the data they record and submit for confirmation purpose.

After data about malaria case successfully submitted the malaria focal person can check whether epidemic exists or ends by using epidemic detection role option and epidemic checking interface form is shown bellow as follows.

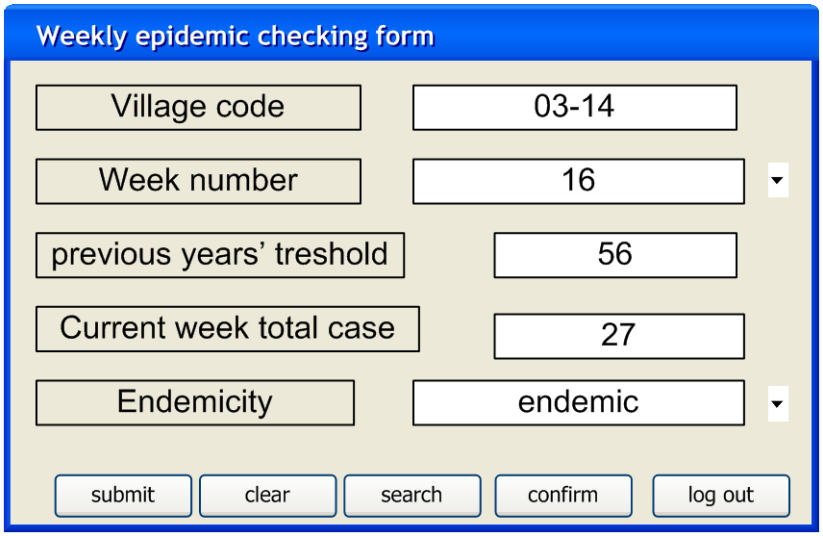


Fig 5 weekly epidemic checking form of HRHBMPCIS

The user fills the required information and clicks submit, the system creates the current week case count along with threshold on epidemic detection table of data base. The user clicks on detect for epidemic then the system displays all rows where current case count greater than the threshold of the previous years the same week. The user then can send epidemic notification for health professionals where address of epidemic is the same. For confirmation purpose the system

send the user personal data along with notification by ordering the user to click on confirmation button before log out.

The system has spray data holding component as spray data base on which the user record data related with spray monitoring. The malaria focal person as spray team leader can add spray data, search, updated and delete records by using the following spray data capturing form.

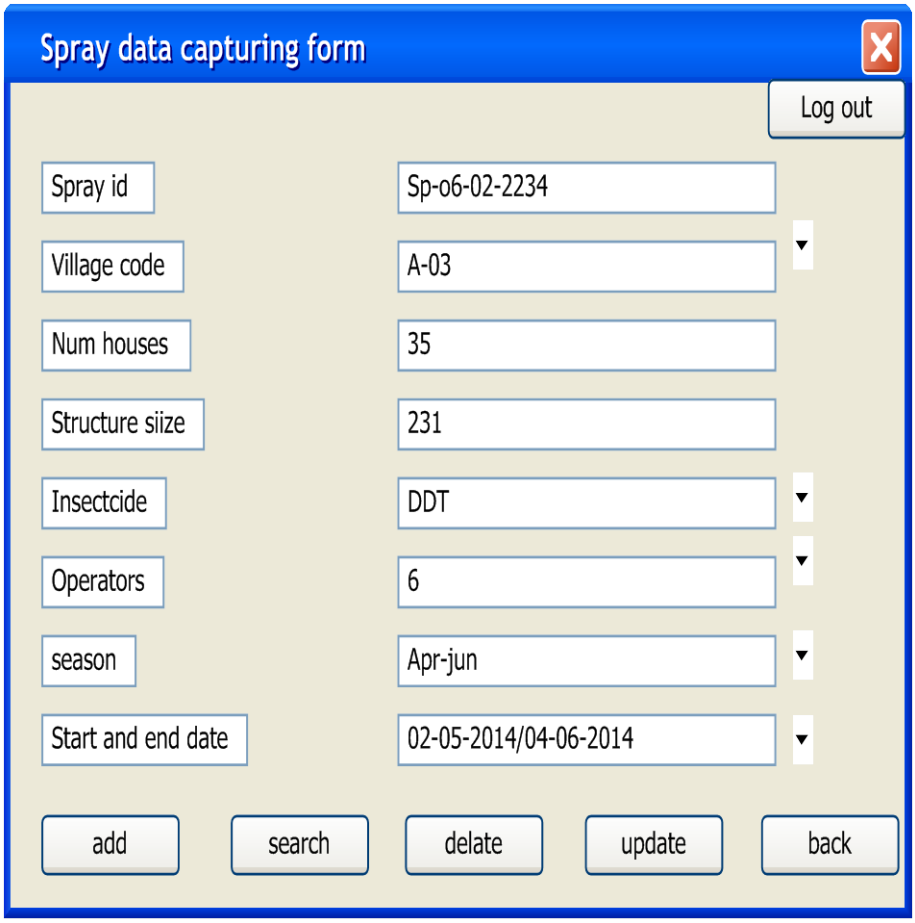


Fig 6: spray data capturing form of HRHBMPCIS

The malaria focal person can login to report generation form of HRHBMPCISs main menu and can also search for edit reporting span. Fig below shows report generation form of HRHBMPCIS

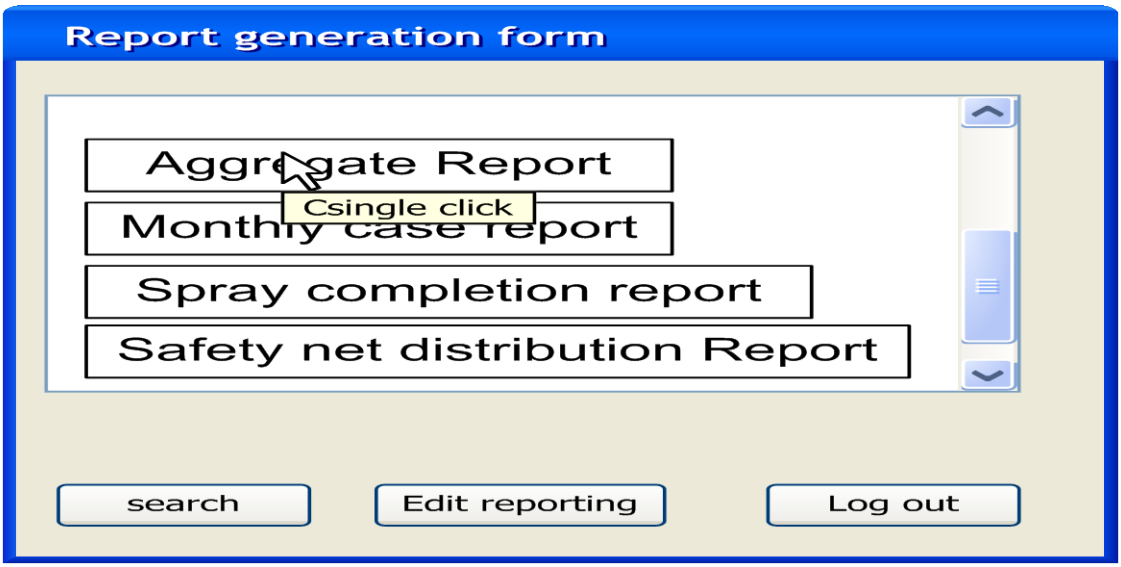


Fig 7 report generation option form of HRHBMPCIS

Aggregate Report output Display Form brings the location, duration, spray data about net coverage and distribution, making them usable information. The malaria prevention and control owner can get from this report whether epidemic occurred within specific village, what intervention measures looks like at village level and even understand about the affectivity of control measures by simply observing and comparing report among different villages with the same intervention.

The following table shows what aggregate report data content will be looks like the following table, after the system implemented.

Table 14: Aggregate report data form of HRHBMPCIS

Village code	Week num	Case count		threshold	epidemic	Village spray last 12 months	Distributed net	Survived net	Village distribution coverage %
		FP	NP						
03	36	12	9	38	yes	Twice	76	34	80

Annex 6

Interview Questions and Observation Check List

Purpose: The interview questions will help to assess the current system and to design the future malaria prevention and control information system for Harari Regional Health Bureau.

General Information

Interviewee: _____

Role/Responsibility: _____

Closed Ended Questions

1. How malaria cases are reported?
2. Who are involved in malaria case reporting?
3. How epidemic is detected from reported malaria case?
4. What prevention and control measures used to control malaria epidemics
5. How ITNs distributed? And what data are captured?
6. How IRS monitored? What data are captured while spray operation?
7. What kinds of reports are generated related to malaria?
8. What are the tools used in reporting and processing malaria related data?

Open Ended Questions

1. What are the features you in the new system?
   _____
   _____
   _____
   _____
2. What are your concerns and worries in deployment of the new system?
   _____
   _____
   _____

Observation Check List

Health institution _____

Date _____

Process to be Observed	Yes	No	Remark
1. IDSR report form exist			
2. Is all essential data recorded on IDRS form			
3. Norm chart exist			
4. Is norm chart being used to detect epidemic			
5. Computer application to process malaria related data			
6. Malaria cases and intervention against malaria well documented			
7. Is there separate record/file for ITNs distribution			
8. Is there separate record/file for IRS monitoring			
9. Is there separate record/file for epidemics			

Observer name _____

Signature _____

Date _____