ADDIS ABABA UNIVERSITY

SCHOOL OF INFORMATION SCIENCE

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M.SC. IN HEALTH INFORMATICS PROGRAMME

Research Project

Title - Design a Web-Based Information System for Community Based Health Insurance System for Gurage Zone Health Insurance Scheme

Prepared by: Ahmedin Hussen

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Designing a Web-Based Information System for Community Based Health Insurance for Gurage Zone Health Insurance Scheme

By Ahmedin Hussen

A Project Submitted to the School of Information Science and Public Health of Addis Ababa University in Partial Fulfillment of the Requirement for Degree of Master of Science in Health Informatics

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Dedication

I would like to dedicate this research project to my beloved family, to my Mam Asma Nuro, to my beloved wife Zehara Jemal and to my daughter Salwa Ahmedin**.**

Declaration

I declare that this project work is my own original work and effort and that it has not been presented for a degree in any other university, where other sources of information have been used, they have been duly acknowledged

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Acknowledgment

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List of Acronyms

AIDS	Acquired Immune Deficiency Syndrome
CBHI	community based health insurance
CBHIs	community based health insurance schemes
CBHMIS	community based health management information system
ER	entity relationship
ETB	Ethiopian birr
FMOH	federal ministry of health
HIIS	health insurance information system
HIPPA	Health Insurance Portability and Accountability Act
HIS	health information system
HIT	health information technology
HIV	Human Immune deficiency Virus
HMIS	health management information system
Html	hypertext modeling language
HTTP	Hyper Text Transport Protocol
ICT	information and communication technology
IS	information system
IT	information technology
MOHR	ministry of health of Rwanda
MySQL	Structured Query Language
OOD	object oriented designing
PHP	Hypertext Processer
SDLS	System Development Life Cycle
SNNPR	South Nations and Nationalities People Region
SOP	standard operating procedures
TB	Tuberculosis
UML	Unified Modeling Language
WHO	World Health Organization
WWW	World Wide Web

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Abstract

Background: Community based health insurance scheme is a mechanism of distributing or pooling of risk among individuals. CBHI is a way to improve equitable access to health service, sharing costs among members and reducing the financial burdens of health care on the poor. In community based health insurance scheme involves three stakeholders these are the insurer, the insured and the service provider. The use of information and communication technology to create cooperative working environment between the stakeholders in the scheme can improve the accessibility and use of health care services at a point of service irrespective of time and geographical location. This can help to improve the use and access of citizens to the primary and advanced health care services. The application of ICT to the major business process of health insurance enables, an ease of access for the various health insurance services provision at the insurance scheme.

Objective: The main objective of the project is to assess the existing paper based insurance system and design a user friendly web based information system for Gurage Zone community based health insurance scheme. In the existing system business processes are handled on paper based and many resources such as time, place, materials and manpower.

Method: The project was limited geographically in Gurage Zone and conceptually to the designing of the web based information system for community based health insurance of unemployed rural and urban dwellers of the community. The project employed an object oriented system analysis and design technique with different data collection tools i.e. (interview, observation, relevant document review) to collect the data required for system design. Analysis and design of the proposed system was done using the UML and Microsoft Visio. My SQL Server has been used to develop the database.

Result: The designed information system of community based health insurance for Gurage zone health insurance scheme comprises of different functionalities like members (the insured) registration, validation, claim adjudication; insurance components which would help to transform the paper based manual system to efficient and cost effective system.

The web based information system for community based health insurance could enhance accessibility of services and information exchange by eliminating unnecessary time consuming processes. Evaluation of designed prototype is done by using empirically inspection of system users by preparing checklists consisting of list of prototype interface concerning questions. From the evaluation results 92% of the respondents (expected users) agreed that the prototype interface are usable.

CHAPTER ONE

Introduction

1.1 Background

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being. These rights are exercised without distinction of race, religion, political belief and economic or social condition [1]. Good quality health care is both a human right and a building block to tackling poverty and reducing inequality [2].

Universal health coverage (UHC) is a simple but inspiring concept, which has risen fast up the global health agenda that is everyone 'whether rich or poor' gets the health care they need without suffering financial hardship [2]. As WHO (2005) defines universal health coverage: is the access to key promotive, preventive, curative and rehabilitative health interventions for all at an affordable cost, thereby achieving equity in access [2]. Governments, policy makers, funders and the international community should come together behind to implement reforms that ensure all people – rich and poor alike - can access good quality health care when they need it [2].

Health financing refers to the "function of a health system concerned with the mobilization, accumulation and allocation of money to cover the health needs of the people, individually and collectively, in the health system [3]. The purpose of health financing is to make funding available, as well as to set the right financial motivations to providers, to ensure that all individuals have access to effective public health and personal health care" [3]. The principle of financial-risk protection ensures that the cost of care does not put people at risk of financial catastrophe [2].

Health insurance can reduce financial barriers to health care access and provide protection of individuals and families against the risk of unpredictable health care expenditures. International evidence clearly shows that universal health coverage will not be achieved in low and middle income countries without voluntary or contributory-based health insurance [4].

Community Based Health Insurance Scheme (CBHIs) is a program managed and operated by a community-based organization, other than government or a private for-profit company that

provides risk-pooling to cover the costs (or part of) of health care services. Beneficiaries are associated with, or involved in the management of community-based schemes, at least in the choice of the health services it covers [5].

The world health report of 2010 on health systems financing proposes that, countries of all nations at all income levels should constantly seek to modify and adapt health systems financing to the specific goal of universal health coverage in mind with twin goals of ensuring access to health services, plus financial risk protection towards achieving sustainable development [4].

Many developing country governments are reforming the way that health care is financed. Several countries are increasing government funding for healthcare, localizing the management of selected health services, and improving the targeting of government spending on the health needs of the poor. Health insurance has emerged as part of the reform drive in many countries, both as a way of enhancing financial resources available for care, and as a means of better linking health demand to the provision of services [6]. Our country government has initiated health care financial reform since 2011 through health insurance. Policy makers are well aware that a country's economic development is closely linked with the health status of its population. Improving access to affordable health care is therefore, central to boosting growth and helping break the vicious cycle of poverty and ill health. Inadequate health expenditures can undermine efforts to combat poverty because sickness reduces productivity, and investment resources may be redirected to meet health related consumption requirements [7, 8].

Electronic information systems have advantage of providing quality and accurate data to make, report potentially more flexible and efficient [9]. To realize the objectives of health insurance it is important to avoid data quality and service accessibility problems in the CBHIs therefore automating the current data (information) handling system both at insurance schemes and healthcare providers. The existing CBHI data or information handling system in the district, regional and national level is totally manual. This manual process has an outcome that hinders making sound clinical decisions, planning and procurement unpredictable and time consuming at all levels. Additionally, it prevents higher level of the hierarchy from viewing the various aggregated data coming from lower levels of the systems.

Health information system (HIS) is one of the important tools for the health sector which involves stakeholders situated at national level, regional, district, service delivery and community. Vertical

information flow denotes transfer of information at certain intervals (daily, weekly, and monthly, quarterly) between levels of healthcare such as community, health facility, and district, regional and national levels [9].

Web-based applications provide the power of desktop and server applications with the flexibility and accessibility of the web. Using web browsers, users can securely access applications from anywhere within the reach of organizations' intranet or extranet [24]. This project would design web-based information system for community based health insurance for Gurage Zone health insurance scheme. Therefore, the project assessed the existing problem in CBHI schemes and healthcare service centers in the District; it identified the requirements for the proposed web-based system (both functional and non-functional) and proceeded to the system design.

1.2 Statements the Problem

Healthcare financial resource mobilization and risk pooling with the application of information communication technology for health care delivery is crucial. As part of the new health sector financing reform (HSFR) initiatives for developing countries, multilateral agencies and donor countries have shown an increased interest in health insurance [11, 12, 13]. An automated business process is recommended to be a preferable way of providing the insurance mechanism to the society [13].

Health information system (HIS) applied to the healthcare financing sector can reduce lengthy administrative bureaucracy for cost compensation services. It can play crucial role for the attainment of quality service and universal coverage of healthcare. To facilitate the link between payers and providers who must exchange secure data about membership, eligibility, claims and payments health insurance information systems (HIIS) are very important [14, 18, 19, 20]. It facilitates the transaction link between payers and providers who must exchange secure data between various stakeholders.

Lack of persistent, interoperable insurance data and information are causing serious barriers towards the achievement of the universal coverage in various countries for unexpected services. Designing web based information system increases accessibility for individual community members at anywhere and anytime. Some community members that have insurance for their

family will be forced to pay during unexpected health events out-of pocket for needed healthcare.

Health care services are known for having the largest budget in the countries. The health insurance mechanism which involves the pooling of risks requires control methods for expenditures. These control methods emphasize majorly on the volume of care, providers service provision, payment rates and costs. But implementing web based information system controls these mechanisms effectively, but it requires substantial administrative capacity and a highly developed, interoperable information systems and infrastructure.

The design of a web based information system for community based health insurance that supports achieving a wide coverage of health care finance and unexpected financial risk protection by improving the availability and accessibility of health care services. Digital data and information processing enables the clients and providers to easily practice community based health insurance services with fewer limitations. It can play a great role for the secure transaction of information across the community based health insurance stakeholders which enable in fulfilling the goal towards achieving for universal healthcare coverage.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of this study:

- To design web based information system for Gurage Zone community based health insurance scheme.

1.3.2 Specific Objectives

To achieve the above general objective of the study, the following specific objectives are formulated.

- To assesses the status of the existing paper based system of CBHI scheme;
- To develop prototypes of the health insurance system;
- To evaluate system prototypes with the end users.

1.4 Scope of the Study

The project covered a design of web-based information system for community based health insurance in SNNPR for Garage Zone health insurance system. The project was geographically limited to Gurage Zone for unemployed community members groups (unemployed rural and urban dwellers) and conceptually focused on designing a web based information system and design prototype of the system. The project didn't cover areas regarding financial transaction and pharmaceutical inventory systems. Technically the project limited to the design of prototype of the system. Because of time limitation and financial constraints it could be difficult to cover whole different life cycles of web based system/software development. The project mainly focused on analyzing the existing manual system, collecting the requirements of users and designs a web-based information system for the scheme.

1.5 Significance of the Study

This newly designed system can identify various important functionalities and simplifies the business processes easy to the different stakeholders. The system identifies the different data regarding insures, health service providers and improves service quality in scheme for stakeholders. The system can help stakeholders of the scheme in:

The insured (community) client: - The system provides an ease of access to scheme members through an electronic registration, viewing client specific clinical data and demographics irrespective of time and geographic location. The system minimizes rate of out-of-pocket expenditure (money expenses) and the amount of time spent in queue during emergency cases and other fatal cases.

The insurance service provider (CBHI scheme): -The works load performed on paper can be minimized with the help of the system. Due to scalable nature of web based system, it could serve to increase geographical coverage of the service and increase in the number of the users the scheme aims to cover. The different clinical and demographic data that are found in the system database would help the insurer to exercise evidence based decision making at all levels.

The health service providers:-The health care provision could be maximized in insurance service. Additionally, the system could help in separating the finance and provision of health care services to different stakeholders. The system could provide a means of an automated standard registration of the different clinical and demographic data. The standardized data transaction in

the system would create transparency and accountability for the mistakes that were made during the provision of care. It strengthens participation in the management of health services and maintains stable membership of the schemes. It would reduce duplication of data in the system, to provide an ease of access to insurance services.

CHAPTER TWO

2.1 Literature Review

In the process of building knowledge, the literature search was a fundamental requirement of all research projects. It was part of any research process and follows the definition of a topic and the preliminary gathering of data. It used to identify published information into the same, similar, or related areas of interest; and to sharpen the focus of the research topic [15].

2.1.1 Theoretical Overview, Function and Practice of community based Health Insurance

It was important to review the different literatures that had been done on similar areas or related works in the different parts of the world especially in developing countries. As it was reviewed the literatures that were held on the community based health insurance schemes in the different countries, there were different problems on the program concerning data and service quality, accessibility, security, reliability and other issues concerning the program. The project has considered the previous works in its problem identification and requirements recognition.

A country's economic development is closely interrelated with the health status of its population. An efficient and equitable health care system is an important instrument to break up the vicious circle of poverty and ill health. Sub-Saharan African countries have tried different modes of health care financing since independence. Due to low and unstable tax revenues and reductions in public budgets, the initial goal to provide "free health care for all" was never achieved. In the eighties, government resources dried up in many countries and decline in the quality of existing services was the result, with poorly paid and less motivated staff and shortage of drugs and medical equipment. Under the pressure to mobilize additional resources for health care provision, public facilities and NGO run hospitals resorted to formal or informal cost recovery strategies by collecting fees at the point of use [9].

Health security and improvement in health outcome are an integral part of the global Commitment to poverty reductions. Efforts are underway practically in all developing countries to improve quality, access, efficiency and effectiveness of health care. Policy makers are well aware that a country's economic development is closely linked with the health status of its population. Improving access to affordable health care is therefore central to boosting growth and helping break the vicious cycle of poverty and ill health. There are a number of ways in

which the government can assist in the management of health risks of the poor [16].Health insurance is one of those social protection mechanisms that is used to safeguard the society. This mechanism addresses the various social and economic vulnerabilities of a society. Community-based health insurance (CBHIs) schemes are one such approach. They are voluntary schemes, and are typically based on concepts of mutual aid and social solidarity. They are designed to assist those in the rural and informal sector for whom other forms of health insurance are not as well-suited [17, 18].

As a risk management instrument, CBHIs can play a major role in smoothing household expenditure patterns. Beneficiaries are associated with, or involved in the management of community-based schemes, at least in the choice of the health services it covers. It can be initiated by health facilities, NGOs, trade unions, local communities, local governments or cooperatives and can be owned and run by any of these organizations. They may be organized around geographic entities (villages, cities), professional bodies (i.e. cooperatives or trade unions) or around health care facilities [18, 29].

Many community finance schemes have evolved in the context of severe economic constraints, political instability, and lack of good governance. Usually in government taxation capacity is weak, formal mechanisms of social protection for vulnerable populations absent, and government oversight of the informal health sector lacking. In such difficult contexts, community involvement in financing health care provides a critical first step towards improved access to health care by the poor and social protection against the cost of illness [16, 21, 22, and 23].

The obstacles to universal financial protection are recognized by most countries. This is perhaps why there has been an increasing interest in financing based at the community level, where it is thought to be easier to identify the contributing population and to collect contributions. The involvement of the community in health financing was in fact motivated, among others, by the Declaration of Alma Ata in 1978, urging maximum community participation in organization of primary health care. Community financing for health is referred to as a mechanism whereby households in a community (the population in a village, district or other geographical area, or a social-economic or ethnic population group) finance or co-finance the current and/or capital costs associated with a given set of health services, thereby also having some involvement in the

management of the community financing scheme and organization of health services [26, 27, 35 and 37].

As it was considered the history of Community based health insurance schemes; they were amongst the first social protection institutions to be established in the industrial market economies. In the Netherlands, mutual health insurance societies were founded by the guilds during the middle Ages. The Friendly Societies of the United Kingdom, the Mutual Benefit Associations of France, Belgium, Germany, Japan and Korea, and the Fraternal Benefit Societies of Canada were the first institutions in their respective countries to offer health insurance. Community-based health insurance was also the earliest form of health insurance to be established in the USA. The first US health insurance program was founded in Baylor Hospital, in Texas in 1929 [28, 43].

In the developing countries, the institution of community-based health insurance is of a far more recent origin. In Sub-Saharan Africa, the majority of the CBHI schemes came into existence only in the 1990s. Reflecting a strong Francophone tradition of mutual health associations, CBHI are far more common in West and Central Africa, especially in Senegal, Benin, Burkina Faso, Cameron, Democratic Republic of the Congo, Mali, and Togo, than in other parts of the continent. Senegal had the longest tradition of CBHIs, with several schemes dating back to the early 1980s. In Kenya, Uganda and Ghana, several schemes originated in the 1990s as part of the search of mission hospitals for new sources of funds after experience with levying user fees proved unsatisfactory. Many of Africa individual CBHI schemes were small, with around 100 beneficiaries, while others, such as Tanzania's Community Health Fund, had nationwide coverage with networks that cover one million or more beneficiaries [27]. Even though Africa has been a pioneer in CBHI, promotion of these organizations remains largely driven by external organizations [27, 28, and 29].

CBHI can play a major role in improving health services in countries like Nigeria, including strengthening high-priority services like HIV AIDS, TB, malaria, and childhood pneumonia, and diarrhea. Most health services, including those obtained by the poor, are paid for out-of-pocket and in many Cases, prices are high. CBHI schemes of varying designs have been introduced Across Sub-Saharan Africa, but with generally disappointing results. Plan-Health supported the development of tools and operating procedures, as well as governance and management

structures for the CBHI scheme and the Fund [10]. These include Standard Operating Procedures (SOPs) for the scheme and the Fund, a drug management system, and a data management system which captures enrollment, re-enrollment, and generates both health outcomes and management reports for the scheme financing healthcare through CBHIs [14].

The Community Based Health Insurance (CBHI) scheme is one of Rwanda's flagship health financing policies, and a major program for helping to improve accessibility to health services across the population. The major challenges that facing the Rwandan government were how to reduce the financial burden of access to health services and increase equity in access to country's' population who were living below the poverty line and to increase the mobilization of domestic resources to ensure the financial feasibility of health services, while keeping out-of-pocket payments at an acceptable level. The introduction of a Community Based Health Insurance scheme began in 1999 and expanded to cover the majority of the Rwandan population by 2012. [30].

Compared to Africa's CBHI's, Asia's schemes are larger (having several thousand members), older, and involve considerable cost sharing with governments. CBHIs play an important role in the health systems of Bangladesh, China, India, Nepal, Philippines, and Papua New Guinea. They are also present, to a lesser extent, in Cambodia, Vietnam, Thailand, Indonesia and Sri Lanka. Several of Asia's CBHIs are owned and operated by large micro-finance organizations (i.e. Bangladesh, India), by cooperatives (i.e. Scheme of the Philippines), by large hospitals, by community development movements (i.e. schemes of Sri Lanka and India), by local governments (i.e. China's county level pre-paid health insurance programs), or by mission groups (i.e. Nepal's Insurance Scheme) [30, 31, 32].

CBHIs play an important role in the health systems of Argentina, Colombia, Ecuador, and more recently, Mexico. Mexico has experiencing rapid growth in pre-paid medical organizations in the 1990s, and in April 2001, the Insurance Law was amended to recognize them as micro insurance entities. CBHIs also play a role in the health care systems of Bolivia, Guatemala, Honduras, Nicaragua, Peru, and Uruguay. In Latin America, CBHIs are closely linked to trade unions and social funds. These are non-profit insurance companies owned by a labor union in the relevant sector [33].

Increased healthcare expenditure caused by the need to cope with injury and illness has been identified as one of the main factors responsible for driving vulnerable households further into poverty. According to Meghan (2010), more than half of health expenditure in poor countries is covered by out-of-pocket (OOP) payments incurred by households. An increase in such expenditure can have catastrophic effects and may reduce a household's ability to generate current and future income and have inter-generational consequences as households may be compelled to incur debt, sell productive assets, draw down buffer food stocks, or sacrifice children's education. Foregoing medical care may lead to long lasting illness, disability or even death [13].

In Ethiopia before 2011 formal health insurance coverage was limited. But there were other community organized social protection systems; like Eder, Ekub and mehaber. This community collaborate social protection institutions were organized to help the members when any member or their family members face adverse situations. These social protection institutions were financial especially Eder and Mehaber were used to support the members when there happen some natural and manmade disasters. The victims were helped financially and materially by these institutions as the difficulty of adverse situations.

In mid-2011, the government of Ethiopia launched a first pilot Community-Based Health Insurance (CBHI) scheme in thirteen rural districts. Among others, the aims of the scheme were to increase access to health care and to reduce household vulnerability to unexpected out-of-pocket health expenditure [17]. To increase the prepaid plan coverage and access to modern health care services, Ethiopian government has developed health insurances strategy. In Ethiopia CBHI intended to cover 83.6% of the population of Ethiopia who are engaged in informal sectors; mainly those dwellers of rural areas and the informal groups of urban. The design of the scheme is based on a feasibility study conducted by an international consultancy company, Abt Associates, which is also responsible for implementation and monitoring of the scheme in collaboration with relevant government bodies at the federal and local level. The basic design of the scheme in terms of benefit packages, registration fees and premium payments, co-payments in collaboration with regional government. The scheme is subsidized by both the central and regional/district governments. The central government provides a general subsidy amounting to a quarter of the premium collected at district level, while the regional and district level governments cover the costs of providing a fee waiver for the poorest 10 percent of the

population. The overall objective of insurance is to promote equitable access to sustainable quality health care, increase financial protection, and enhance social inclusion for the majority of Ethiopian families via the health sector. Specific CBHI objectives are to:

(1) Improve financial access to health care services,
(2) improve quality of health care services,
(3) increase resource mobilization in the health sector,
(4) Strengthen community participation in the management of health services, and
(5) Strengthen national capacity for policy development and scale-up of health insurance coverage in the rural and urban informal sectors (FSHR 2011) [17].To achieve these objective, it is important to automate the system that improves the service coverage, quality and accessibility.

2.1.1.1 Components of Community based Health Insurance

Due to the complexity of health care system; there exists a complex network of information flowing between various stakeholders and a variety of business process. Health insurance and its various components have various set of relationships, settings and perspectives in the medical care system. The community based health insurance scheme has a payment mechanism which involves access to financial services; which provides a mechanism for sharing the risk of incurring medical expenditures among individuals. On the other hand, the human component (Peoples or users), are considered to be important in which other components relay on. People are the users of the scheme who are able and willing to use the insured health services when they perceive themselves to be sick. Medical service providers are also part of the health insurance component. These components are involved in the provision of the service to the insured by being paid and on a contract basis with the insurers. These components include health centers, Hospitals, Clinics and different Health Care organizations [40, 41, and 42].

Another important component of community based health insurance is the business processes which are involved in settling of the payment and registering peoples to be included in the system and performing various activities. These components may take different forms with different operational and practice differences. Mainly known business process in the community based health insurance scheme include Protection plan, scheme members' selections and registrations, premium collection, signing contractual agreement with health care providers,

monitoring medical services, paying for services, Cost refund and the recent Managed care [43,44].

2.2 Empirical review of web based health information system

2.2.1 Web Based Health Information Systems

The World Wide Web ("WWW" or "Web") is a techno-social system to interact humans based on technological networks [24].The use of web is growing at a phenomenal rate across the globe [25]. The reason for the Web's success is largely due to its simplicity for use and information retrieval. Its nature of simplicity and usability makes web to be preferably used in any sector for management and transaction of information. For the full functioning of the web, it requires cooperation between information providers and users [25]. The use of information and communications technologies (ICT) in support of health and health-related fields have the potential to greatly improve health service efficiency, expand or scale up treatment delivery to thousands of patients in developing countries, and improve patient outcomes [47].

The availability and accessibility of the web made secure transfer of confidential patient information fast and reliable. Patients can take their information wherever they go for medical care. The web can also enable patients to make informed health care choices. In most of developed nations the patients use online support groups, chat rooms, of a particular health condition or course of therapy. Also Web based physician network is in use ever than before [48].

As a basis for designing complex information systems the Web-technology has matured a lot over the last few years. The technology is still fairly simple with a number of unsolved problems, but the advantages and potentials are so significant that most of today's design of information systems to some extent is based upon web-technology. Organizations increase their investment in and usage of web-based technology. The scope of web-based application has grown enormously and has moved to become a platform that can support all facets of organizational work. In parallel with this trend the activities to be IT supported become increasingly knowledge demanding, and the actors are confronted by increasing demands for improved quality products or services, improved complexity of the products and services, higher flexibility, shorter lead-times, etc. To cope with these demands work is often undertaken by large groups including people with different background and perspective. More actors become involved and an

abundance of decisions have to be made by mutually interdependent actors. Actors involved in complex cooperative activities need support for communicating, coordinating their activities, keeping track of state of affairs in the field of work, sharing information, etc [49].

2.2.2 Health Information Management System

Health management information systems can be defined as a program that was designed to provide reliable and comprehensive information about the health system to health managers, to enable them to make decisions that would improve the quality of services. It is therefore; very important to ensure that there is quality data to be used in decision making. Such decisions would be valid and reliable because they would be evidence based [38, 41].

Information is an important asset in any organization. It requires investment of valuable resource either in production, distribution or acquisition especially in health area. Nowadays a massive budget allocation of a country's government is for health sector than others sector. Health care is almost completely information dependent science. Information used can be, patient-specific where information is generated by and used in the care of patients in the clinical setting or knowledge-based where the scientific information is used for the care. Much of clinical practice involves gathering, synthesizing, and acting on information [39, 45].

Since most of the information in healthcare is personal and confidential, the management of information in health care is critical. More over health care consumers need and want as much confidential and accurate information as possible concerning their consultation and treatment options. It will enhance the quality of medical records, and protection of client privacy and confidentiality [45].

The development of community-based health management information systems in developing countries is not well documented. The CHMIS had several constraints and limitations, like inadequacy of qualified and dedicated community volunteers to run the CHMIS, lack of skills to handle quantitative information, lack of incentives and supervisors for community health workers and inadequate financing of the information resource centers [14]. Two important principles can be drawn from the Bungoma CHMIS. First, although DHS staff may assist communities in conceptualizing, designing, implementing and utilizing the CHMIS, the community must use the system to make its own decisions. Second, communities must see a benefit to themselves in operating a CHMIS. The basic premise to be adopted in the development

of any CHMIS model is that it should be designed with a focus on improving the health status of the community [36].

2.2.3. Community Based Health Insurance Information Systems

Information should form the backbone of decisions that effect change in all areas [22]. It is therefore, paramount in health, for information to be used for decision making. In effect, this will bring about equity in health resource allocation. The development of comprehensive community based health information systems is increasingly becoming important for measuring and improving the quality of health services [22].Therefore, in many developing countries including Ethiopia has made efforts to strengthen their national health information systems to provide information for decision-making in managing health care services. A Community based health Information System (CBHIS) is a type of health information system that is based in the rural community and informal settlements of urban areas. Its objective is to produce relevant and quality information to support decision making. The CBHIS should hence strive to complement the functions of a health system which include: Improving decision-making, improving service delivery to the population and subsequently Impacting positively on the health outcomes of the target population at different levels of the health system. Health systems performance would be enhanced not only by bridging the interface between the community and the health system, but also encouraging timely decision making and action based on available information [22].

A Community Based Information System provides evidence grounded in the community, gathered, analyzed and used by the community and therefore, has the potential to improve timely decision making planning and action as well as monitoring of improvement. CBHIS enables community to follow up progress of planned activities towards set objectives thereby ascertaining accountability. Usefulness of CBHIS is greatly enhanced when linked to Health Facility Information System, and used for dialogue, for timely evidence-based decision making. Community based Health Information System allows health managers and service providers to document, analyze, and use information to improve coverage, continuity, and quality of health care services at all levels by better planning, monitoring, and evaluation of health services [44].

Information systems are increasingly important for measuring and improving the quality and coverage of health services. The restructuring of health information systems (HIS) has become an important trend in the entire developing world since the adoption of primary health care as a

global strategy for achieving 'health for all' goal [45]. Information is not an end in itself, but a means to better decision making in policy design, health planning, management, monitoring and evaluation of health programs and services, including patient care. It improves overall Health service performance and outcomes [45].

Information is not an end in itself, but a means to better decision making in policy design, health planning, management, monitoring and evaluation of health programs and services including patient care. It improves overall health service performance and outcomes. Health management information systems can be defined as a plan that was designed to provide reliable and comprehensive information about the health system to health managers, enable them to make decisions that would improve the quality of services. It is therefore very important to ensure that there is quality data to be used in decision making. Such decisions would be valid and reliable because they would be evidence based [38, 39].

The process of restructuring the health information systems in Malawi began in September 1999, with an analysis of the strengths and weaknesses of the existing information systems [48]. There was agreement regarding the need to establish a comprehensive system capable of feeding information to the users at community, health facility, district and national levels. The design process started with identification of minimum indicators, datasets and a 5-year strategy for strengthening the routine health management information system (HMIS) [48]. The testing focused not only on data collection and processing, but also on the use of information in routine management at local and district

2.2.4 Components of Community based Health Insurance Information System

Information systems majorly contain six components i.e., hardware, software, data, people, methods and process. Each one of them is laying into three categories. These are technology, human and process factors. In order for the community health insurance scheme to function fully these components must work together to bring commonly share value. As an independent information system, the input, process and products of health insurance scheme adopts those information systems components [45,46].

Generally countries of the world are expanding their health coverage to their public/citizens through the expansion of national health insurance schemes. The implementation of community health insurance schemes are varied among the countries, despite their variation in the

implementation they tend to share common information system components that are involved in the exchange of health insurance data [48].

Distribution and use of health insurance information products to the different users is made ease by the introduction of new technologies. The main business activities in the insurance system are; registration, insurance eligibility and verification, standard coding of diagnosis and disease with ICD, Claim processing, Claims submission, and Payment posting are thought to be common in most health insurance practices. Data exchange among the various components in the insurance scheme is important for the successful functioning of the business process.

Data privacy is a serious matter for all healthcare stakeholders including providers and patients. Patients can suffer moral, emotional and financial damage if their billing data, credit card numbers and Social Security numbers, are disclosed. Mitigating risk and providing strong security to the private or confidential information in any health care service provision requires serious security measures [46].

2.3 Related Works on web Based Information System

The main purpose of writing this literature review is to understand what knowledge and ideas that have been established about Web Base information System. It also would help to identify the strength and weakness in that system. Besides that, it used to identify direct related work resources and to collect different information from research, articles and journal in web site.

A web-based Course Information System (CIS) has been developed for the Computer Science I/II courses held between 2000 and 2003 by Prof. Dr. R. Lois, which was attended by 300 to 450 students. It aimed to maintain and present each student's submissions and grades and holds related information such as worksheet texts, submission deadlines and the assignment of students to teaching assistants. In short, it was covered most of the administrative data that comes up in regular university courses. The objective of the system has been to support traditional forms of organization by means of computer technology, rather than enforcing new and artificial policies. The experiences indicated that the system could be considered reliable and mature. In this project object oriented methods used for design of the system. Use cases, ERD, system architecture design and My SQL were employed to design the system [50].

A web based data base system of patients' information system for health care delivery of the national health insurance scheme of Nigeria was developed in 2012. The objectives of the web based national health insurance information system was to design a centralized patient information system for health care centers to access patients' information repository for effective and timely access to information when and where it was needed. Before 2012 in Nigeria, patients' data were scattered among various health maintenance organizations. The designed system helped to integrate data to be promptly organized for accessibility, retrieval and distributions among health care practitioners for delivery and effective services. The internet could be helped as a tool to solve the problems of capturing those data into a centralized online data depository system [51].

To design the system the three tiered web model architecture was used as its underlying technology and presented an architecture design for centralized information database system. When the system was deployed it would has saved time in accessing patients' health information and health care delivery and it would have achieved and also opened a new trend for the health industries. Apache server, PHP, HTML and My SQL was used for the design [51].

A web-based blood bank information management system for the National Blood Bank of Ethiopia was a study conducted by Gadisa Kebede in Addis Ababa, Ethiopia may 2016. He carried out a design at National Blood Bank Center, Addis Ababa. The student followed an object oriented system analysis and design approach to analyze and design the system. To have the requirements of the system he has used in-depth interview, document reviewed and inventory were done to analyze the situation. To model the design of the proposed system Unified Modeling Language (UML) modeling techniques was used and both HTML and PHP were used to develop the system prototype. And My Structured Query Language (MySQL) database management system was used to design the database (52).

The student used use case diagram to show system business process actors and system boundary, activity diagram to show basic business activity flow, class diagram was used to describe objects model of the system. And finally, the designed system prototypes of the user interface were evaluated by users. The results of the user interface testing shows that the system prototype was done and it shows that 75% of the participants in the evaluation have shown positive attitude to the interface and response for the system usability (52).

A web based system to support nursing care planning system by siraj sebhatu for wolita sodo qutona hospital in Ethiopia 2012. In this project the objective was to design a web based system for support of nursing care planning system and to develop prototype system interface. Object oriented design methods were employed to model system and the different unified modeling language tools were used. The three tiered architecture design employed to design system architecture. HTML, PHP and MySql were employed to manage designed system [53].

A web based social health insurance information system for Ethiopian health insurance agency was designed by Natnael Almu AAU, Ethiopia May 2016. The student was gathered the requirements of the designed system from Ethiopian health insurance agency and organized the requirements and used software development cycle to design the proposed system. Object oriented design approach was employed to develop different system bodies and visio visual, dreamver, HTML, PHP, CSS and MySql used for prototyping user interface designing of the system. Three tiered system design architecture was used to design the system architecture. The prototype user interfaces were evaluated by users of the designed system who were respondents of questionnaire prepared by the researcher [54].

CHAPTER THREE

3. Methodology

A methodology is "a systematic principles, practices, and procedures applied to a specific branch of knowledge that would provide guidance for researchers who work on research and provide a mental model for the presentation of its outcomes. A methodology supports the design of methods for requirements analysis might provide guidelines for specific expected elements of requirements analysis, including organizational context, data gathering, modeling, and the form of the requirements specification [55].

"Design science…creates and evaluates IT artifacts intended to solve identified organizational problems. It involves a rigorous process to design artifacts to solve observed problems, to make research contributions, to evaluate the designs, and to communicate the results with appropriate audiences [55]. Therefore, the design methodology applied in this project was object-oriented design approach. Unified modeling language (UML) development techniques applied in the process of requirements capture, model organization business system and design.

3.1 Study Area

The project was conducted in SNNPR for Gurage Zone health insurance scheme that was established in 2015 since January 1 to May 2017.

3.2 Study Design

This research project was employed object-oriented methodology for designing the proposed web based information system that involves different stakeholders includes insurance schemes (insurer), the insurance members(community) and the healthcare service providers(health centers, hospitals). The object-oriented methodology was selected because it enables to develop large scale independent application components. Methodologies usually offers a guidance on a number of models that can be used to design a system and define a set of formal notations in which the recommended models can be written down and documented [56].

The method also allows decomposition of a complex arrangement into a primary object apparent in the system. For the design of web based system for the health insurance scheme an object-oriented system design methodology be used because of its highly dynamic, flexible and scalable

nature. Once the objects are defined and the system functionality is assigned, major components of the software system can be developed independently. Then, the system would be tested using usability testing steps as its necessity [57].

3.3 Data Source

The Ethiopian Health Insurance Agency Community Based Health Insurance department, Gurage Zone Health Insurance Scheme and three woredas' health insurance scheme in the zone all were used as required data source. These were selected purposively to obtain the required data for the study. They were directly and indirectly involved in facilitating or providing the different information need for study and process about community based health insurance in their own respective departments. From EHIA the director and IT department coordinator were selected, from the Zone and the three woredas' insurance scheme the coordinator and the data clerks were selected for the interview. For interview purposively 2 people out of 9 from EHIA, 2 people from zonal scheme out of 5 and 2 people from each woredas' out of 3 or totally 6 people from 3 woredas out of 9 people were selected for the interview. Totally 10 people out of 23 people were selected for the interview. The rationale behind is that they have a direct interaction with the system for executing various insurance claims, registrations, reports and handling different client data.

3.5 Methods of Data Collection

In this project, face to face interview was used with key informants on the existing community based health insurance schemes. The responses were recorded, which were used as an essential input for defining of requirements which was important in designing of the web based information system. In addition to the interview, analysis of different paper based documents, different claim forms, reports and registers were overviewed. Observation of service delivery by the researcher at CBHI scheme was used as its importance. This project was used primary data source which was collected by interviewer, and observations and secondary data was collected by document analysis. The analysis helped to collect requirements

3.6 Data Processing, Design and Analysis

For designing of the web based community based health insurance information system, the Object-Oriented Analysis and Design science techniques were used.

3.6.1 Object-Oriented Design Approach

There are different modeling languages for modeling object oriented design and analysis, which has become a standard modeling language for object-oriented design. The Unified Modeling Language is a set of 13 different diagram types that can be used to model software Systems and so supports the creation of many different types of system model. The UML is appropriate for modeling systems ranging from enterprise information systems to distributed Web-based applications. It is a very expressive language, addressing all the views needed to develop and then deploy such systems. The UML is the official industry standard for object-oriented modeling [58].

The UML is not limited to modeling software. In fact, it is expressive enough to model non-software systems. Multiple models are needed to understand different aspects of a system. UML addresses the different views of a system's architecture with different diagrams as it evolves throughout the software development life cycle. There are two major kinds of diagram types: structure (static) and behavior (dynamic) [58, 59**].**

Structure Diagrams: Structure diagrams show the static structure of the objects in a system. Elements are described regardless of time. The elements in a structure diagram represent the meaningful concepts of an application, and may include abstract, real-world and implementation concepts. Structure diagrams do not show the details of dynamic behavior, thus here class diagram employed to show static states of object in the system.

Behavior Diagrams: Behavior diagrams show the dynamic behavior of the objects in a system, including their methods, collaborations, activities, and state histories. The dynamic behavior of a system can be described as a series of changes to the system over time. In this project the researcher used use case diagram, activity diagram, collaboration (communication diagram) and sequence diagram which were dynamic employed in this project

Unified Modeling Languages used were:

- ✓ Use Case diagram
- ✓ Class diagram
- ✓ Collaboration diagram
- ✓ Sequence diagram

- ✓ System Architecture
- ✓ activity diagram

The design was used Unified Modeling language. Microsoft Visio and Dreamweaver, in the development of the prototype for this project, Dreamweaver was used. HTML was used for the construction of the interface and PHP was used to create the different functionalities, business rules and connections to the database. MySQL server was used to create the tables and save various data on them. These tools were selected for the designing and development that were chosen on the basis of their ease of use, availability, supportability of the system

3.6.2 Software Development Life Cycle (SDLC)

A systems development life cycle is composed of a number of clearly defined and distinct work phases which are used by systems engineers and systems designer to plan for, design the information systems. A SDLC aims to produce high quality system designs that meet or exceed customer expectations, based on customer requirements, which move through each clearly defined phase, within scheduled time-frames and cost estimates [55].

Systems development: refers to all activities that go into producing an information systems solution. Software development is dynamic and always undergoing major change. Systems development activities consist of:

- Systems analysis
- Modeling,
- Design
- Implementation and testing. To manage this level of software development life cycle, a number of SDLC models or methodologies have been created, such as **"agile".** In this project work agile methods were planned to be used to the design system processes. Thus

Collecting all the requirements from the user at the beginning of project development is very difficult. Users typically have difficulty explaining what they need, and the problems increase when developers fail to translate requirements into working software [55].

Object-oriented systems development centers on the object, which combines data and functionality. In simplified terms, object-oriented systems development is a way to develop

software by building self-contained modules or objects that can be easily replaced, modified, and reused.

3.7 System Testing Phase

The researcher used empirical (inspection) usability testing to maximize the usability of the prototype WBISCBHIS developed. The prototype WBISCBHIS is tested against the requirements to make sure that the system prototype developed is actually solving the needs gathered during the requirement phase**.**

3.8 Operational Definition

Claim- Formal request to the insurer for asking a payment based on the terms of the insurance agreement after the healthcare service provider giving the necessary health care service to the insured**.**

Claim Adjudication- refers to the determination of the insurer's payment or financial responsibility, after the member's insurance benefits are applied to a medical claim or pre-authorization.

Claim Processer- is a Person who checks for claim coverage and validity. They are expected to review and assess claims submitted by patients to ensure that they were certainly covered for a medical procedure by the scheme.

Clients (Patient) insure- person or an individual who dwells in the study areas and place in which he/she lives must be registered to use an insurance service and pays the premium. **Insurers**: A legal entities that controls and directs the insurance scheme. It is governmental organ that control and facilitates the insurance service.

Health care service provider- is an organization who has a contractual agreement with the health insurance insurer to provide service for those insures who are registered as insurance members and eligible.

CBHIIS- is a community based health insurance information system which enables interpretability and automation for the community health insurance scheme

Community based health insurance- a social protection mechanism which involves rising and pooling funds to finance health services, from those peoples who are working in an informal sector tasks.

3.9 Ethical Consideration

During research project, the different documents from CBHIs and health units for the research project primarily used for academic achievement only for M.Sc in health informatics. Ethical clearance was obtained from Research and Ethics Committee of the School of Public Health of Addis Ababa University. And written permission letter was also produced from the respective concerned bodies during the data collection. The investigator in order to maintain confidentiality of client data; patient name and address were not used. During data collection and organization, ethical issues was addressed as important component of the research

3.10 Method of Dissemination of Results

Being an academic project, at the end of the project document would be delivered to AAU as partial fulfillment of M.Sc in health informatics. Furthermore the result of this project would be disseminated to SNNPR health bureau, SNNPR Health Insurance Board, Guraghe Zone health insurance scheme and Gurage Zone health office.

CHAPTER FOUR

Result and Discussion

Analysis and Design of the System

4.1Analysis

4.1.1 Introduction

Requirements Collection and analysis are of the basic and essential steps in the software development cycle. Investigations of the existing system in use by various means provide the basic and necessary inputs for the system to be designed. The collected inputs should be organized in a meaning full manner to provide the appropriate functionalities of the system in a way that shows the flow of information, data generated and the users of the system. In this chapter the existing system in use, the business process, the system modeling and the design of the new system are presented.

4.1.2 The Existing System

Totally most of information exchange and processing in the insurance scheme of Gurage Zone currently is processed in manual methods. There is no any software designed in use for the scheme to register insurance members, exchange of data and information between the scheme and other stakeholders. In the insurance scheme excel is used to record insurers general data (demographic, financial and healthcare data and information). But most of information exchange handled in manual.

Manual insurance member registration, data and information retrieval in the existing system is time consuming, unsuitable and tiring. It is hard to manage client information and difficult to retrieve the required client information in the time needed and to desired standard. There are a lot of files in the office that contains different data about of client (membership data, financial claim data and health care service providers' data).

Unreadable handwritings in claim processing, it's a tiring and time taking which require a lot of health professionals and accountants not only these but also correcting errors need professional judgments. This is mainly caused by because of lack of standardized working system. The claim

processing team does not use standard ICD for coding the diseases. These cause reliance in the claim processers' team functions.

Problems regarding claim processing decision caused by lack of professionals who address all the claims with in short period of times. Currently most of the personnel's that are engaged in claim processing decisions are Accountants and health officers. As most of the claims contain clinical information, processing the claim requires basic knowledge and understanding of the diagnosis, treatment and clinical procedures. So that it needs participating health professional from different departments.

However still there is a problem regarding some clinical issues which require specialist's advice and involvement prior and post treatment claim authorizations and decisions. Based on the observations and the responses from the key informants of the scheme, it shows that the scheme doesn't have any mechanism to protect the confidential and personal health data of the clients. Thus anybody in the office can see the data without the consent of the client. This act of violation of personal information is against the right of the client and standard insurance procedure set by law. Therefore in health insurance system there should exist the professionals and patients data confidentiality demand control mechanism where there is no mechanism/system to handle these crucial stimuli.

4.2 Findings in the Current Organizational System

By the use of the structured questionnaire developed for interview, the following findings were identified. The identified issues are presented in accordance with the different information system components.

4.2.1 Existing system

In existing system of the CBHI scheme there is fragmented service provision mechanism which requires integration and interoperability. Mainly the claim and client service departments have different functionalities which needs secure and strong interoperability. The existing client registration business process involves registration of clients by their respective kebele on a form which is prepared by the insurance agency. In each kebele there exist the community coordinators who are responsible for identifying eligible community members for CBHI program. This organized committee in each kebele registers eligible client and his/her family.

The family registration includes partner and children who are aged fewer than 18. After registering each customer's information in two copies and one of registration copy is sent to the branch scheme so that a data clerk in CBHI scheme records on excel and client identification number be generated from excel based client data registration.

There is another team nominated by the scheme named claim processing team which plays the major role of preparing, accepting, processing and validating claims from the different health service provider facilities. This team accepts the different treatment and diagnosis data then checks them to provide payment decisions. These decisions are made by analysis of the claim which is conveyed by paper which needs different professionals on a regular basis. But currently in most of the schemes the team is led by accountants and few health professionals.

While the service provision facilities are mainly concerned with validating the eligibility before they provide any service to the client and after the service is given, a patient encounter form is filled with claim form that prepared by the insurance agency. These institutions provide health care services that are the heartbeat of the health insurance. They provide the kind of relationship the insured should have with the insurer.

4.2.2 Data and Process in the Current system

Based on the investigation and statements concerning different data in scheme problems are identified. The scheme is mainly concerned in recording, storing and processing of mainly membership, vital demographic, health care (clinical, diagnostic and treatment) and financial data. The information process in the existing system consists of registration, claim processing, claim decisions provision and eligibility assignments. Most of these processes are done on paper using manual methods. In time of gathering requirement information for the project, manual recorded data samples were taken to identify the data types and data elements included in the existing records. There were three types of data in the scheme i.e. members registration data, financial premium contribution data and health care providers data. For each individual members' registered data is recorded on individual paper formats. These forms are collected and filled in individual profile in the scheme. The health care service providers' data in the schemes is also filled in different profile of the institutions' files. Generally the problems in the existing system were:

- ✓ data redundancy in different files

- ✓ data overloading
- ✓ Recording data on existing formats is very tiring and time consuming
- ✓ Incomplete and inaccurate data records occur very frequently
- ✓ Loss of filled formats from individual clients file
- ✓ Lack of standard disease code and unclear health care service usage reporting mechanism
- ✓ Lack of control in data and information flow
- ✓ Lack of standard data storage and communication
- ✓ Lack of confidential data storage and retrieval of health data and information
- ✓ Lack of information and process interoperability between the different stakeholders

Information retrieval is done by searching individual names and a Microsoft Excel generated identification number of clients, which is recorded previously. The exchange of data and information between scheme and concerned bodies is stored and forwarded mainly by paper reports. Currently the scheme does not have any real time automated system for data analysis and information processing in use. Besides the data and information processing, there is no mechanism to check the data quality and flow control in the organization.

The health care service utilization review of each client was recorded manually thus it was copied and attached to patient file in a place where the client receives service. When redundant service provision given to the client, it made recording of data huge with each visit at different service providers setting and in the insurance schemes also different data standard make the clients to have different files at different settings with varying standards.

4.2.3 Report /Communication in the Current system

The information exchange between the scheme and other concerned bodies was totally manual. There were no automated system to generate reports regarding claims, dynamically changing members and members' family status and other activities in the organization. The clients would use paper based change request form to announce any change in them and their families' status. These change notification process would take long times to be processed. The service providers would need client's information and insurance coverage information for validation of eligibility

and controlling of service provision. In the existing paper based system there were no mechanisms for actual checking of membership from supplier side except the paper card in hand with the insured, which would be prone to fraud and faked.

In the existing system insurance information flow among the scheme, service providers and the concerned bodies was in a hand written way or in using telephone. This manual information flow had a possibility of being lost and edited without legal and formal change handling mechanism. Within the scheme reports are prepared daily, weekly, monthly, and quarterly and annually. These reports mainly include number of insured's, service utilization, diseases patterns, treatment patterns, financial expenditure. And these reports were submitted to the different concerned government offices using manual paper based mechanism

4.2.4 Users (People in) the Current system

All the customer registration (data clerk in the scheme) and claim processing persons have access to editing, updating any client information in the existing system without legal permission. The customer registration office is responsible for the errors that are made during recording of customers data. While the service providers and claim management team of the scheme are responsible for errors regarding processing of claims (the scheme coordinator, accountant of the scheme and organized team of the health care service providers in health care facility). In the scheme all the officers have the basic computer skills. According to the information gathered from scheme officers almost all of the officers have a good internet usage custom and have internet access in the office and also can use social media's networks.

Table 1: Stakeholders and their responsibilities

Stake holders in the current system	Their responsibilities
CBHI scheme	A government organ that provides Insurance service to the community (insures) and signs contractual agreement with health care providers Controls functionality of the service according to agreement
Health service providers	Any health facility that have concluded an agreement with insurance agent to Provides health care service for beneficiaries according to contractual agreement. Hospitals and health centers.
Woreda, zonal health offices and regional health bureau	Government organ that facilitate the program, control legal issues and accept general reports from schemes.
Member	A person registered for the community based health insurance scheme and paying contribution to the scheme to receive the service provided by the supplier.
Regional insurance coordinate	Government institute that Issues rules and regulation for the functionality of the schemes and accepts reports from schemes.

4.2.5 Work Flow in the Current Insurance Management System

In the existing system the organization would follow a national guide line for client insurance registration, claim processing and management .The insurance registration procedure comprises of:-

- ✓ Clients and their family members information registration
- ✓ Status change management: birth, death, marriage etc
- ✓ Eligibility assignment and validation: providing insurance ID

- ✓ Control and monitor the whole system

While the claim management department has a responsibility of

- ✓ Processing claims: checking service provision documents and making payment
- ✓ Providing decision regarding claims
- ✓ Service Provider and client service utilization control: the service provision should be according to the agreement.
- ✓ Fraud control: controlling fault
- ✓ Procedural change management: service providers and service users should flow the contractual agreement between scheme and service providers.

The problems in the claim department and registration process are handled by their respective focal personals in department.

4.2.6 Existing Software and Hardware in the Current system

There are five desktop computers in the zonal insurance scheme, thus each one of the officers have their own computer. The officers use the computers mainly for Microsoft Excel based report writing and browsing internet. There are thirteen woreda and two town administration in the zone each woreda has insurance scheme except three i.e. twelve district schemes present in the zone. The findings are obtained from the interview and observation done on the existing system. The investigation on the existing manual system helps to identify the opportunities, problems. Moreover it will help to identify the possible stakeholders and to understand the business domain of the stakeholders

4.3 The Proposed System

The newly proposed system for the Gurage Zone Community Based Health Insurance Scheme would help to facilitate and improved service provision of the stakeholders and to enhance the creation of standard data sets with secured information transaction. The new system would reduce the errors that were common in the manual paper based recording process. It would also help real time, fast claim data and information processing. The generation of defined report from the system would also enable to make sound decision by the stakeholders and policy makers.

Additionally the system would help to reduce and control moral hazards, supply and demand side induced unnecessary service utilizations.

To check the eligibility and manage any status change of scheme members with full security control from the insurance scheme would also be another feature of the system. The system generally would support registration system, record management system, eligibility validation system; claim management system, support to send referral information management from sender to receiver of the system, sends notification messages of vital events and report generating system. This proposed system would have a great importance and would solve the problem in manual system i.e. any data handling and exchange would be electronic that minimizes huge paper files in the scheme and health care service providers setting. The new system would reduce errors and help proper documentation for each and every step of insurance service process and patients treatment data. The new web based system would enable the different insurance schemes in the different district provides the access of digital data entry, store, dissemination and retrieve with the support of the necessary access privilege.

4.4 Functional Requirements

Functional requirements mainly deal with explaining on what has to be done by identifying the necessary task, action or activity/ and functionalities the system should provide to users and the tasks that must be accomplished [60]. This web based community based health insurance information system is designed in the way that enables the stakeholders to gather, analyze, distribute and utilize health insurance information at whole organization levels (system boundary). Besides those functionalities it will enhance secure health information transaction, proper control of service utilization and standard data definitions across the system. The functional requirements were presented below**.**

Table 2: Functional Requirements

RQ_ID	USE CASE ID	Requirement Descriptions
RQ_1	GZCBHIIS _1	The system should enables registration of client and his family members in the registered scheme.
RQ_2	GZCBHIIS _2	The System must provide a structured view of the insured members information
RQ_3	GZCBHIIS _3	The system should enables searching of data from the database by name, identification number, primary phone etc. to see if beneficiary has existing enrollment record
RQ_4	GZCBHIIS _4	The system should allow validate eligible client from the database by insurance id , or by the registered phone number
RQ_5	GZCBHIIS -5	The system should keep records of scheme and client's basic health care and personal information
RQ_6	GZCBHIIS -6	The system should accept data based on the sets of rules and policy and refuse some actions from ineligible(uninsured) client which are decided not to be included and covered by the insurance
RQ_7	GZCBHIIS -7	The system should enable the service provider submission of claim requests
RQ_8	GZCBHIIS -8	The system should enables users to update specified data sets and record based on its privilege
RQ_9	GZCBHIIS -9	The system should enable the registered user to view insurance and personal data with restricted access privilege
RQ_10	GZCBHIIS-10	The system shall enable users to make secure transaction of claim adjudication request and decision
RQ_11	GZCBHIIS-11	The system shall enable the health professional to submit and apply changes to the status of the client and his family during Vital events(death, birth, disability and mental illness)
RQ-12	GZCBHIIS-12	The system shall enable user to have secure transaction of pre-authorization request and decision
RQ-13	GZCBHIIS-13	The system should enable generation of report based on daily, weekly, monthly and annual basis
RQ-14	GZCBHIIS-14	The system shall capture name and ID number of authorized person that authenticated beneficiary during pre-authorization request
RQ-15	GZCBHIIS-15	The system should send, reportable and epidemic diseases notification alert to the WOREDA, ZONAL health office and REGIONAL health bureau.
RQ-16	GZCBHIIS-16	The system shall support data exchange in actor relationships.
RQ-17	GZCBHIIS -17	The system should enable to control group of system users.

4.5 Non-functional Requirements

The non-functional requirements describe user visible aspects of the system that are not designated to the functional behavior of the system. It is the overall characters that make the product property attractive, usable, fast or reliable to the users. It is the feature (visual appearance of the human interactive interface of the system) of the new product. They cover on a number of issues from user interface to security issues and the constraints of the system to improve quality service. Non-functional requirements lists include portability, availability, scalability, reliability, efficiency, human engineering, testability, understandability, interface, security and modifiability of software quality**.**

Table 3: Non-Functional Requirements of WBISCBHI

Req -id	Requirement descriptions	Requirement type	Requirement source	Ranking	
				Mandatory	Optional
1	The system should provide service within different hardware and software platform versions without limitation of time, location and technology.	portability	Reference	√	
2	The system should be available for 24 hours a day and 7 days in a week.	availability			√
3	The system should provide secure information transfer without confidentiality defect traits	security	Users request	√	
4	The system should support varying users' request. it shall allow faultless scalability and the network infrastructure accommodation	scalability	Reference [61]		√
5	The system should at least use English language or Amharic for all interfaces	usability	Usability of interfaces		√
6	Reliability in the system should exist by settling standard rules that users follow for consistent data and information exchange. The standard rules help to create, organize, disseminate and store a common database of system for users.	Reliability	Reference [56]	√	
7	The system should use client-server architecture			√	

1. Portability

The system will provide service to users without time, geographical location and technology limitation. Portability is the ability of a system to run in different environments. Also it is an act of producing an executable version of a software unit or system in a new environment, based on an existing version. These different environments refer both to the hardware and software platforms that are designed by different manufacturers which help to reduce the cost of redevelopment [56].

2. Availability

Since mankind's healthy needs are unlimited, health facility should have to work and be open for the service for 24 hours/day and 7 days in a *week* to provide health care demand of the community. The deployed system has to functions without interruption of electricity power break and the server should support the system functionality without interruption. In addition the system should be use English language since it is difficult to translate the diagnosis and medication of illnesses.

3. Scalability

Scalability is the ability of the platform to scale both up and down to support varying numbers of users or transaction volumes. The application should be able to scale horizontally (by adding more servers) or vertically (by increasing hardware capacity or software efficiency) [57]. It is to mean to widen the scenarios of the intended system. Even if the designed system aims to serve in a district level, it has to scaled up to the zonal and regional level and even to the national level based on the interest of system users. While designing this project, it considered currently available health institutions and level of health professionals increasing in the country. Therefore the system should rise up to hold this escalating condition without a noticeable performance reduction. Due to the numbers of healthcare providers as well as professionals are increasing, so, the architecture used should allow faultless scalability and the network infrastructure also provide accommodation. Along with the scalability issue, it is simple to add services or integrate works with other systems. In addition to using a tiered architecture, to further simplify scalability, Web based system has to support health insurance service to allows changes, to consume the common services [58, 59].

4. Privacy and Security

In health insurance information system there exist different business processes and transactions that need security. Since the system is going to handle personal information which is confidential, it should be protected from an unauthorized users and intruders. No one can log into the system without a registered user name and corresponding password. The system should grantee for each authorized users access with its unique user name and password. Moreover the system will use encryption techniques to avoid the tapping of the data while in its transfer. The system users can communicate and interact with each other without confidentiality trait. This will prevent the system from being accessed by unauthorized.

5. Reliability

In a system where there exists variety of users interaction, various type of information needs and different critical decisions going to made, there should exist standard of rules and settings that help to communicate and understand concerning the data and information flow throughout the stakeholders in the business environment. Each of the business integrators should flow the rules settled to interact with the system. Consistent data and information flow through the system would facilitate the interaction simply. Unless ignorantly, Decisions made using this data wouldn't harm anyone and would have reality for its consistence and tolerability. In health insurance in system, there is variety of data type that flow throughout concerned system which integrated insurance members, health care providers and other health insurances' service coordinators. Each of these bodies should be interacted the system with a common standards of rule. The data that are created, organized, disseminated and stored would help in the system to bring common database for them. It helps to make health and financial decisions and also policy makers use it. It should be preserved in a secured place and portable current technologies where outreach of unauthorized users, damage from physical touches and natural disasters. They should preserve backup copies of the data in them for reuse when damaging problem happen. Since web based system will supported by internet networking and the information created in the system helps to make different clinical and financial decision by policy makers and financial institutions. It also helps to handle different errors and take corrective measure automatically [60, 61].

6. Performance

Since Health professionals are engaged in stressful tasks in their service provision environment and also dalliance for a micro second would cost a life. In health insurance service provision and the customers' service management consists huge data type and content it needs automated system that helps to minimize resource (space, time, materials and professional person) that is required to provide complete service for the clients. Therefore designing an interactive system with interfaces that minimize the users' tasks duration and facilitate interaction with the system is very important. To enter and retrieve data from the system, usable user interface should reply guaranteed performance for the system users. The system shall have flexible and convenient interface for data import/export with other application [58, 59] In order to maximize the performance of the system, the system should allow easy sign in of user to the system. The system should be able to convey a client's records as for every request of the health professional. The system users should be able to retrieve the clients' information within the given standard. The system should display required service usage information of specific patients' rapidity in requested time.

4.6 The Proposed System Architecture (Three Tiered System Architecture)

In the health insurance system there are different data types that are crucial for the complete functionality of the system. The data concerning insurance members, financial data and the healthcare service provider's data. These are the major data types obtained from the insurance agency. Health care service providers obtain the various critical information concerning members from the insurance agents' data source stored on their database. Users can access and save onto their databases and data warehouses on a regular basis for the purpose of use in diverse communal and health matters. To access this secured information resource it needs accessibility privilege from the authorized personnel [72, 74].

To realize the full functionality of community health insurance information system, it is important for System components and technologies be integrated with one another within an institute and outside of it to enable smooth operation of the system. System architecture is used to depict the different components of informational needs and process within the intended system.

Architecture modeling is used to describe the action that each component capture based on stakeholders' desires and concerns. Information systems architecture is used to show the key elements and relationships that constitute the required system. For the successful implementation of the Enterprise architecture, it is necessary to bring together the basic building block of information system and showing how to interact components that facilitate the communication among the building blocks [75].

Therefore in designing the community based insurance information system the three tied architecture design system is used to show the desirable design components of web application environments. These include client (front layer, browser on client device), the server (the middle layer, software connector or controller request and response) and the database (the back layer, data storage part) are the basic parts required to address the three tied information system. There are different standard rules and protocols that used to interact with these components of the system to enter, retrieve and process easily in the working environment.

The stakeholders who require these data that stored geographically in different place can acquire there needed information using web browsers. They need information from those differing locations with various protocols and data definitions and data structures. The three tier architecture information system design can address these stakeholders requirement [76]. In this proposed web based information system as it involves various transactions, retrieval and processing that can be implemented using a web browser on any computer that can has an access to internet, thus the system use three tier system architecture. This three tied system architecture runs on a web technology. Thus the proposed web based technology provides great scalability, portability, increase efficiency, reusability with ease of maintenance during failures. The system has a dynamic nature so the retrieval and entry of data can be performed whenever possible irrespective of time and geographical constraint. In each components of the tier there is different tasks performed i.e. presentation, control (connection) and data storage [73].

4.6.1The Front Tier (Web Browser)

Web browsers that are available on most computers and devices are used to access and retrieve the various data from different location with the help of web application protocols. From the various web protocols HTTP and HTTPS are already built in most computers for web browsers. The system involves participants that need to access and retrieve various data from various locations and devices. The advantage of web applications can be used to make the availability of the services throughout the coverage areas. Besides the scalability of the web applications on the front end, a number of users can be served at the same time from the same or different locations. This state depends on the capacity of the server, speed of the internet and processing capacity of the computer

As this tier is the front end with which the users get access to the system through the web protocols it needs a serious security controls. The different stakeholders in the system are assigned with different privilege to access functionalities of the system. This is made to provide varied permission to each user according to the need type of stakeholder group assigned. The assignment of the group is made by the type of functions each user engage with and the informational need of each user. In order to address secured communication, business transaction and authentication, creating user privilege and secure socket layer connection that used to controls and encrypts information exchange between the front and the middle layers of the tier is very important.

4.6.2 The Proposed Middle Tier (Web Application Server or Web Server)

This layer of the system handles the basic business logic and the rules in which the system has to perform in. The web application layer holds all the applications codes that make possible the communication between the database and the front end. In this layer most of the application logic and rules help to translates clients process needs into database queries and brings databases responses with regard of the information request and data need of the users. It act as a bridge between the user and the database and functionalities' the user needs from the system. The provision of authentication privilege, client's validation, user account checking and the various queries accessibility laws are found on this part of the health insurance information system layer. It controls the general data flow between requester (user layer or front layer) and the response (database layer or back layer).

4.6.3 The Proposed Back End Tier (Database layer)

The third end or the back end layer of the system used to stores and provides the different data that are required for the full functionalities of the system. In this layer the different data that are collected through member registration, patient clinical data, demographic data and different customers and financial data are stored and saved on this layer for retrieval. The major functionalities that the system provides are gathered from the different service providers in a modularity basis. This helps to create an opportunity for the system to implement the new tiered technology. The diagram below shows the three tiered architecture design of the GZWBISCBHIS (Guraghe Zone Web Based Information System for Community Based Health Insurance Scheme).

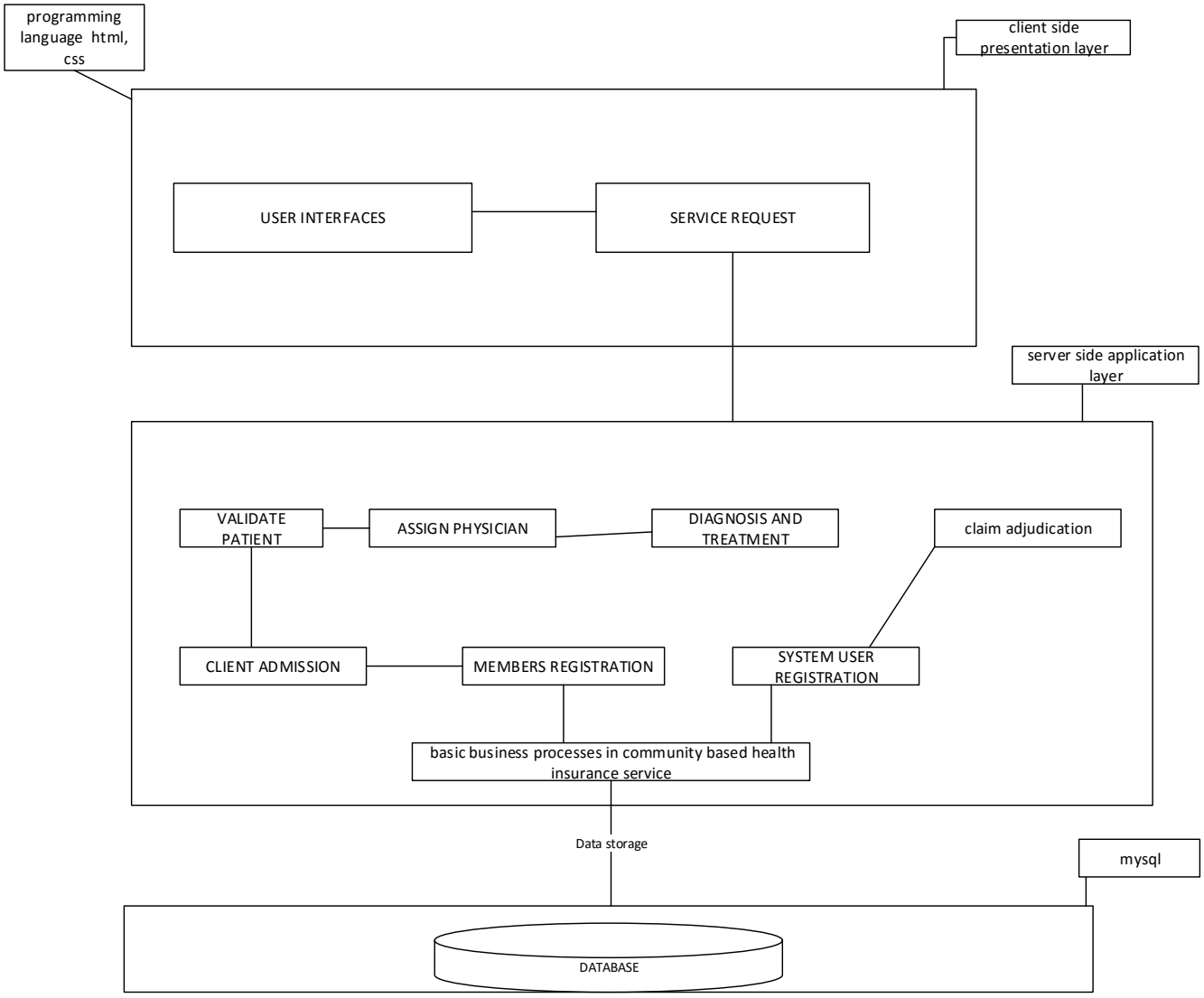


Figure 1: The proposed three tiered architecture of web based information system for community based health insurance scheme

4.7 Modeling

4.7.1 Process Modeling

Technique used to represent the conceptual framework of the basic business process (activities) in an organization is called modeling. Modeling is representation of the general activities that has overtaken in a business, data flow throughout the business domain and the business logics that should exist in the process. It shows the business flow within and between organizations.

Modeling helps to simplify understanding of the general business scenario for a business system and depicts various processes of information transfer throughout the business domain. Thus understanding the common business knowledge in the organization enables one to identify present business situation and able to derive the new design requirements proposed.

4.7.2 The proposed system

The proposed system would integrate those different functionalities that need to be interoperable for full functioning as a system. The system would have a registration module which registers client, system users and health care service providers. After registration of client, the system generates individual identification number. These numbers would be used for every access need of the client data from and into the system. The identification number can also be used as a file identifier for the clients file to be saved on the database. When there was a need for validation of a client to use any service, the eligibility management unit would provide the eligibility checking and validation of the client.

Providing respective health care services to the client, health care providers would record each service provision and individual client's clinical data and save on the database. Each health professional would submit claim request with insured's clinical history onto the database. Therefore claim processing teams would use the data as a reference during claim processing and pre approval processing.

Using the claim request information forwarded by providers, the claim adjudication management unit would spread the client's data over the network. Since the new system is web applicable, any health professional assigned as a claim processer to provide the needed decision for the claim can browse and see it. Based on the recommendation provided by the claim adjudication group, the insurance agent would

accept or reject the claim request. The claim can be processed further and their payments be made in accordance with the decision. Not only claim adjudication but also some procedures which require pre- authorization by the scheme can be processed and decisions be easily made. Finally the decision report is generated and then transmitted to concerned stakeholders

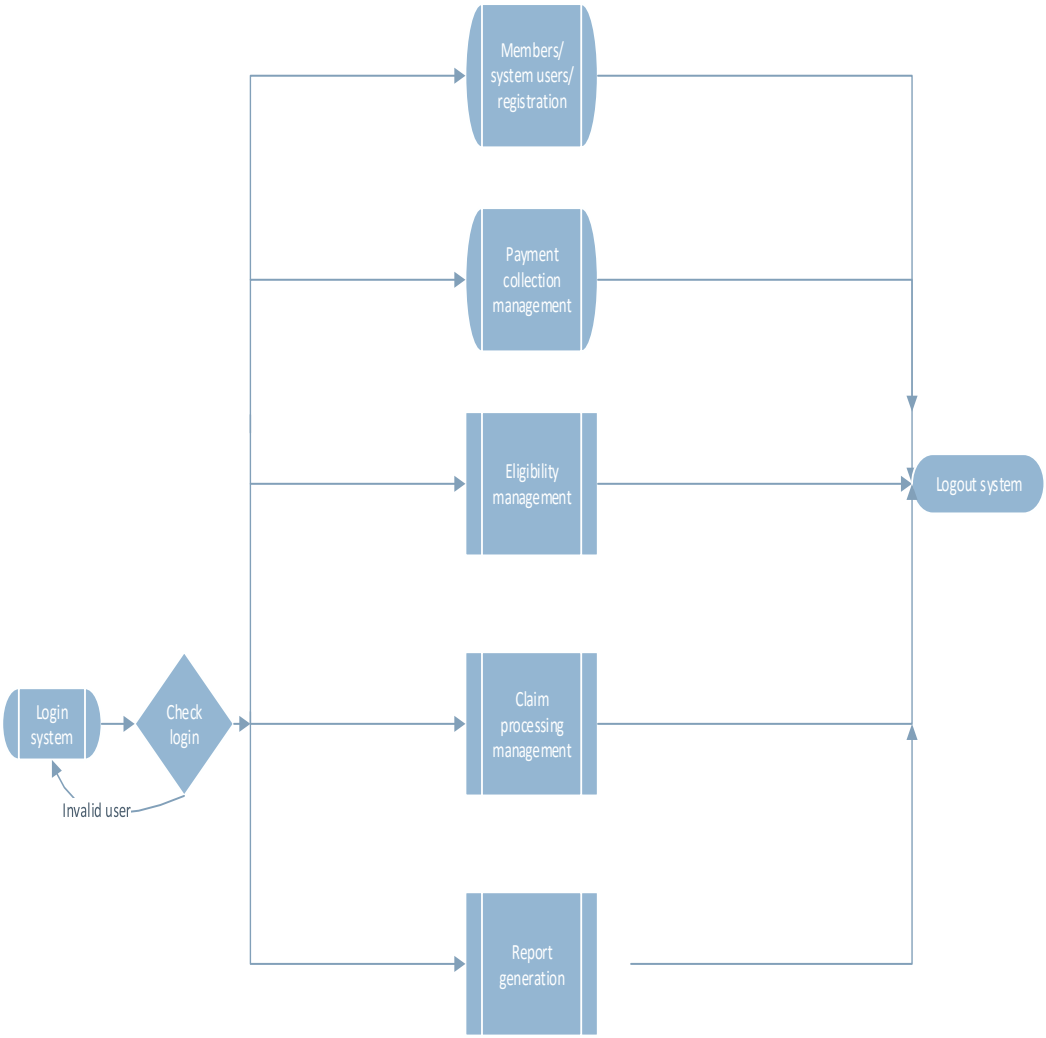


Figure 2: Business process modeling of the proposed web based information system of community based health insurance scheme system.

4.7.3 Conceptual Modeling

The intent of the conceptual modeling is to direct attention at an appropriate decomposition of the system without delving into the details of interface specification. The conceptual architecture identifies the system components, the responsibilities of each component, and interconnections between components. It shows the basic business functionalities in the system and decides system boundary and the functionality should included in the system environment. Conceptual models normally show the environment and several other automated systems. However, they do not show the types of relationships between the systems in the environment and the system that is being specified. The diagram bellow shows the different business processing in the main web based information system of community based health insurance system.

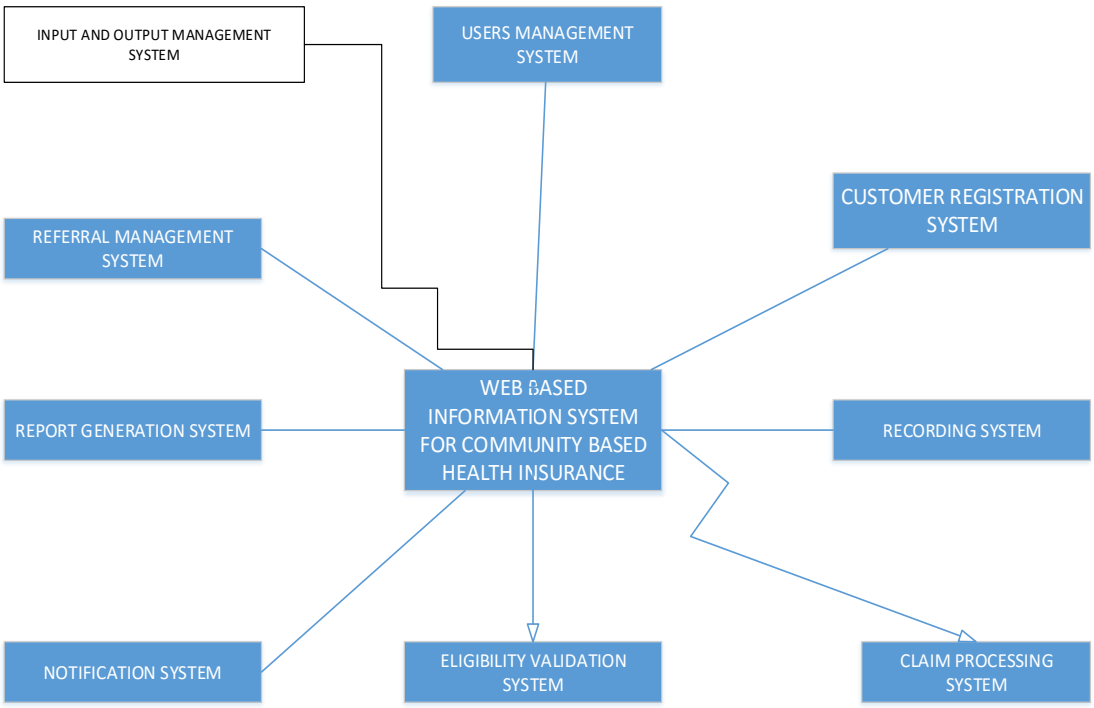


Figure 3: Conceptual modeling of the proposed system/web based information system for community based health insurance scheme

4.7.4 System Modeling

System modeling is the process of developing abstract models of a system. In modeling software system there exist different approaches with which the designers will follow in their work. The model can depict the different features of the system that is planned to have it. These models are done in time of requirement engineering which helps to map features (output) in delivery system. In modeling of the system different business interactions, structures and related behaviors are targeted that is expected at the final system [62, 63]. Implementation technologies are not at an enough level of abstraction to facilitate discussions about design, which creates a need for software models. Models describe the desired structure and behavior of a system. They are important for visualizing and controlling the system's architecture. A model is a simplification of reality [64]. It provides a better understanding of the system, which expose opportunities for simplification and reuse.

Defining a model makes it easier to break up a complex application or a huge system into simple, discrete pieces that can be individually studied. It is easy to focus on the smaller parts of a system and understand the "big picture". Hence, the reasons behind modeling are readability and reusability. Readability makes it easy to understand, and understanding a system is the first step in either building or improving a system. This involves knowing what a system is made up of, how it behaves, and so forth. Modeling a system ensures that it becomes readable and, most importantly, easy to document. It involves capturing the structure of a system and the behavior of the system. Reusability is the consequence of making a system readable. After a system has been modeled, similarities in terms of functionality, features, or structure are identified

4.7.5 Use Case Modeling

Use Case modeling is the simplest and most effective technique for modeling system requirements from a user's viewpoint. Use Cases are used to model how a system works. Use cases are not inherently object-oriented approach. It is really a form of process modeling. It is, however, an excellent way to lead into object-oriented analysis of systems. It is an external (user) view of the system which is intended for modeling the dialog between the users and the system. Use cases are generally the starting point of object-oriented analysis with UML [65, 66, and 67].

The Use Case model consists of actors and use cases. An Actor is a role of an object or objects outside of a system that interacts directly with it as part of a coherent work unit (a use case).

Actors also represent users and other systems that interact with the system that are drawn as stick figures. They actually represent a type of user, not an instance of a user. Use cases represent the behavior of the system, scenarios that the system goes through in response to stimuli from an actor [67].

In the web based information system for community health insurance mainly the following actors present each of them with their respective recognized tasks**.**

Table 4: System actors and its' description for web based information system on community based health insurance

Name of actors	The description for actors
Customer (insured clients)	Is a person for whom the health insurance scheme provides insurance coverage
Health insurance scheme(agency)	Is a government body that is responsible for registering the client in order to provide insurance coverage.
Data clerk	A person who works at the service provision setting and performs registration or validation of insured's data up on clients' arrival to the scheme or the health care institutions.
health office, RHB or FMOH	Is respective health organization that is responsible for controlling and overseeing the agents' (scheme's) functions and accountable to take responsive measures during epidemic or emergency outbreak of diseases.
Health professional	Is a person who works in the service provision setting, performs diagnosis, treatment to the insured and performs claim request
Stakeholder	A person/organization interested in viewing the reports generated by the system.

Claim Adjudicator	A group of health professionals and an accountant who provide the pre-authorization or authorization claim decision
System administrator	Is a person who provides different security access permission to the system users and maintains user account of the system.

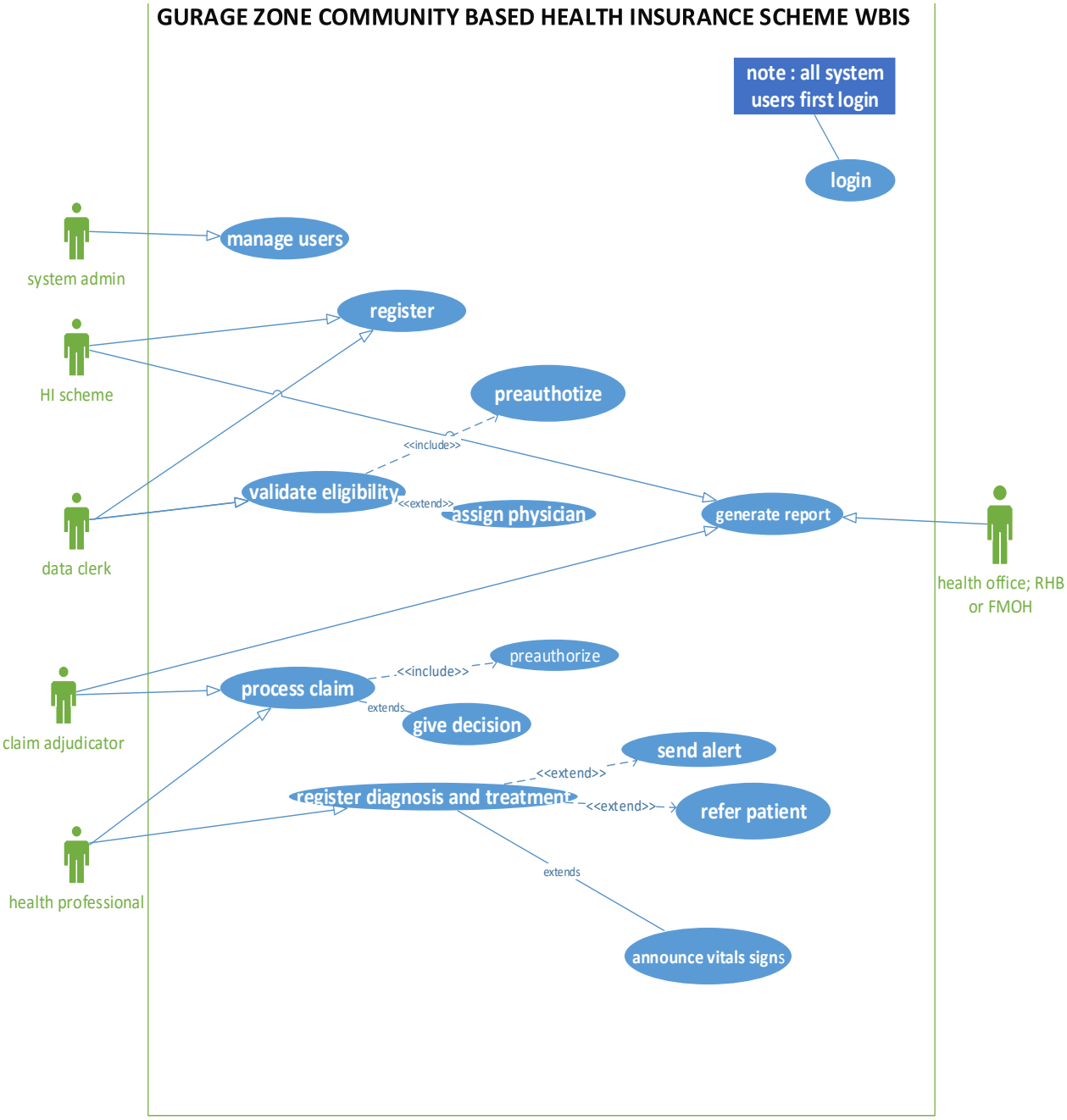


Figure 4: The use case diagram for the proposed system/GZHISWBIS/

The web based health information system for community based health insurance system

Login

User admin

Customer registration

Register system users

Validate eligibility

Assign health professional

Register diagnosis and treatment

Send referral

Process claim

Send alert

Generate report

Table 5: Use case narration for the login system

Use Case- Id	Uc-01
Use Case Name	Login
Use case Description	Describe how the user is authenticated by the system for the different functionality
Primary Actor(S)	Health insurance scheme(insurer), health professionals, data clerk, claim processers, report viewers, system admin, respective health office or FMOH
Trigger	The user opens the home page
Pre-Condition	The user must have username and password
Post-Condition	The user logs into the system and system displays main page.
Basic Scenario	1. The user opens WBCBHIIS ; 2. The user clicks to login button; 3. The system displays login form; 4. The user enters user name and password 5. The user clicks on login button; 6. The system validates user from database and displays main page 7. The use case ends.
Alternative scenario	4. A. if the username or password is incorrect, the system displays an error message “not registered ” 4. B. if the user does not use the correct password , the system will lock after successive three trial

Table 6: Use case narration for registered system users

Use case ID	Uc-12
Use case name	Register system user
Use case description	The Zonal Health Insurance scheme registers insurance schemes in different woredas/town of the zone to make them part of the community based health insurance system and others of system users(health providers)
Primary actor(s)	Gurage zone health insurance scheme
Triggers	The users request to be get community health insurance coverage for the clients and for their family of its own distinct
Pre-condition	The registered users must login into the system The registered users must be authenticated and authorized by its own assigned privilege it is handled by system admin.
Post-condition	The user data will be saved onto the database A specific user ID will be generated
Basic scenarios	1. The system displays a user registration home page 2. The registered users select the user registration page 3. The system displays users registration page 4. The registered user insert necessary user information 5. The system checks for the data type whether it is in the correct format 6. The registered user clicks on the submit button or updates the filled data 7. The system saves or stores the users data onto the database 8. The system user exits the system 9. The use case end

Table 7: The use cases narrations for register customers into the system.

Use case id	**Uc-02**
Use Case Name	Register customers
Use Case Description	Health insurance scheme (agency) register eligible community members for community based health insurance coverage.
Primary Actor(S)	Community based health insurance scheme(agency)
Trigger	Community health insurance coordinators of respective kebele in woredas and town request to get insurance coverage for eligible individual form the community and his/her family.
Pre-condition	The user in scheme(data clerk) must be logged into the system The scheme user must be authenticated and authorized by its own assigned privilege
Post-condition	The customer data be saved on the database A specified customer ID will be generated
Basic Scenario	1. The System displays member registration home page 2. The scheme user (data clerk) click on the members registration page 3. The system displays members registration form 4. The user inserts the necessary information. 5. The system checks for the data type if they are in the correct format. 6. The user clicks on the submit button or updates the filled information 7. The system saves the member information onto the database. 8. The user exits the system 9. The use case ends
Alternative scenario	2 .A. if the scheme changes user status , the user opens update status page 2. B. The scheme user inserts the update status Information 5. A. if wrong data type is inserted to the system , it will notify to correct the information 6. A. If the scheme user skip the necessary information , the system prompts an error message on the blank space 7. A. if the customer is registered, the system display “Registered” message 7.B. if the customer is not registered , the system display “Not Registered” message

Table 8: The use case narration for user account admin

Use case id	Uc-03
Use Case Name	Administer user account
Use case description	This use case describes how the manager to create, update, manage or remove a user account information process and provides privilege to the users of the system
Primary actor(s)	System manager
Secondary actor	System user
Trigger	The manager must login into the system and access the different service of the system based on its privilege.
Pre – condition	The system manager must be registered system user. The system manager must be authenticated and privileged user of the system.
Post-condition	Users account information should be controlled.
Basic scenarios	1. The System manager should opens the system administrator home page 2. The manager clicks on system administration page. 3. The System displays the different users account options of the system. 4. The system manager clicks on add a new account creation form 5. The System manager checks a user account from list of Identification numbers or phone number. 6. The System manager fills the required information on the forms 7. Click submit button to save the data 8. The system creates user account with provided privilege to use the system 9. The system validates and confirms the inserted data 1. The use case ends
Alternative scenarios	4 a. if system manager wants to view registered users he/she clicks on view registered account user option. 4 b. if system manager wants to update user account he/she clicks on update users account to update users accounts option

	4 c. if the system manager wants to delete he/she clicks on delete user account option. 5 a. the system manager checks the information changes on the users account. 5 b. the system manager clicks on submit button to save changed information. 5 c. the data will be saved onto the system user database 8. a) if the system manager wants to deactivate the user account b) click on the identification number of that user c) The system displays the information of the user d) The system manager clicks on deactivate button of the system. e) the system will deactivate the user account from the database f) the data will be saved onto the database 8. if the primary password mismatches with the confirmation password a) the system notifies the passwords "not match" b) the system lets the user to reinsert password 9. If the system administrator skip the necessary information a.1 the system prompts an "error" text message a.1.1) if the information is updated the system display "Updated" message a.1.2) if the information is not updated the system display "Not Updated" message

Table 9: Use case Narration for Validate Clients

Use case id	Uc-04
Use case name	Validate clients
Use case description	The data clerk validates client (insured's) insurance Identification number before allowing clients(insured's) to grant access to different health services
Primary actor(s)	Data clerk(receptionist)
Triggers	The client(insured) or his/her family(partner and children aged less than 18) must arrival at the accredited health care setting to obtain health care service
Pre- condition	The data clerk must be registered as system user The data clerk should logged into the system The data clerk must be authenticated and authorized The client (insured) is registered
Post- condition	The system should validate the client (insured) by his/her registered phone number and with Identification number.
Basic scenarios	1. The system displays Validate client home page 2. The data clerk clicks on Validate client form 3. The data clerk inserts an ID or phone number on to the form. 4. The data clerk should clicks on search button 5. The system searches for the entered data from the database 6. The system prompts result 7. The data clerk exits the system 8. The use case ends
Alternative scenarios	5.a. if the ID or phone number is correct the system display "Eligible " 5 b. the system displays "assign physician" page 5 c. The data clerk clicks on "Assign physician" page. 5 d. if the identification number or phone number is incorrect the system display "Ineligible

Table 10: Use case narration for assigning health professionals

Use case id	Uc-05
Use case name	Assign health professionals
Use case descriptions	The data clerk(receptionist) assigns health professional for the insured client from specific department of the accredited health care setting
Primary actor(s)	Data clerk or receptionist nurse
Triggers	The client (patient) is validated by his/her registered phone number or ID number
Pre-condition	The data clerk (receptionist nurse or physician) must be registered system user The data clerk should logged into the system The data clerk ,receptionist nurse and health professional must work in the same health care setting and authenticated and recognized system user
Post-condition	The system assigns customer (patient) to health professional(physician) The client id be sent to physician account
Basic scenarios	1. The system displays Client home page 2. The data clerk clicks on assign physician option button of Client home page 3. The system opens assign physician form 4. The data clerk selects the specific physician and his/her department from the list 5. The system checks the availability of the physician 6. The data clerk assigns customer (patient) to the specific physician 7. The client(patient) data appear in the specific physician account 8. The system prompts result 9. The data clerk exits the system 10. The use case ends
Alternative scenarios	5.a if the physician is not available the system displays “not available ”text message 5a.1 the data clerk cancels physician assignment 6. If the client(patient) is assigned to physician 6.a.the system prompts “Assigned” message

Table 11: Use case narration for claim processing system

Use case – Id	Uc-06
Use case name	Claim process
Use case description	The physician who is system user after service provision will send the client clinical information to claim processer and the claim processer use the information as evidence to make clinical decision
Primary actor(s)	Claim processers in respective insurance scheme(agency) , health professionals
Triggers	It helps for payment and stores evidence about the insurance service provision
Pre-condition	Claim processer should work in the insurance agent and the registered system user Claim processer should logged into claim processer home page Claim processers should record processed claim information of the client on claim processing form
Post-condition	The processed claim information should be sent to the scheme and the requested decision should be made in the settled condition.
Basic scenarios	1. The system displays claim adjudication home page 2. The claim processer clicks on a pending claim approval option menu form 3. The system displays pending claim approval page 4. The claim processer selects clients claim appearing by their insurance ID 5. The claim processer clicks on that specific identification number 6. The system displays the full medical history of the client

	7. The claim processer provides decision 8. The claim processer exits the system 9. The use case ends
Alternative scenarios	4a if the pending claim approval is pre- authorization 1. The claim processer selects customer claim ordered by their insurance ID 2. The claim processer clicks on that specific identification number 3. The system displays the full medical history of that client 4. The claim processer provides pre-authorization decision 4b if the pending claim authorization is a claim 1. The claim processer selects client claim ordered by their insurance identification number. 2. The claim processer clicks on that specific identification number 3. The system displays the full medical history of that client 4. The claim processer provides claim decision

Table 12: Use narration for send notification system

Use case id	Uc-07
Use case name	Send notification message
Use case description	The system sends notice messages to respective health institution and EMOH
Primary actor(s)	Health care professionals
Triggers	When the physician diagnosis the client's health case if any new cases obtained through the process the physician reports the notification message to the concerned bodies
Pre-condition	The physician should works in accredited health institution The physician should be registered system user The customer should be assigned to that physician by the clerk The physician logged into the system
Post- condition	The system send notification message of reportable diseases to the concerned bodies
Basic scenarios	1. The system displays notification send home page form 2. The physician records clinical data into diagnosis and treatments form and then saves onto the database 3. The physician selects diagnosis and finding option form 4. The system opens diagnosis and finding form. 5. The physician records the different clinical and physical findings into diagnosis and finding form 6. The physician opens the reportable disease and finding form then records reportable diseases 7. The he/she saves the data onto the database 8. The system will send the report to the concerned bodies as alert 9. The physician exits the system 10. The use case ends
Alternative scenarios	5 a. if the system send the reportable disease notification 1. the system prompts "Notification sent" 8.b if the system fails to send the reportable disease notification the system prompts "Notification Not sent"

Table 13: Use case narration for generate report system

Use case id	Uc-08
Use case name	Generate report
Use case description	Describes the process of generating different reports for privileged report viewer
Primary actor(s)	Insurance agent ,health institutions
Triggers	1. The system user request to generate report 2. The user login into the system
Pre condition	The report viewers should be authorized to view the report from the system database The report should exist in system database as the report viewer need (request) Report viewers should have security access for the confidential data
Post condition	Report is generated based on the need of the report viewer
Basic scenarios	1. The report viewers should open view report home page 2. The report viewer clicks on the generate report menu. 3. The system presents the list of available reports types. 4. The report viewer should clicks the report of his/her need 5. The system presents the description of that report 6. The report viewer confirms the report if it is what he/she needs 7. The system generates the selected report 8. The system displays the preferred report on the viewer computer screen 9. The system saves the report onto the database 10. The report viewer click on print button to print the generated report 11. The use case ends
Alternative scenarios	7 .1 if the system displays the available options of report type 7.1.1 The report viewer select one or more filtering criteria from the options 7.1.2 if there is no data match with report viewers request 7.1.3 The system prompts" no matching data found" 8.1 if the user confirms to have the report in different format 8.1.1 The report viewer click on the export report button 8.1.2 the report viewer Select the file type report his/her need

Table 14: Use case narrations for diagnosis and treatment of the system

Use case ID	uc-09
Use case name	Diagnosis and treatment
Use case description	The system register general medical and clinical history of the patients
Primary actor(s)	Health professional (physician)
Triggers	The system displays complete diagnosis and treatment assessment result of patient(client) The system displays a complete list of symptom and problems summary
Pre-condition	The physician should be logged into diagnosis and treatment home page The physician must be authorized system user The patient should be assigned to that physician by the clerk The patient should be eligible to the system
Post- condition	The system should saves or stores patient diagnosis and treatment results on the client database.
Basic scenarios	The system should display the insurance service providers(physician)account The physician selects the customer medical and clinical history record processing menu options The physician selects customers insurance identification number from the list The physician selects client information process option The system displays recording patient clinical history form He/she registers the necessary client information on the form He/she should save and stores the data on the client database

	He/she exit the system The use case ends
Alternative scenarios	7.a. if customer data is saved on to the customers' database 7. a.1 the system prompts "saved" text message 7. a.2 after saving the data onto the customers' database the physician opens discharge option 7.a.3 the system clears the identification number of the client from the list 7. b if the system do not save the data on to the database 7. b.1 the system prompts "Not saved" text message 7. b. 2 else if the diagnosis and treatment result have wrong data types, it will not be saved onto customers database. 7. c if any new events happen in the customer data, the physician opens the vital event notification option menu. 7. c. 1 the system displays the vital event notification form 7. c. 2 the physician register type of the new event. 7. c. 3 he/she saves the data onto client database **7 .c.** 4 he/she leaves diagnosis and treatment home page

Table 15: Use case narration for patient referral system

Use case id	Uc-11
Use case name	Refer patient
Use case description	The clients are referred to higher health institution for cases that are above the capacity of initial healthcare facility
Primary actor(s)	Health care professionals in primary health facilities that send patient
Secondary actor(s)	Health care professionals in receiving health facility
Triggers	The patient is referred to higher health care facility for severe cases
Pre-condition	The client should be referred from previous health facility The sender and receiver health facilities should be registered system user The initial healthcare facility should attach the patient history with referral information
Post-condition	The receiver health institution should provide feedback to the sender
Basic scenarios	The system should display insurance healthcare service providers institution list The physician should select referee institution from the institution list The system display the selected health institution account The physician select referral form Referral form is displayed The physician fills the necessary patient and sender health facility information on the referral form He/she submit the patient information on receiver health facility account He/she save the data on the referral list He/she print the backup copy The use case ends
Alternative scenarios	2. if the selected institution account unsuccessful then he/she select another facility account.

4.7.6 Class diagram modeling

Class diagram is representation of a collection of objects with common structure, Behaviors and relationships. Most importantly class is an entity in object-oriented analysis and system design. It describes the types of objects that exist in the System and shows the static relationships among internal classes of the system. Class diagrams are the foundations of object oriented modeling. The Class diagram can be used to show the attributes and the operations of a class and also the constraints that apply to the way the objects are connected. In other word class models show the classes of the system, their interrelationships (including inheritance, aggregation, and association), and the operations and attributes of the classes [68].

Conceptual and structural model of a system is depicted using class diagram. It has a wide variety of purposes, like analysis and design of systems. Class diagram contains three main - sections: class, attribute (behaviors) and method (functions).

Class is collection of related objects in asystem. There are different classes in this system. The classes can either major class or subclass. The major classes include system user, insurance members, members' family, institution, employers in the system, user account, and patient and subclasses includes labdiagnosis, treatment, drug prescription, vital signs, drug list, report, ICD, diseases.

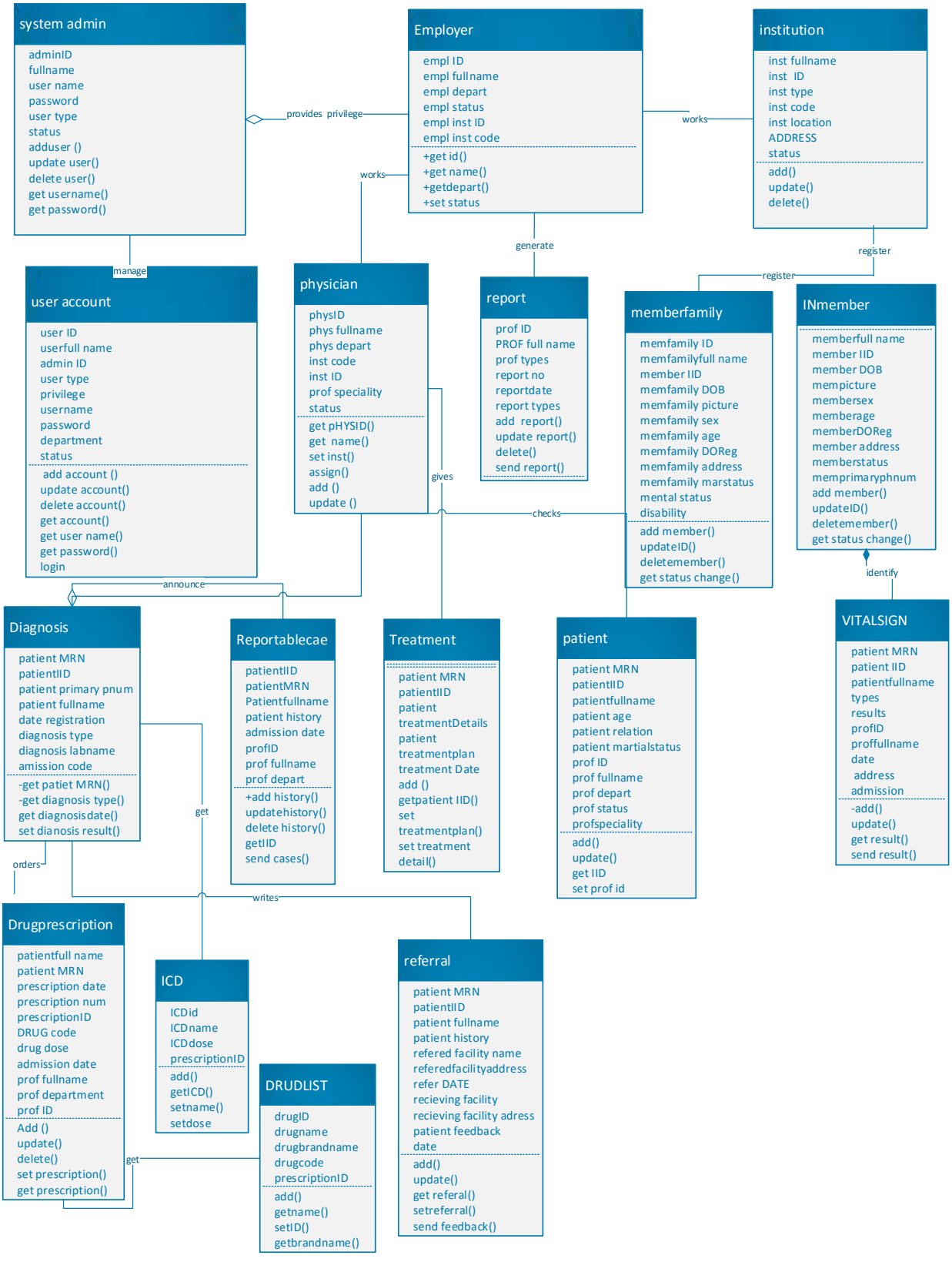


Figure 5: Class diagram of the system

4.7.7 Activity diagram

It is one of unified modeling language, system design tool. An activity diagram shows the procedural flow of control between two or more class objects while processing an activity. Activity diagrams can be used to model higher-level business process at the business unit level, or to model low-level internal class actions. In this system an activity diagram is used to show flow of events in interaction of objects (classes) in the insurance service delivery system. It used to show how is the scheme currently doing business, or how would like to do the business. Since the activity diagram is less-technical in appearance and business-minded people tend to understand them more quickly, the researcher preferred to use the activity diagram [69].

The activity diagram starts with a solid circle connected to the initial activity. The activity is modeled by drawing a rectangle with rounded edges, enclosing the activity's name. Activities can be connected to other activities through transition lines, or to decision points that connect to different activities guarded by conditions of the decision point. Activities that terminate the modeled process are connected to a termination point [68, 69].therefore; the following diagrams depict the activity client registration, client family registration system and validate eligibility system of insurance scheme information system.

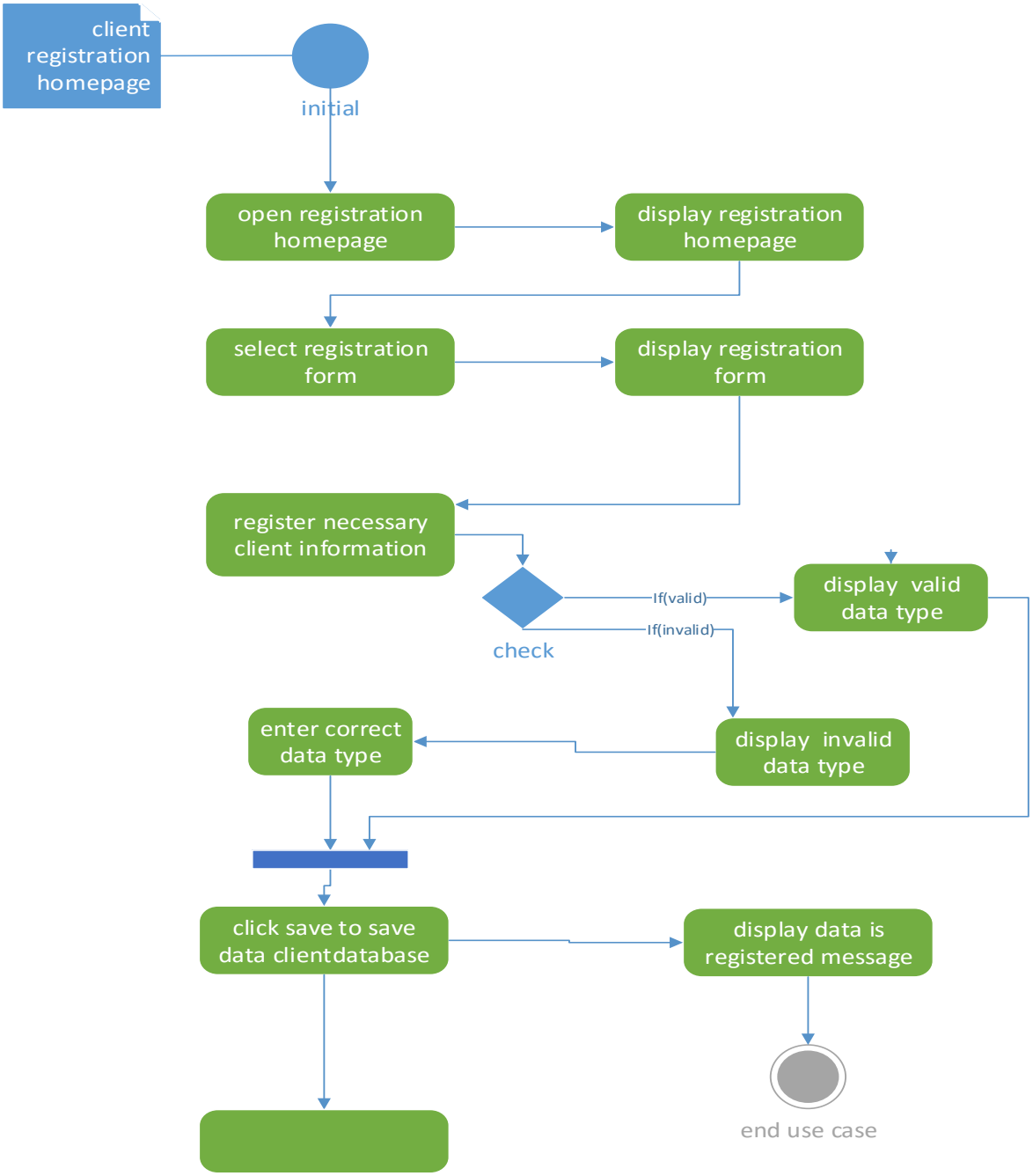


Figure 6: The activity diagram for client registration page

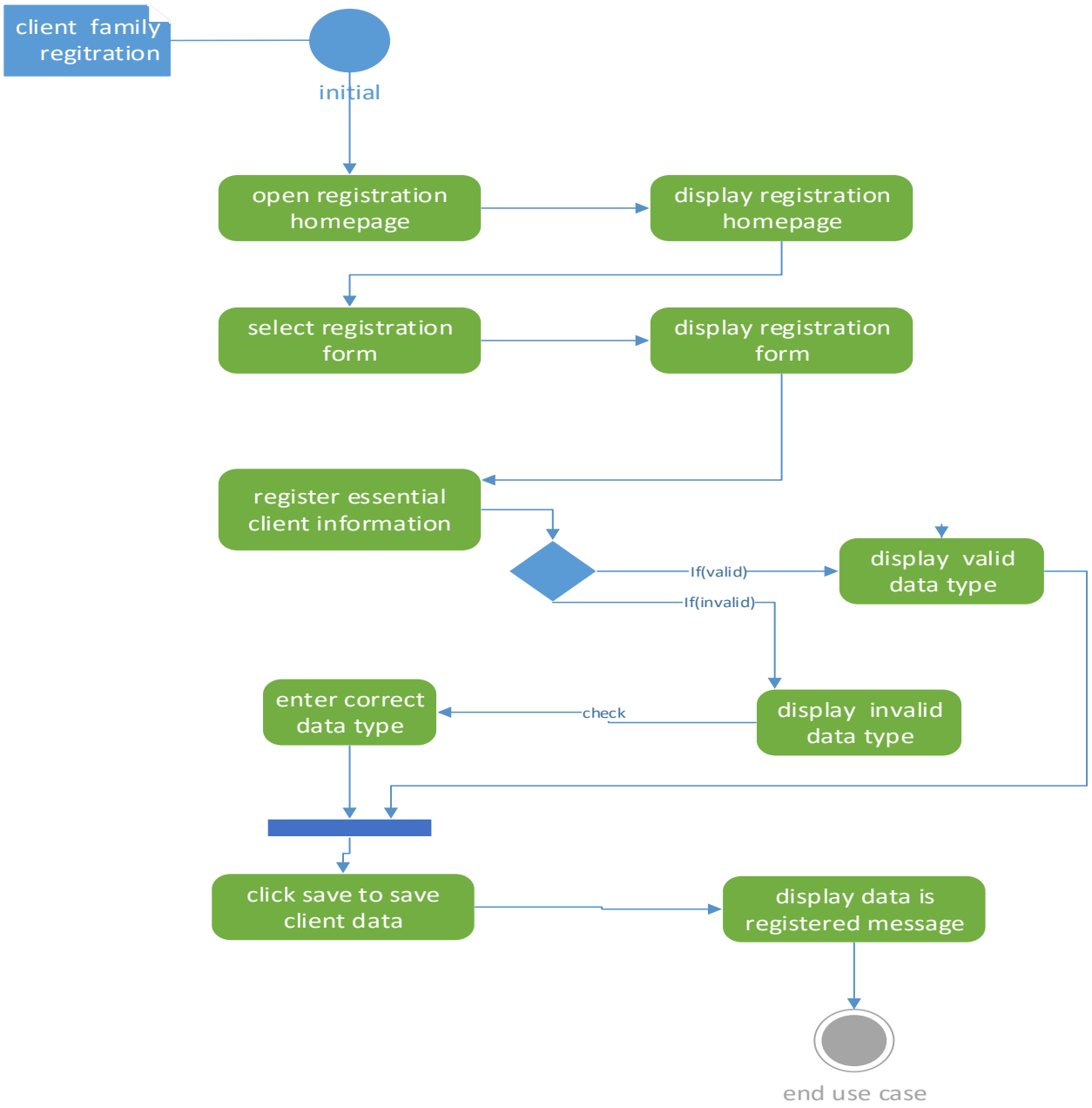


Figure 7: Activity diagram for client family registration homepage.

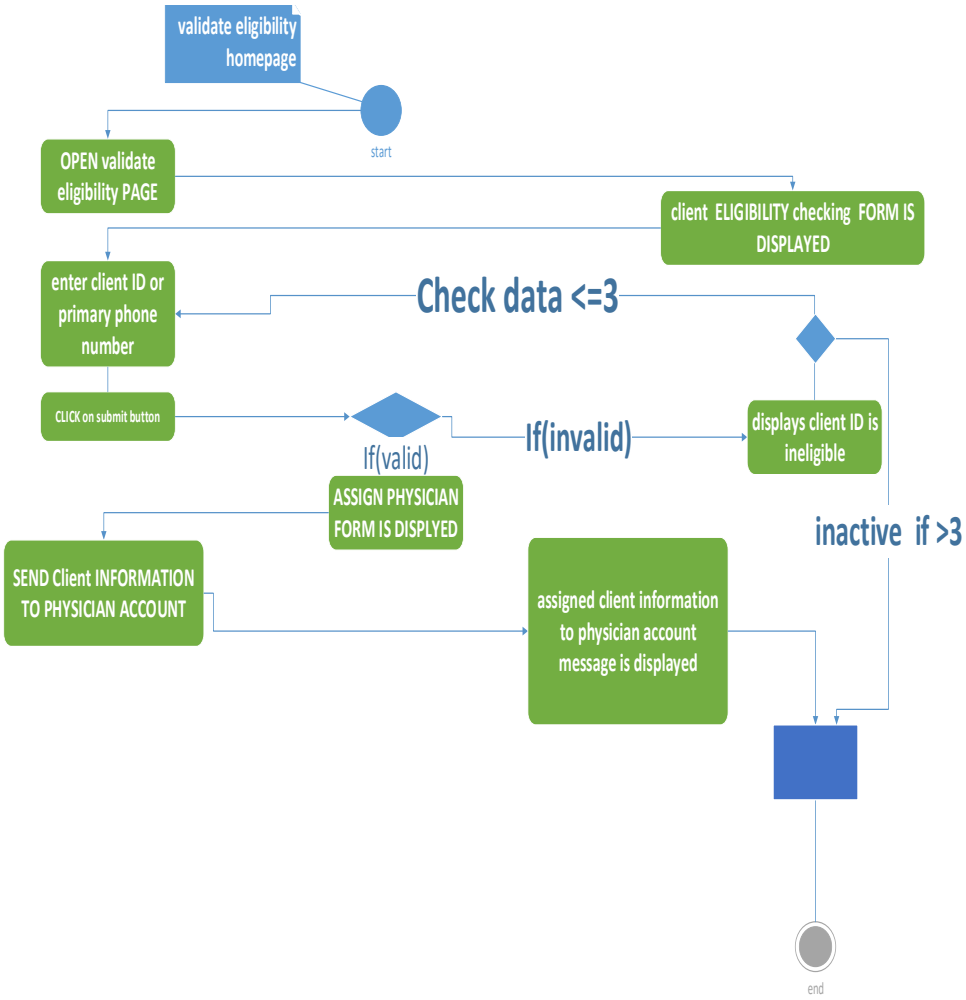


Figure 8: The activity diagram for validate eligibility of client page

4.7.8 Collaboration diagram

Collaboration diagram is one of unified modeling language, tools. It is used to capture dynamic interaction between objects and systems. It consists of objects and associations that describe how objects communicate to accomplish one complete task. The components of collaboration diagram are the objects in the interaction, instance of operation that allows the association and the communication pattern of objects in collaboration (synchronous or asynchronous) [70].

Collaboration diagrams provide a clear picture of collaborating elements and their roles in the model. They are useful to visualize the collaborating parties executing a scenario in terms of a sequence of messages [71]. Therefore, using collaboration diagrams improve the expressiveness of the model. Besides, they allow use case realization, which is important both in analysis and implementation phase of any software engineering process

In these section the collaboration diagram for different use cases are presented

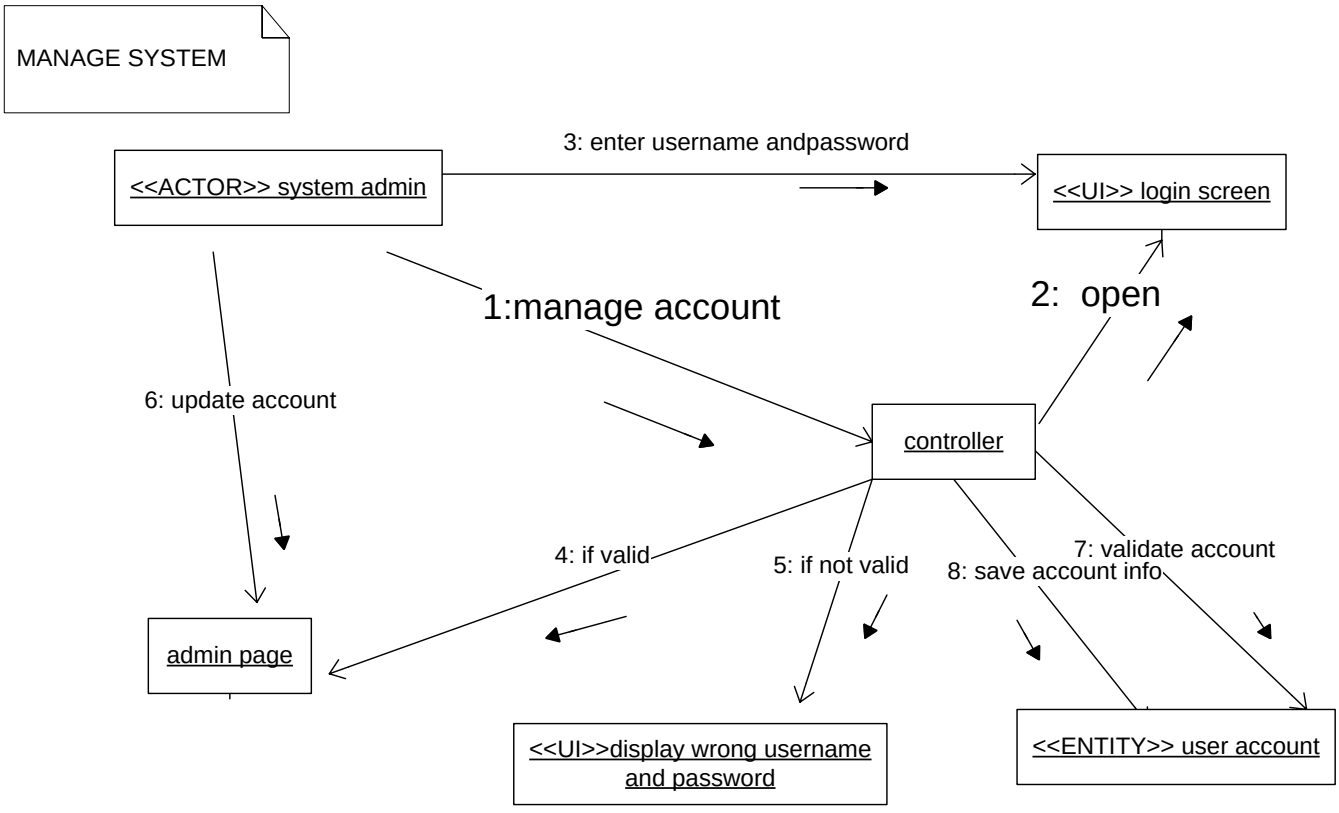


Figure 9: Collaboration diagram for system administrator

When an Administrator wishes to manage account, administrator controller creates log-In screen to enter user name and password after the validity of the user name and password is checked the administrator page will be created then the administrator can manage account.

This diagram clearly shows the sequence of actions and communication among components. The possible participants of the interaction are system administrator, controller, user account and user interface**.**

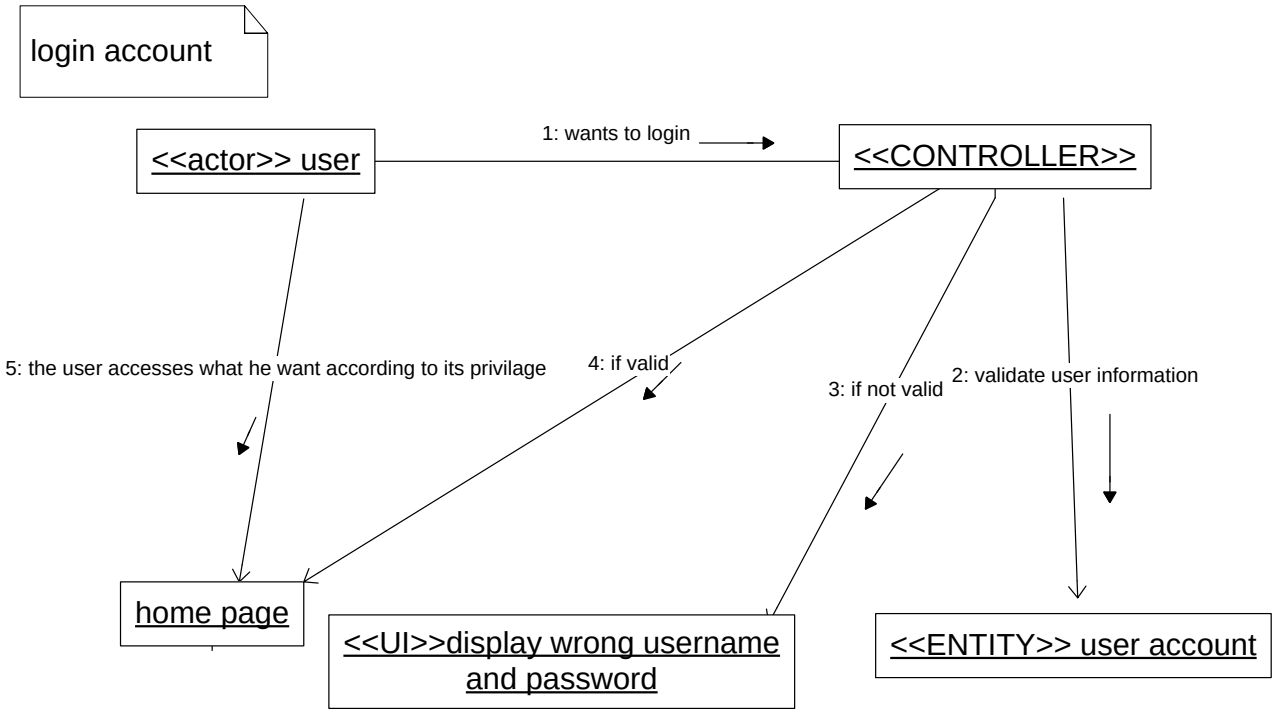


Figure 10: Collaboration diagram for login account

When a user wishes to log in, Validate controller creates log-In screen to enter user name and password after the validity of the user name and password is checked, the home page will be created then the user will select and access what he/she wants as he need. In this diagram the possible participants of the interactions are user, validate controller, user account and the user interface that are the bases for the realization of login use case.

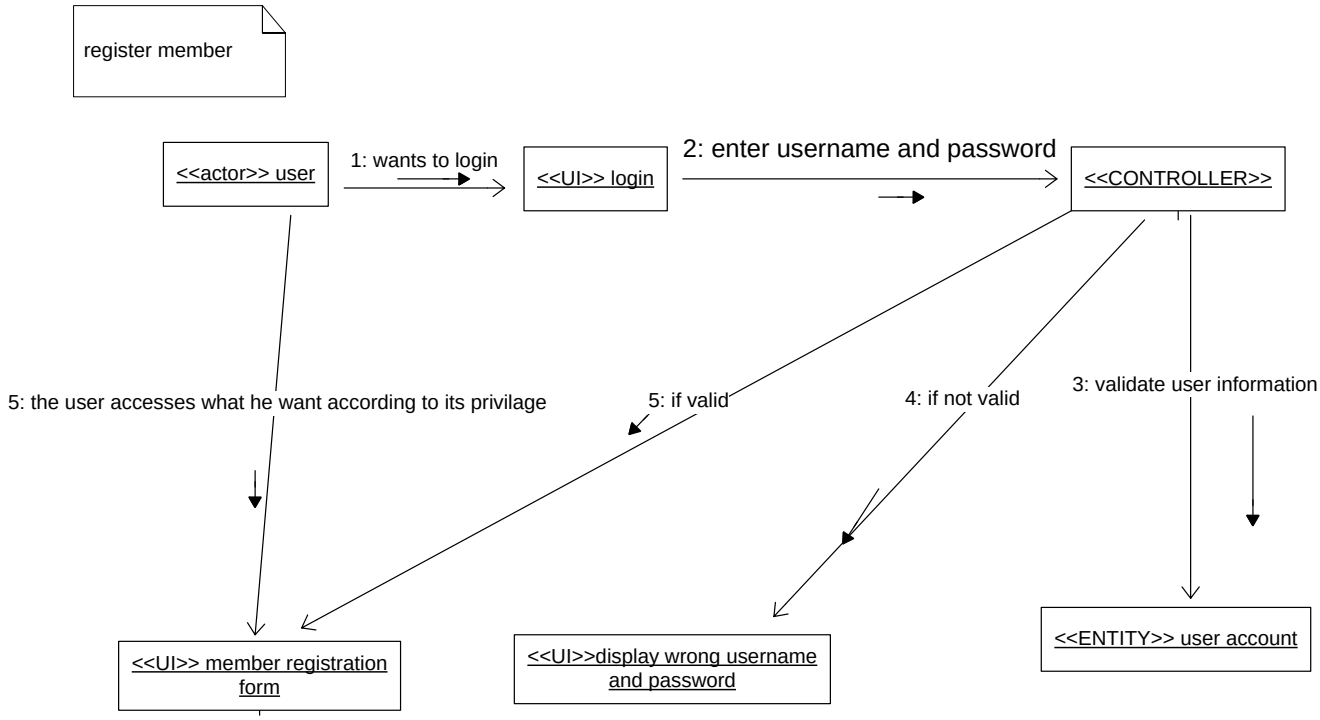


Figure 11: Collaboration diagram for member registration

The above diagram shows the collaboration diagram for register member of the insurance .when the user wants to register him/her customer, logs in the system and enter username and password to get registration page. After checking the validation of the login information, user can access what he wants according to its privilege. The interacting components to realize registering members are user, controller, user account and the different user interface.

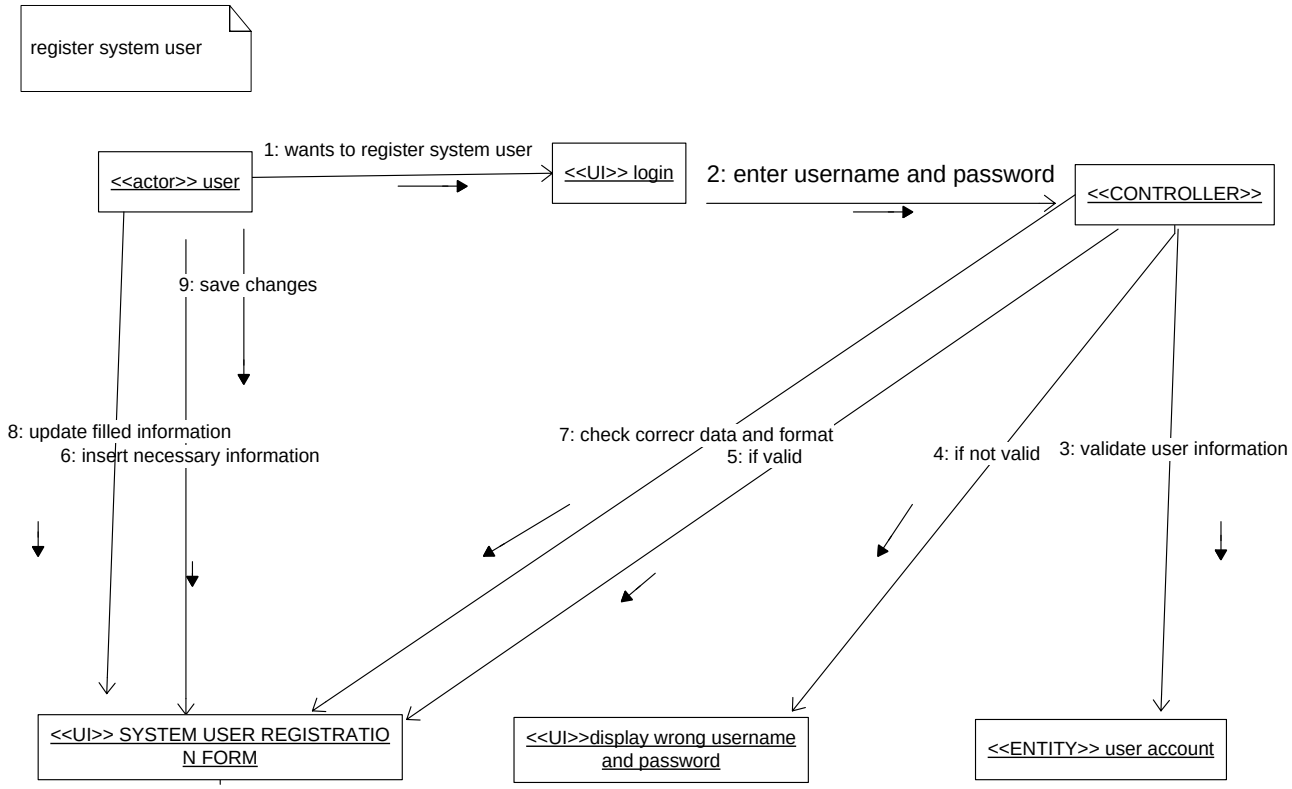


Figure 12: Collaboration diagram for system user registration.

This collaboration diagram shows the components of system user registration use case that used to realize the system. The possible participants that interact in this use case are the user (system owner), validate controller, the user account and the different user interface. If the system user wants to register new system user, he/she needs to validate its information for authentication to use the system.

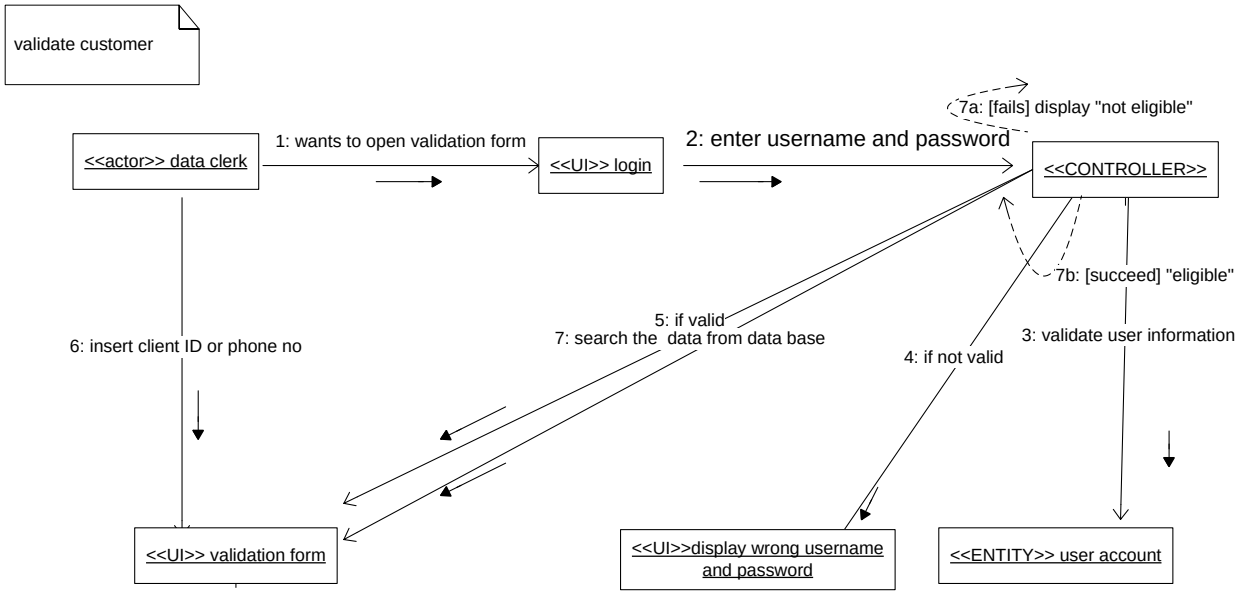


Figure 2: Collaboration diagram for validate client.

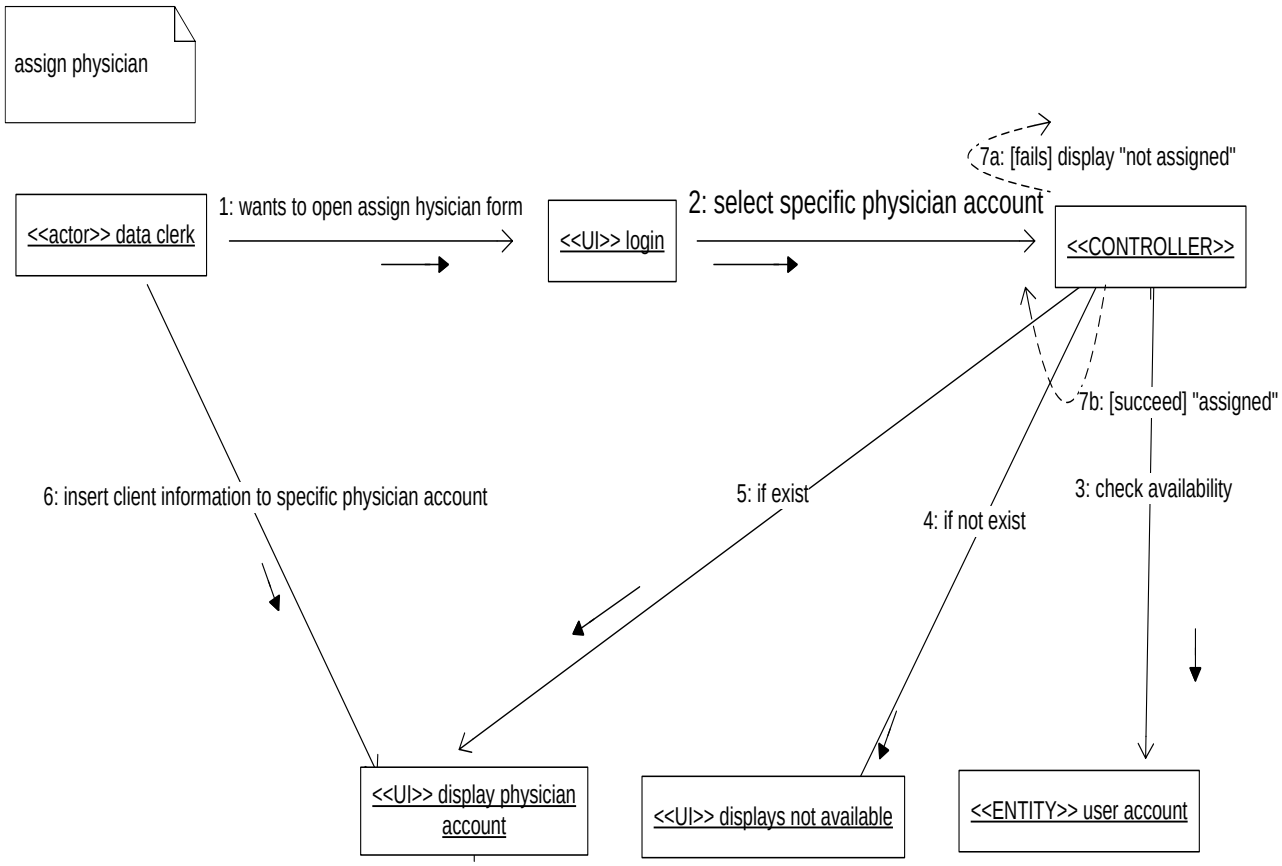


Figure 14: Collaboration diagram for assign client to specific physician account

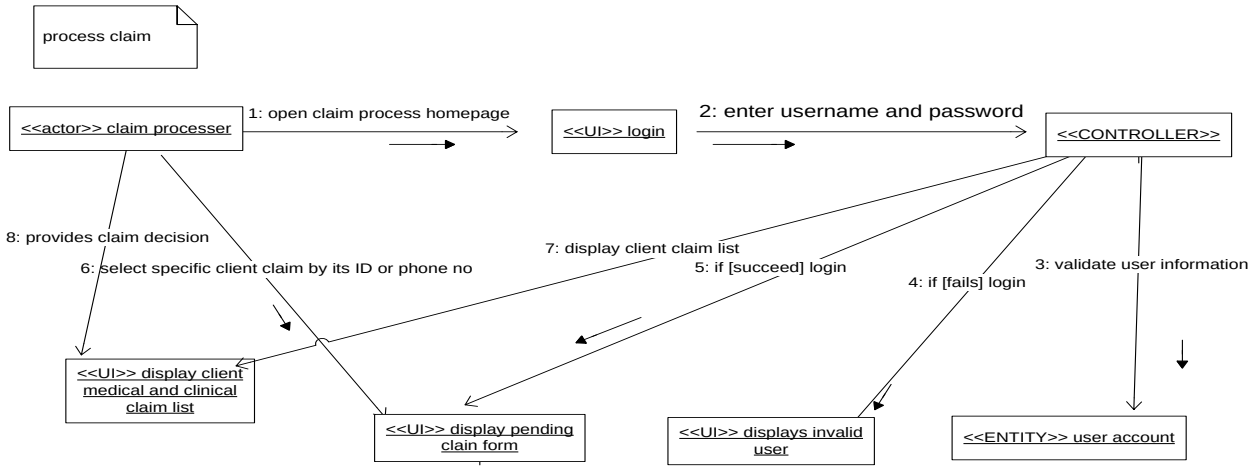


Figure 15: Collaboration diagram for system client claim process

The diagram depicts the collaboration diagram for processing claims in the system. The possible participants in the process are the claim processer, controller, user account and the user interface that are the bases for the realization of the report generation use case. The system do not allow for user who do not have access privilege .i.e. the report will not accessed by unprivileged users of the system. The confidentiality of the report is preserved.

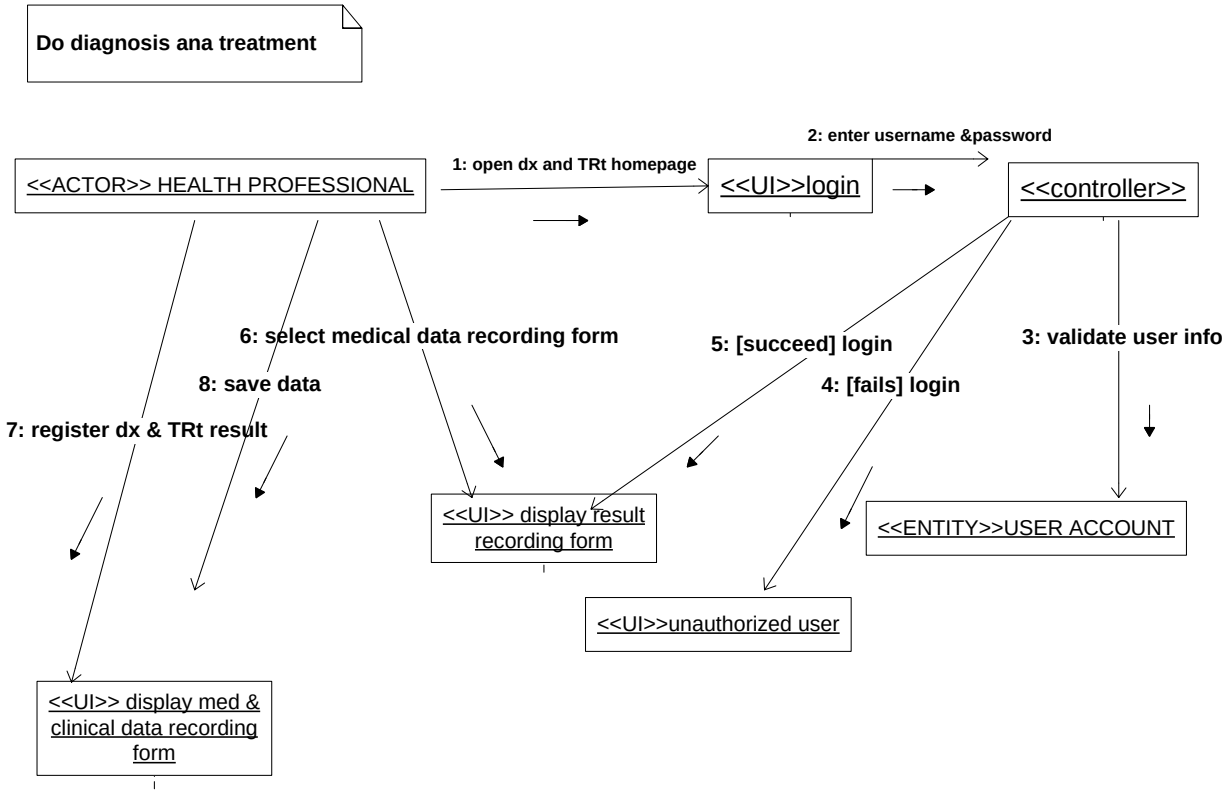


Figure 16: Collaboration diagram for diagnosis and treatment result recording

This collaboration diagram shows bird eye view of diagnosis and treatment process in the system. The possible participants of the process are health professional, controller, user account and user interface that defined in the collaboration diagram. The system allows the report view only for authorized users. The authorized users can access the required report with their provided access privilege.

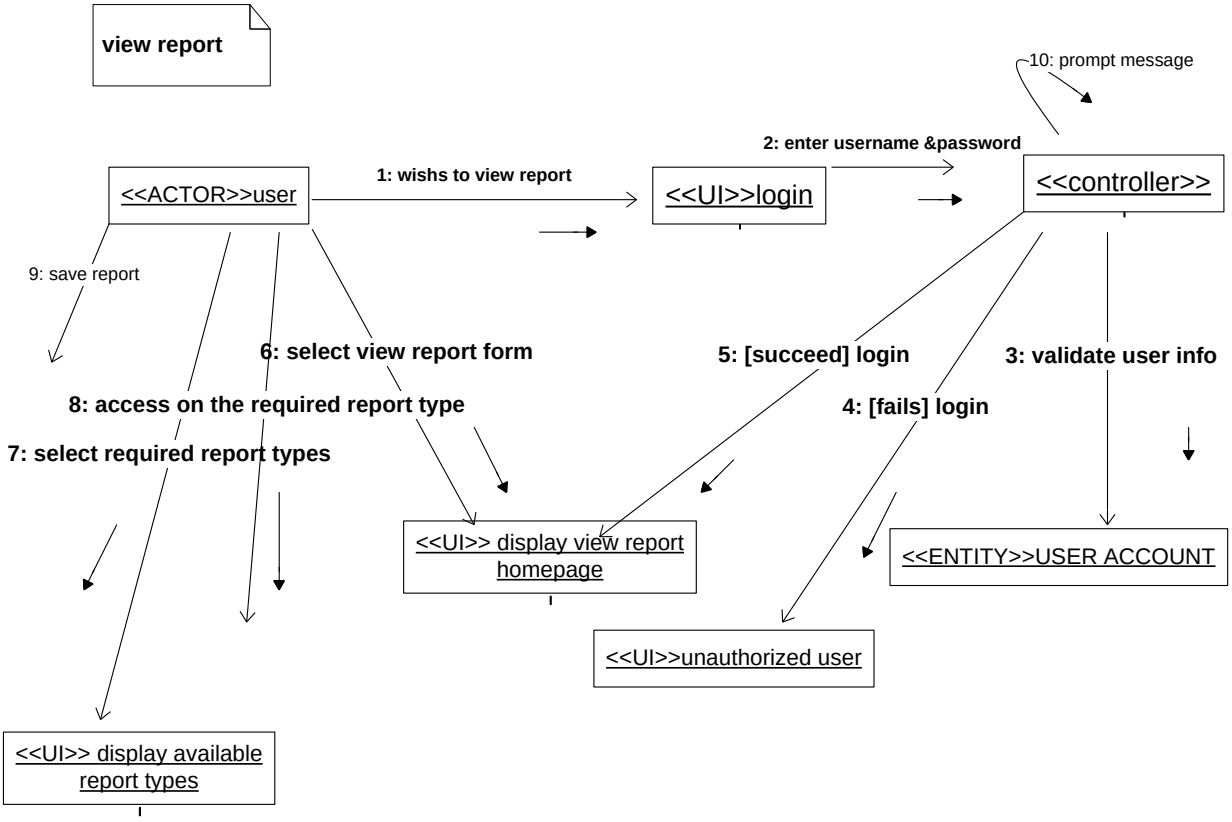


Figure 17: Collaboration diagram for view report.

Possible participants of this use case are user, controller (DB), user interface and user account defined in the diagram. The diagram shows the realization of "view report" use case with abstract collaboration diagram.

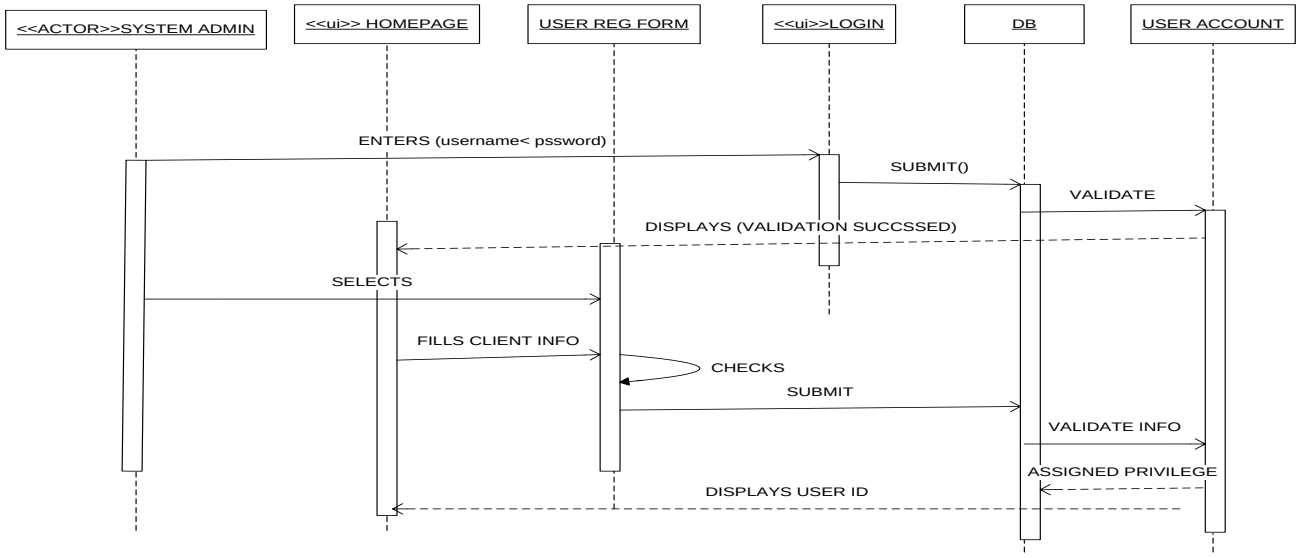
4.7.10 Sequence Diagram

Sequence diagrams show a detailed flow for a specific use case or even just part of a specific use case. It is almost self-explanatory that shows the calls between the different objects in their sequence and can show different calls to different objects. A sequence diagram has two dimensions: vertical dimension shows the sequence of messages/calls in time order that they occur; the horizontal dimension shows the object instances to which the messages are sent (68).

To draw a sequence diagram it is important to put rectangular (square) box on top of your diagram, identify the class instances (objects) by putting each class instance inside a box. In the box, put the class instance name. If a class instance sends a message to another class instance (object), draw a line with an open arrowhead pointing to the receiving class instance (object) and place the name of the message/method above the line. Optionally, for important messages, you can draw a dotted line with an

arrowhead pointing back to the originating class instance; label the return value above the dotted line. (69).

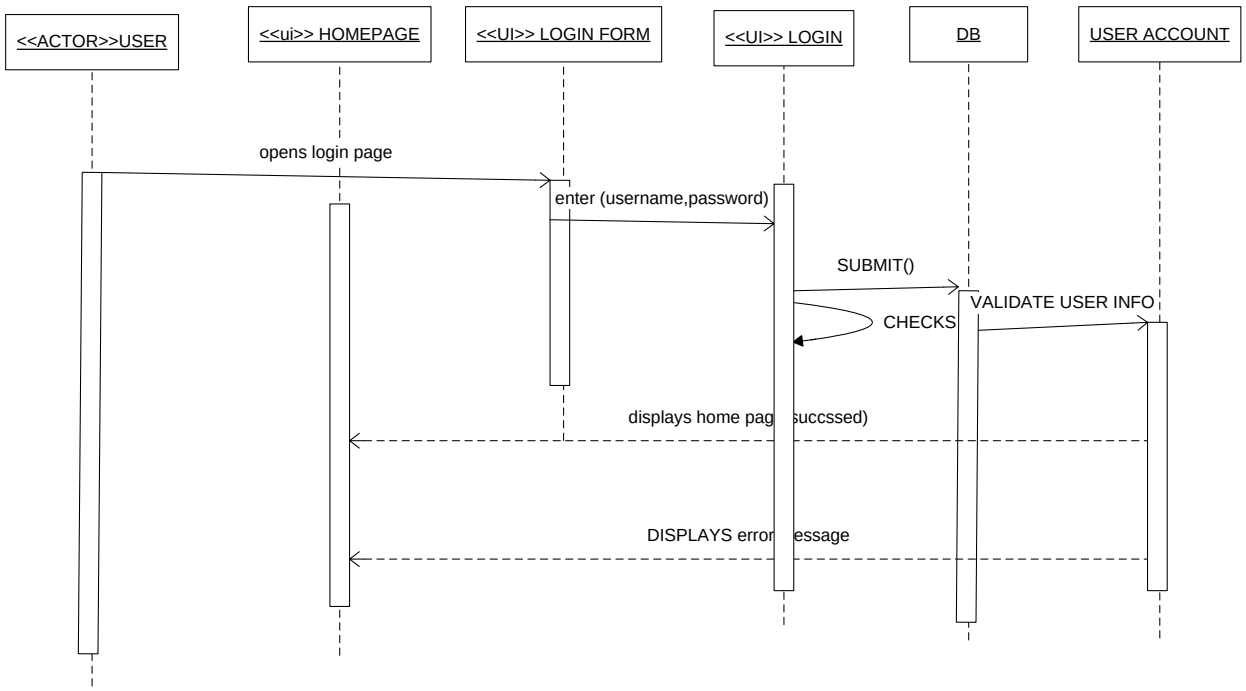
The sequence diagrams presented in the following diagrams depicts some of the use case in the system. The diagrams are the use cases of system user registration, login system, client registration, validate eligibility and assign physician and view report. The diagram consists of the classes (objects) in interaction; the messages (calls) between components and the lifeline time of interacting classes (objects) are presented.



SYSTEM USER REGISTRATION

- System administrator wants to register new system user
- He/she enter his/her opens login page
- The system displays login page
- He/she enters user info
- The system check validity
- The system displays user registration home page
- System admin opens user registration form
- System displays registration form
- System admin fills necessary info
- System admin submit the data
- System checks the validity of the data
- The system displays message “assigned privilege”
- The system save the user info
- The system displays user ID

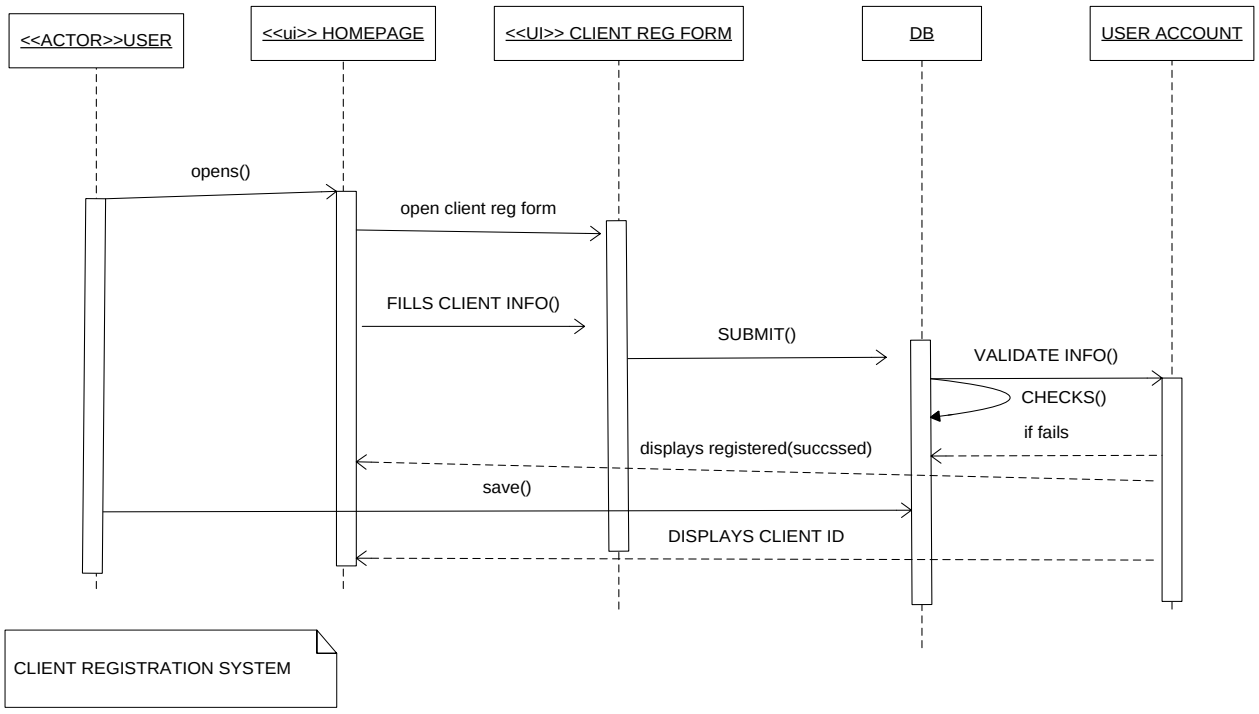
Figure 18: The sequence diagram for system user registration



LOGIN SYSTEM

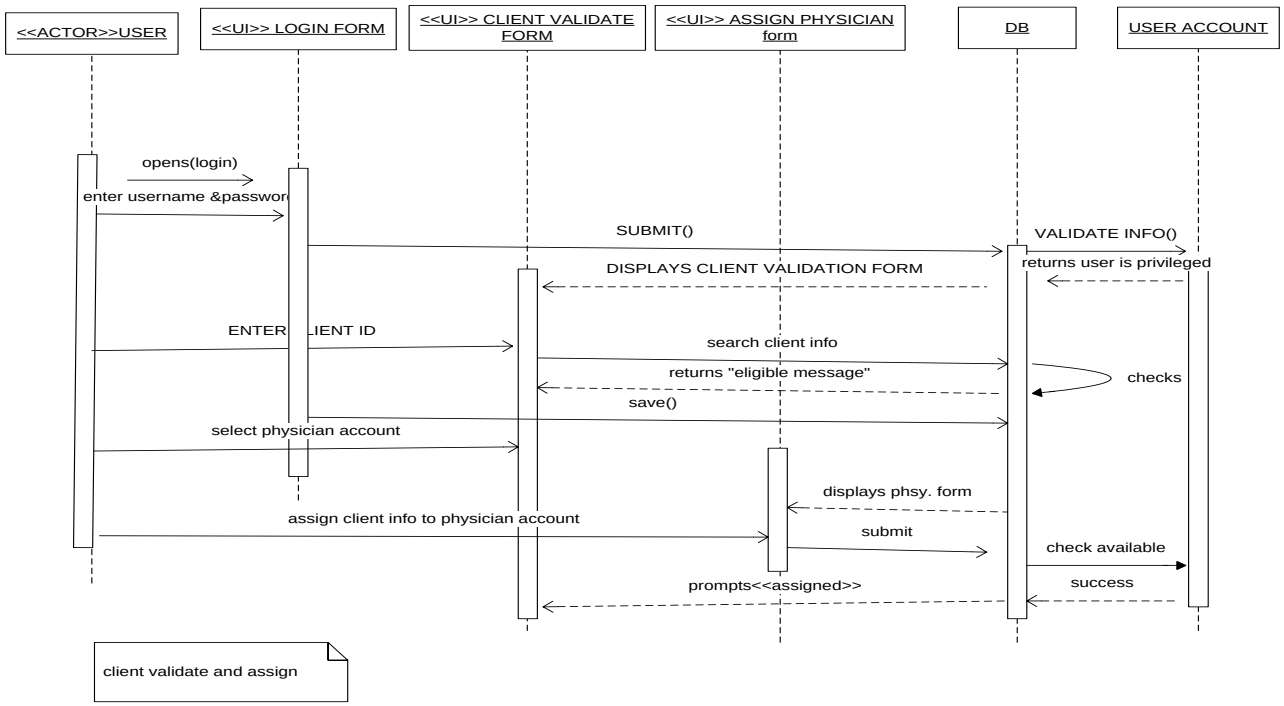
- System user opens login form
- The system displays login page
- He/she enters username &password
- User submit the data
- The system check validity
- The system displays user main page(succeeded)
- System displays “not registered user”(fails

Figure 19: Sequence diagram for login to system of CBHIIS



- System user opens home page
- User clicks on client registration form
- The system displays registration form
- user enters client info
- User submit the data
- The system checks validity
- The system displays registered(success)
- User clicks save
- System displays automatic registered client ID
- If System fails register client info
- System displays “not registered”(fails)

Figure 20: Sequence diagram for client registration of CBHIIS



- System user opens login form
- User enters username & password
- Submit info
- System validate user info
- System displays client validation form
- User enters client info
- User clicks search result
- System prompts “eligible” message
- User saves data
- User selects physician account
- System displays physician account
- User assigns client info to specific phys. Account
- User submits client info
- System checks availability
- System prompts “assigned”

Figure 21: Sequence diagram for validate and assign use case of CBHIIS

CHAPTER FIVE

5.1 User Interface and Human Factors

User interface is the point of interaction between the user and the system. For users to easily communicate with the system usable system interface are fundamental. User interface design creates an effective communication medium between a human and a computer. The user interface is important for system success. If the interface is poorly designed, the user's ability to tap the computational power of an application may be severely hindered. In fact, a poor interface cause implemented application to fail [72,76].

To design effective user interfaces it is necessary to think of important guide to design principles i.e. place the user in control, reduce user's memory load and making the interface consistent. User interface design begins with the identification of user, task, and environmental requirements (Pressman2001).

User interface is the frontal component (front layer) of a system from which the system users interact with the system i.e. the external screen that is used to communicate the system and exchange information with the other system components. It must be usable for all system users to minimize the time needed to adapt the system. Designing user friendly interface of an information system is important for any system designers to deliver acceptable products for intended users of the product.

5.1.1 User Interface Prototyping

Prototyping is an essential component of interactive system design. Prototype represents many forms of the planned design interface that is going to be developed from rough sketches to detailed working prototypes. They provide concrete representations of design ideas and give designers, users, developers and managers an early hint into the new designed system, functionality, interactivity and usability will look like to the end users [74].

Prototype increases creativity in the new system to be designed, it allows early evaluation of design ideas, help designers think through and solve design problems, and support communication within users and multi-disciplinary design teams. Prototypes, because they are concrete and not abstract, provide a rich medium for exploring a design freedom. They force designers to be creative and to articulate their design decisions. Prototypes represent design ideas

and encourage designers to tackle their differences of opinion. The imprecise or incomplete aspects of a prototype highlight the areas that must be refined or require additional ideas [74].

User interface is a primary working environment for the users. The designed user interface should be easier in appearance, contain necessary features and easily adoptable to end users. Moreover, starting from the selection of the interface color to the choice of the various sizes of the web page is done in discussion with the different users of the system. So prototypes are diverse and can fit within any part of the design process, from the earliest ideas to the final details of the design. In this section the designed interfaces are depicted from the home page interface to the different functionality interface parts of the system.

5.1.2 Basic Interface and Subsystem Interface Description

To understand the whole system, it is important to break down the entire system into smaller subsystems parts. In the subsystems there were functionalities which have the same purpose in a group.

The proposed health insurance system has a total of seven basic interface and sex subsystem interfaces which are part of the basic interfaces (subsystems).The basic interface of the system includes:

Login interface This user interface is responsible to offer the authentication and authorization of the users to the different functionalities that the system provides.

Client Registration interface: Enables the user to register the client demographic and personal data.

Client family Registration interface: This user interface enables the system user to register the family members of the client during the registration of the client.

System User Registration interface: This user interface enables Gurage Zone community based health insurance scheme (system owner) to register the different system users that the client being registered and took service at.

Account interface-enables the assignment of different users in the system process data according to their privilege

Manage user account interface- enables the system administrator to provide various privileges that the user needs and also it helps the system administrator to enable or disable the users in the system.

Diagnosis and treatment Registration interface: enables the physician to register the different diagnosis and treatments results of the client during the visit of him/her to the physician office.

Parts of basic systems (subsystems) include:

Validate client interface- enables the data clerk to check the eligibility of the client that is whether he/she is registered or not on the database to have an insurance service.

Assign physician interface- enables the data clerk to assign the client who is validated by the system during care provision to the different physicians that are working in the different departments in the health care setting

User Account interface- enables the physician to see the various clinical and diagnostic data that he/she had previously and record new diagnostic also used to view the different client data that are registered on that organization

View interface- enables the different users of the system to view the different data of the client.

Claim processing interface-enables the claim processer to view the different claims and pre-authorization requests that are sent by the physician after providing the different care and treatment procedure. In addition to these the claim processing user interface enables the claim processor to provide the different claim and pre-authorization decisions with reasons that are important to insurance service

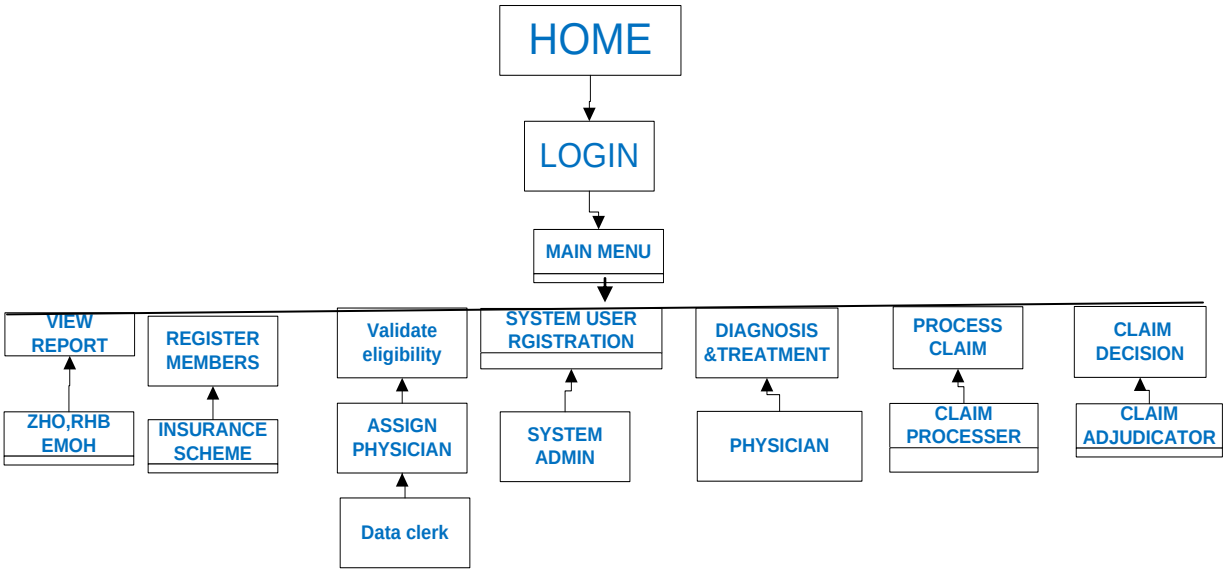


Figure 3: The interface flow diagram of the proposed system

The above diagram depicts a work flow view of the basic system interface components that each user of the system should know and access different system functionalities based on assigned privilege.

Figure 4: homepage of the proposed system

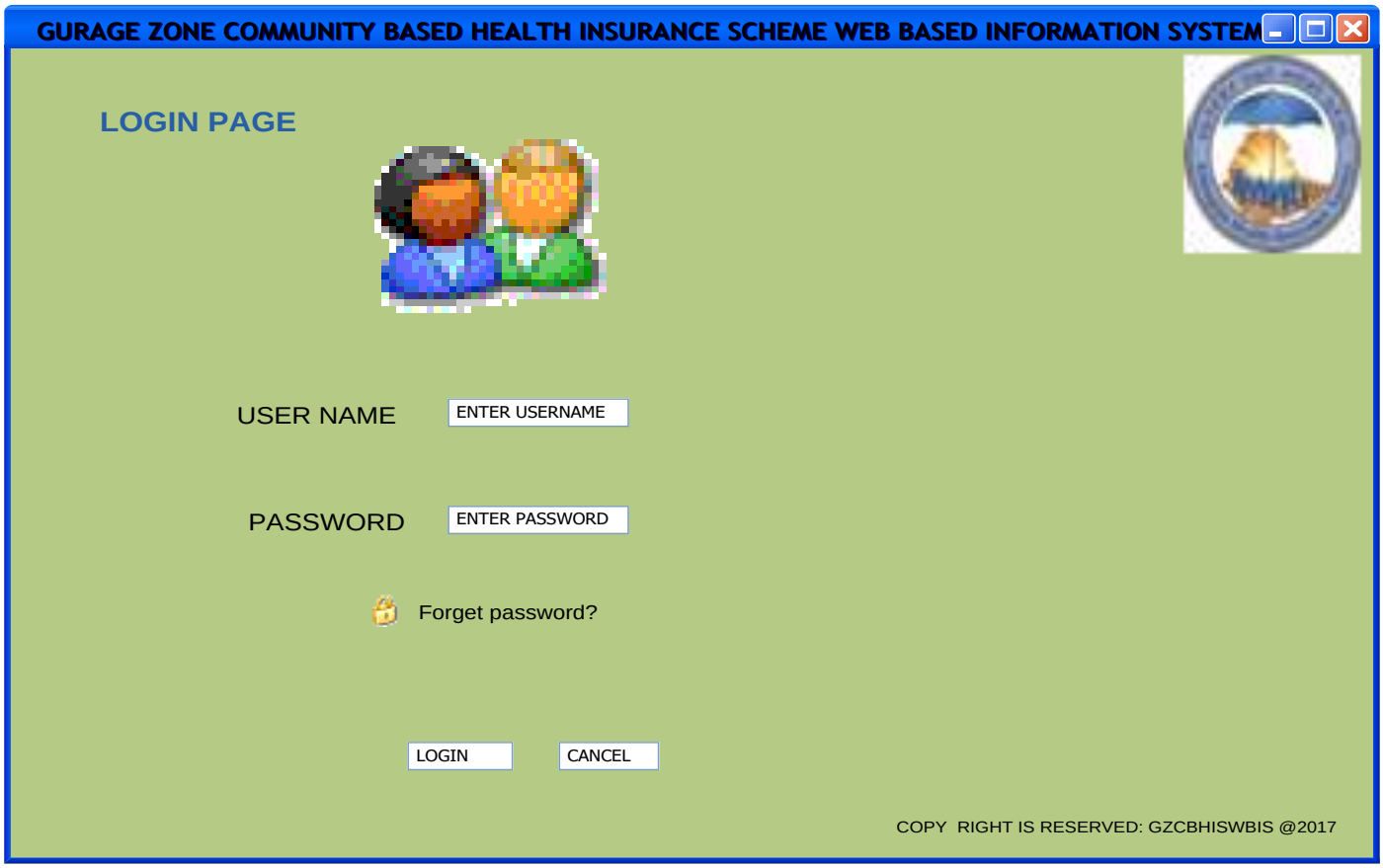


Figure 5: The user interface for login page of the proposed web based information system of community based health insurance scheme.

This user interface enables users to enter the different functionalities of the system. For anyone who has a privilege to interact with the system he/she must have the appropriate password and user name and assigned by the administrator of the system. It is a gateway to the system.

Figure 6: Main menu user interface.

This interface provides the major system functionality selection elements that the different system users want to access using their assigned access privilege. Any user should enter an authorized user name and password to access any of the system components i.e. he/she should login into the system with the required functionalities of the system. Thus he/she must be registered by the system. The system does not allow unauthorized visitor to interact into the system.

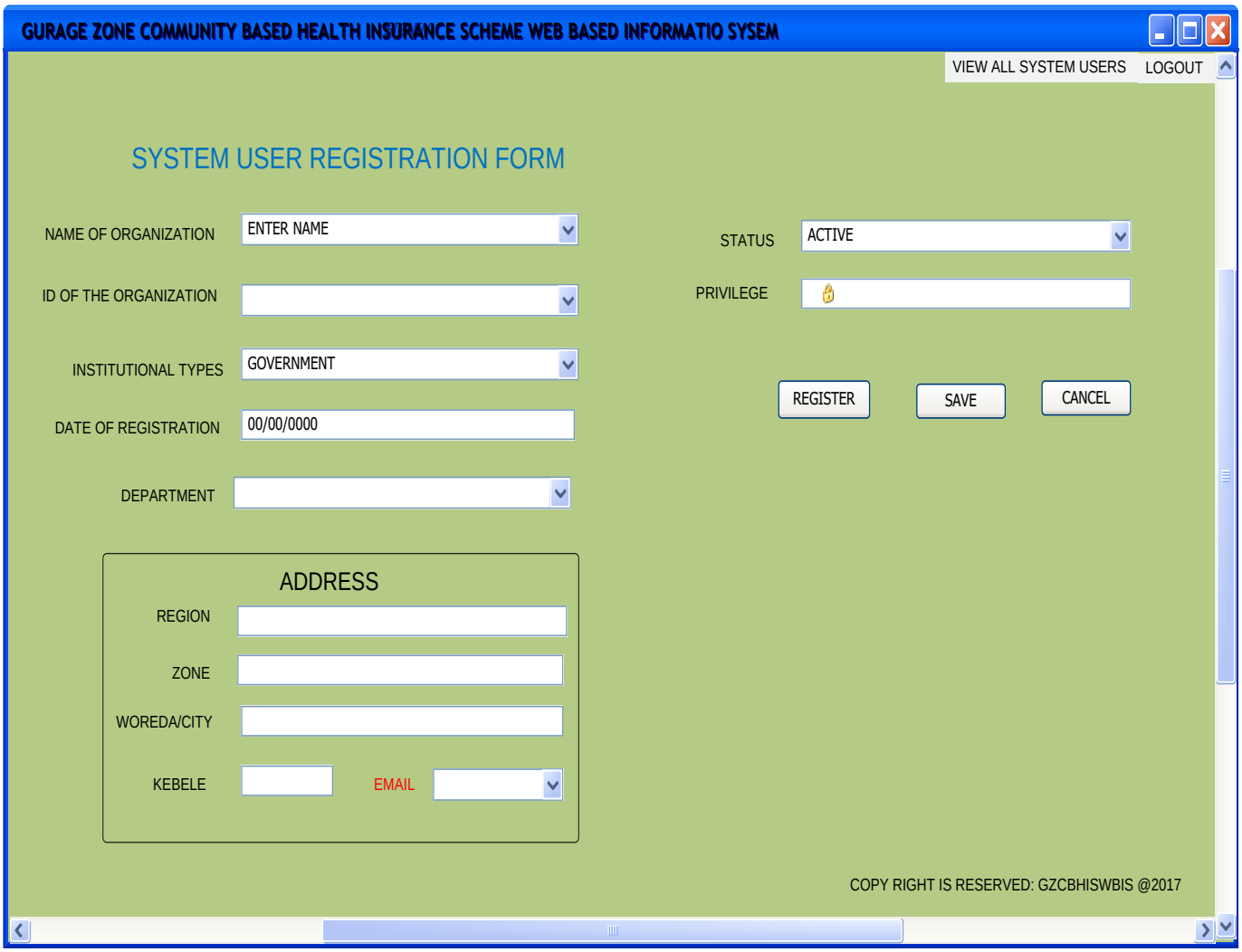


Figure 7: System users' registration page.

This interface is used to provide accessibility privilege for the system users. The privilege is provided for the system actor that may be persons or organizations that want to directly or indirectly interact with the basic functionalities of the system. The main system users of this system are the different insurance schemes, healthcare facilities, health professionals in the health service settings, the respective health institutions and others.

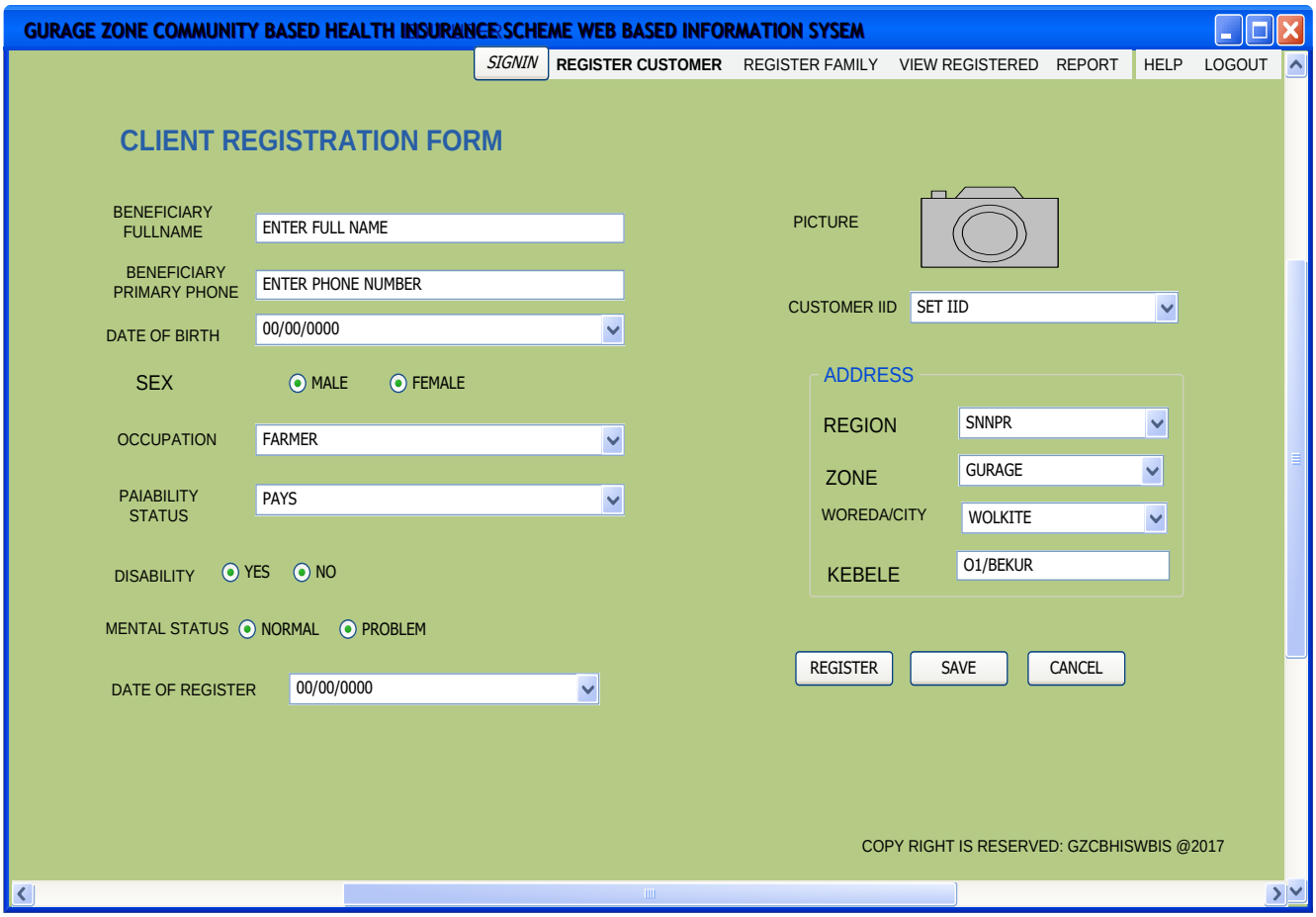


Figure 8: User interface for client registration.

This user interface provides client registration functionality of new members for the insurance scheme. The interface enables to insert the necessary client data into the system and the system provides automatically insurance identification number to the client. Therefore the client would be the member of the scheme and can utilize the service delivered by any healthcare facility which conducted contractual agreement with the scheme using his/her identification number. Then the client data is saved on the system database.

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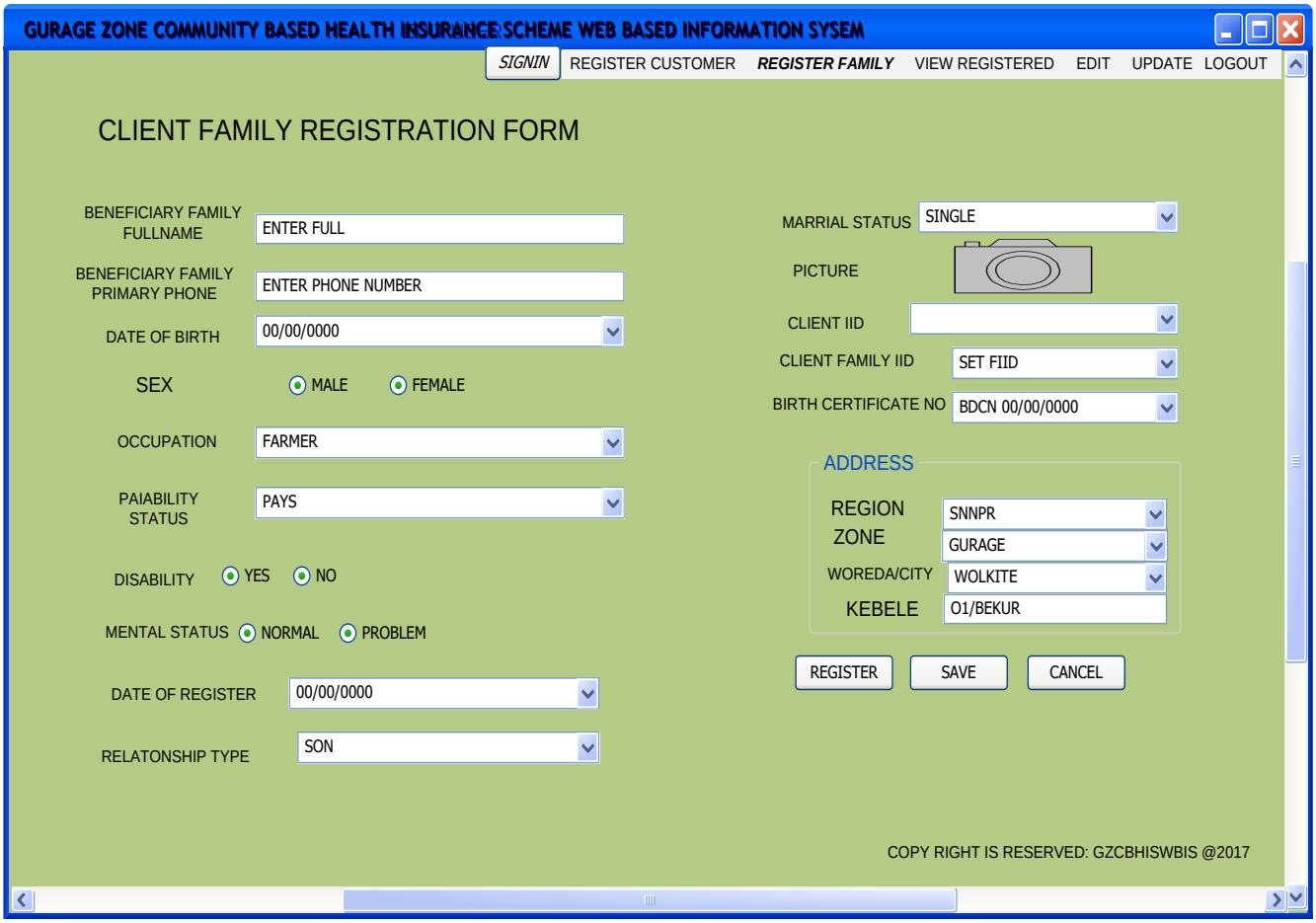

Figure 9: Users interface for insurance member family registration

This user interface enables the insurance scheme to insert the general clients' family information into the system. The registered client may have partner and children who are under the age of 18. Under the 2010 proclamation of the EHIA all family members that is spouse or children who are under the age of 18 should be registered in order to be able to use the different insurance services provided by EHIA. This user interface also used to verify if the user is under the age of 18 and also registers the birth certificate, mental and disability status of the user with other necessary information.

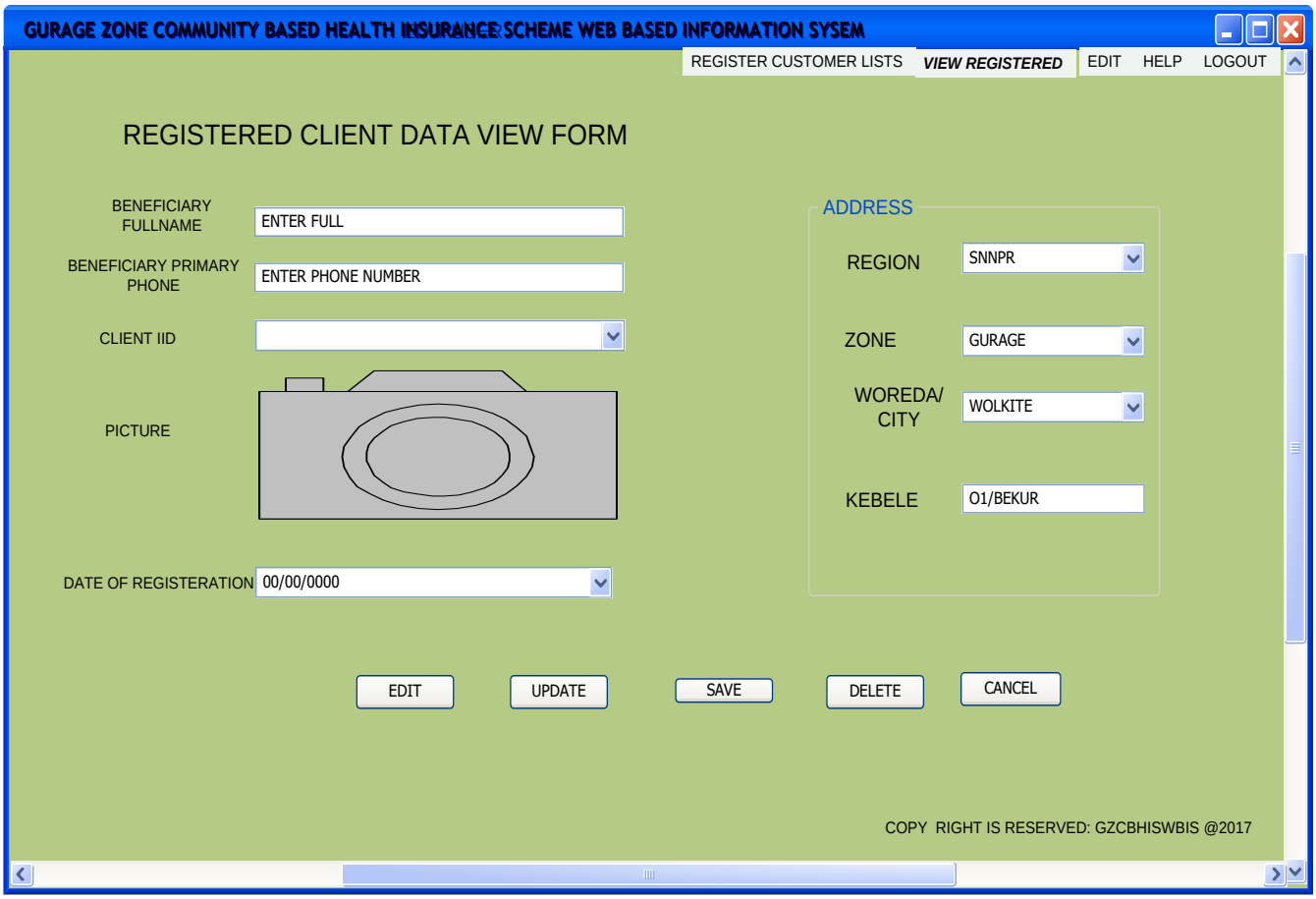

Figure 10: User interface for registered client data view

This user interface enables the scheme to view registered member data using the customer identification number or the customers' primary phone number and verify the client information if any change is requested by the member. This change is undertaken by editing and updating previously stored data by the system database and store the verification occurred by the system.

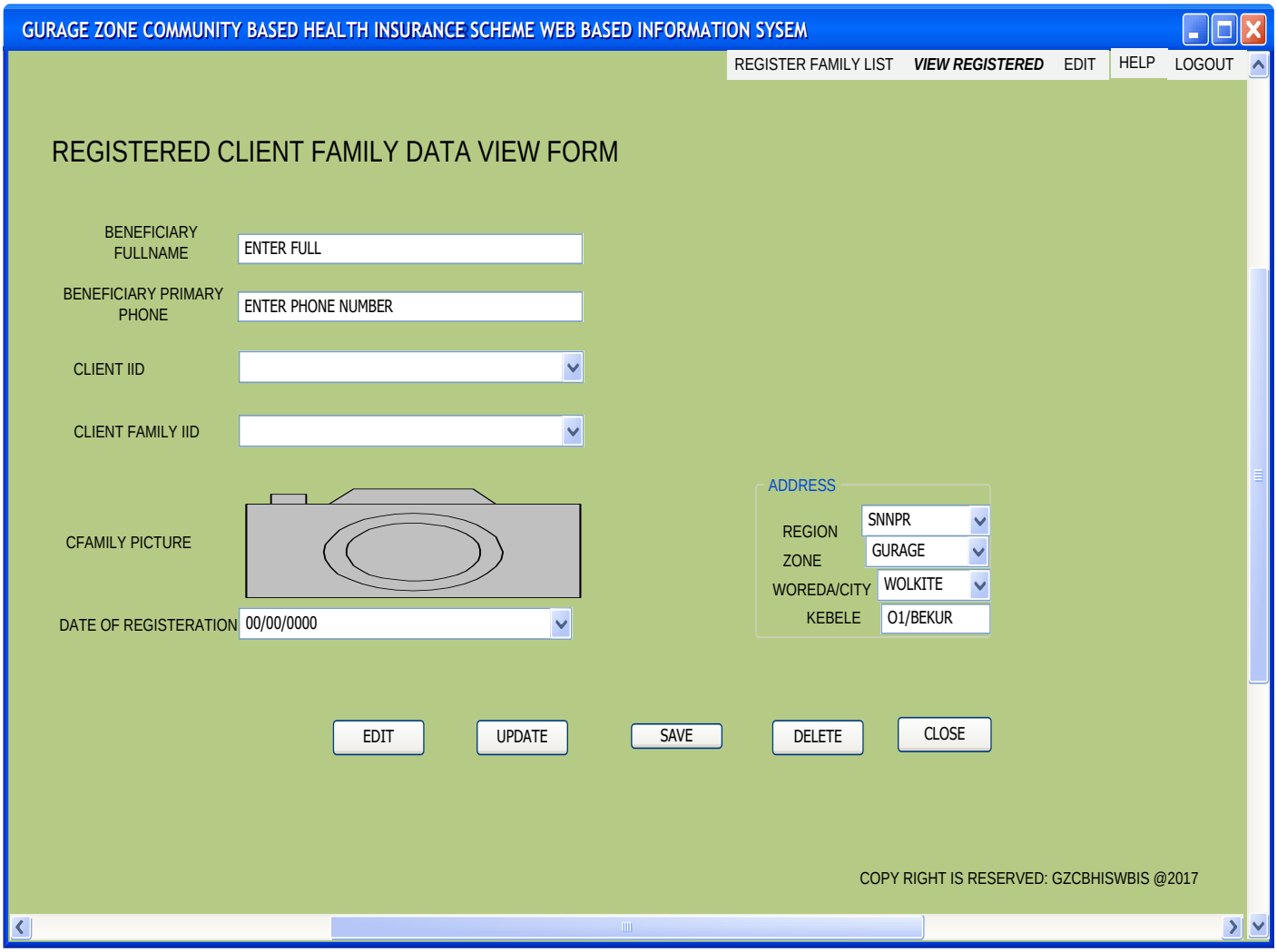

Figure 11: User interface for customers' family member data view.

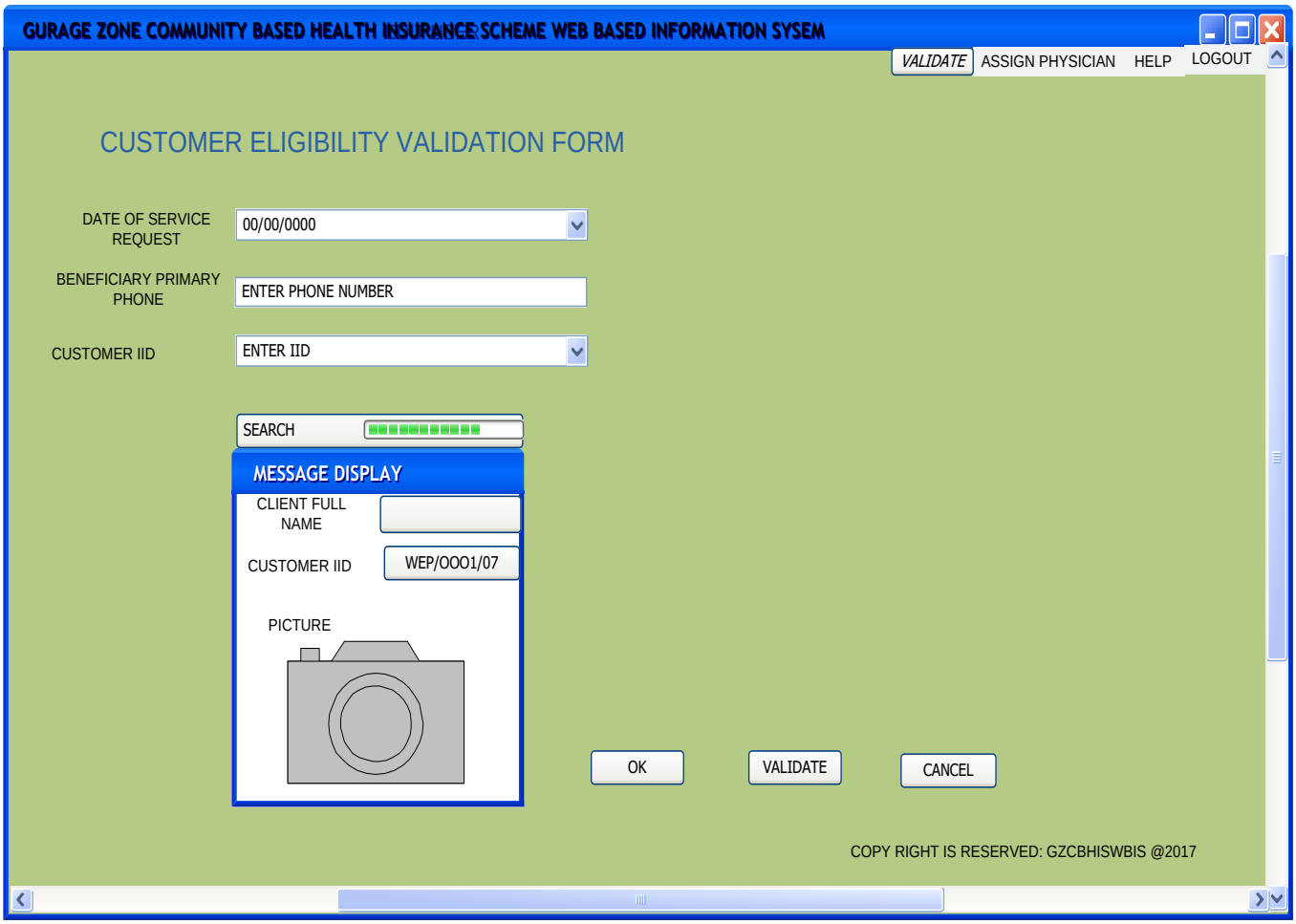

Figure 12: User interface for validate eligibility of clients.

This user interface is used by the data clerk in healthcare facility to check service request by clients. The validation of the user in service provision setting is an essential and integral process of insurance service and to make sure the correct membership of the registered customer at the healthcare setting. This user interface provides a user authentication access to the system database upon the customer arrival at the health care setting to get health care services.

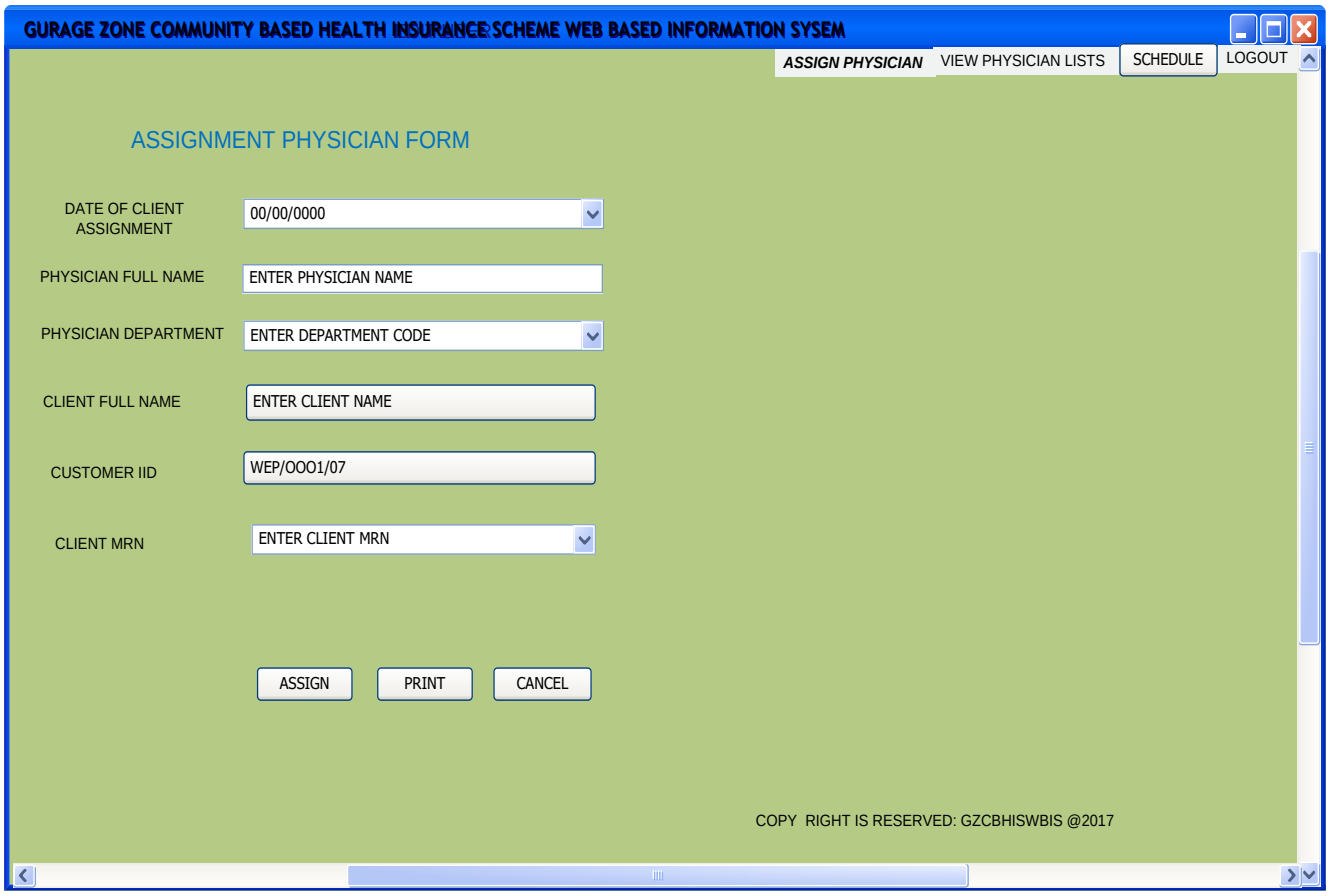

Figure 13: User interface for assign validated customer.

This interface is used by data clerk after verifying the validity of the client who requests healthcare service in the accredited health institution. The data clerk checks the availability of physician schedule list in specific day and then assigns the client to specific physician who is working at the specific health care setting in which the clerk works at. It minimizes the time that the client spend on queue waiting for the available physician on the different departments in the healthcare settings. The whole client information appears within the physician account

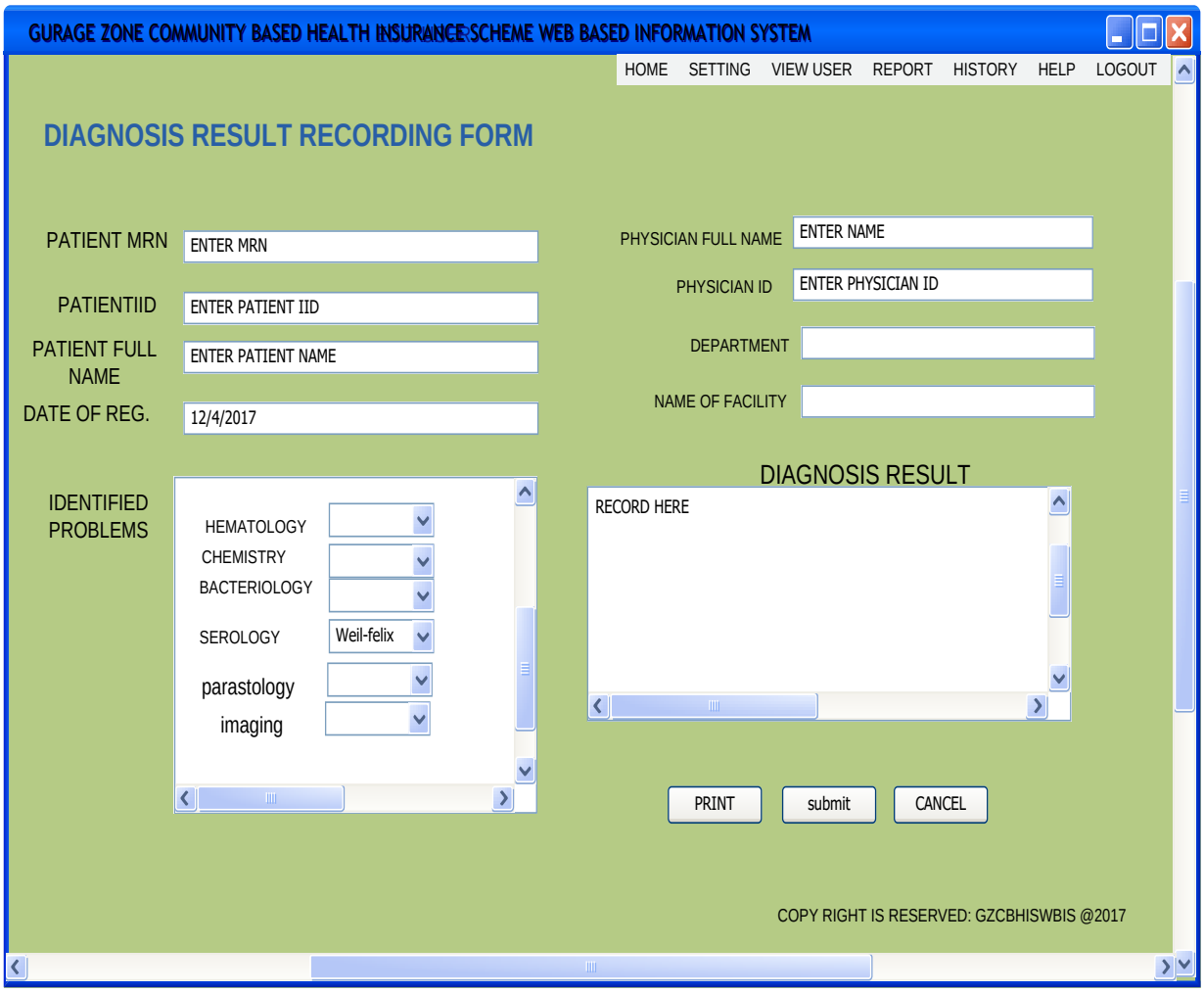

Figure 14: User interface for recording diagnosis result of client.

This user interface is used to record patient diagnosis results in healthcare provision facilities. It enables physician to register important client demographic data, the different test types and identified test results concerning the patient**.**

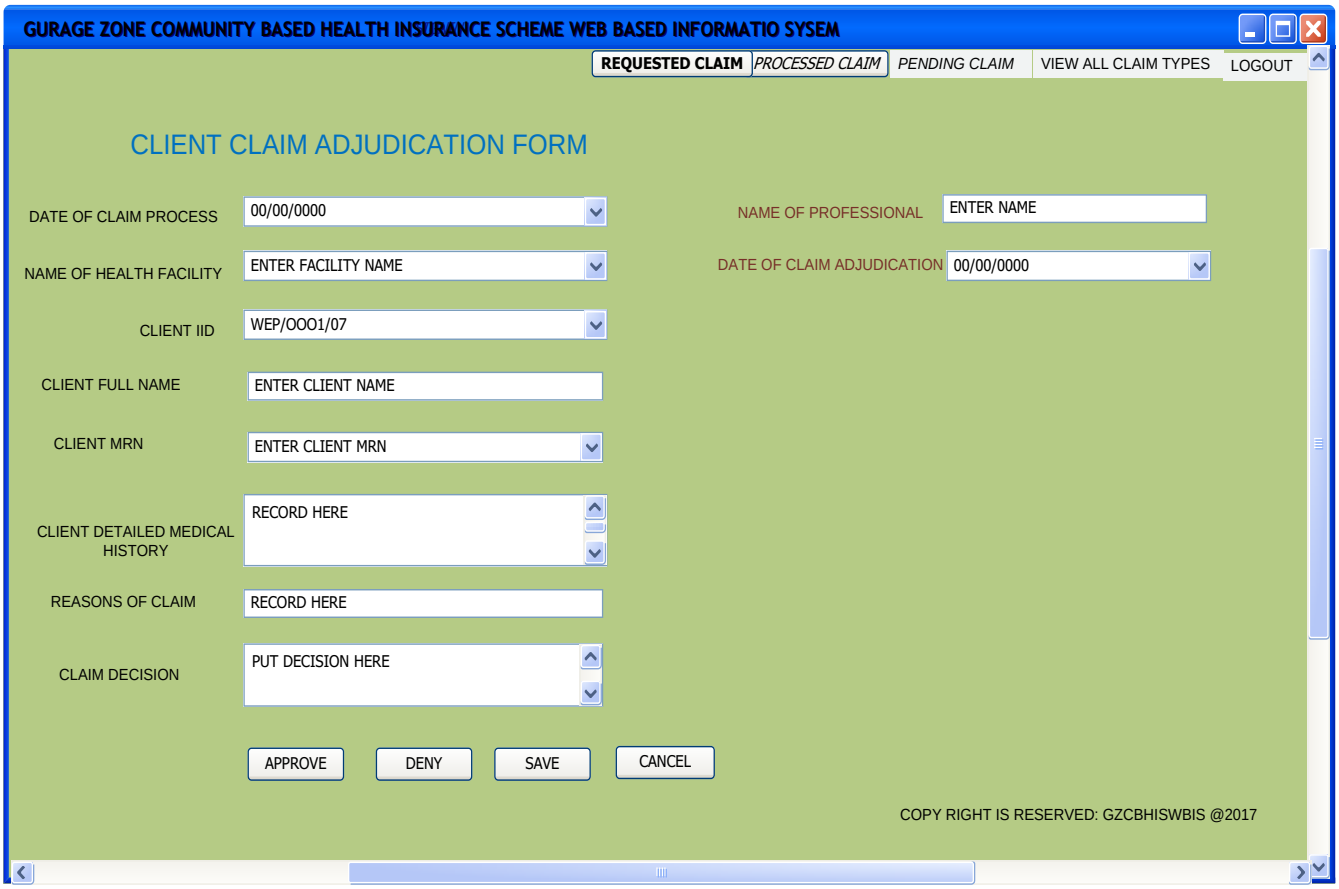

Figure 15: User interface for claim adjudication (claim processor)

This interface enables claim processor to record and submit the processed claim results of the general diagnosis and treatment of the patients. The claim request or pre-authorization request will appear on the claim processor account. The claim processor obtains the requested claim of the patients on his/her account. The claim processors obtain its accessing account from system administrator as the claim processors and chosen by the scheme (EHIA) to provide the claim decision work. On this interface; claim processor can see the full medical and clinical history of the patient before providing the claim decision.

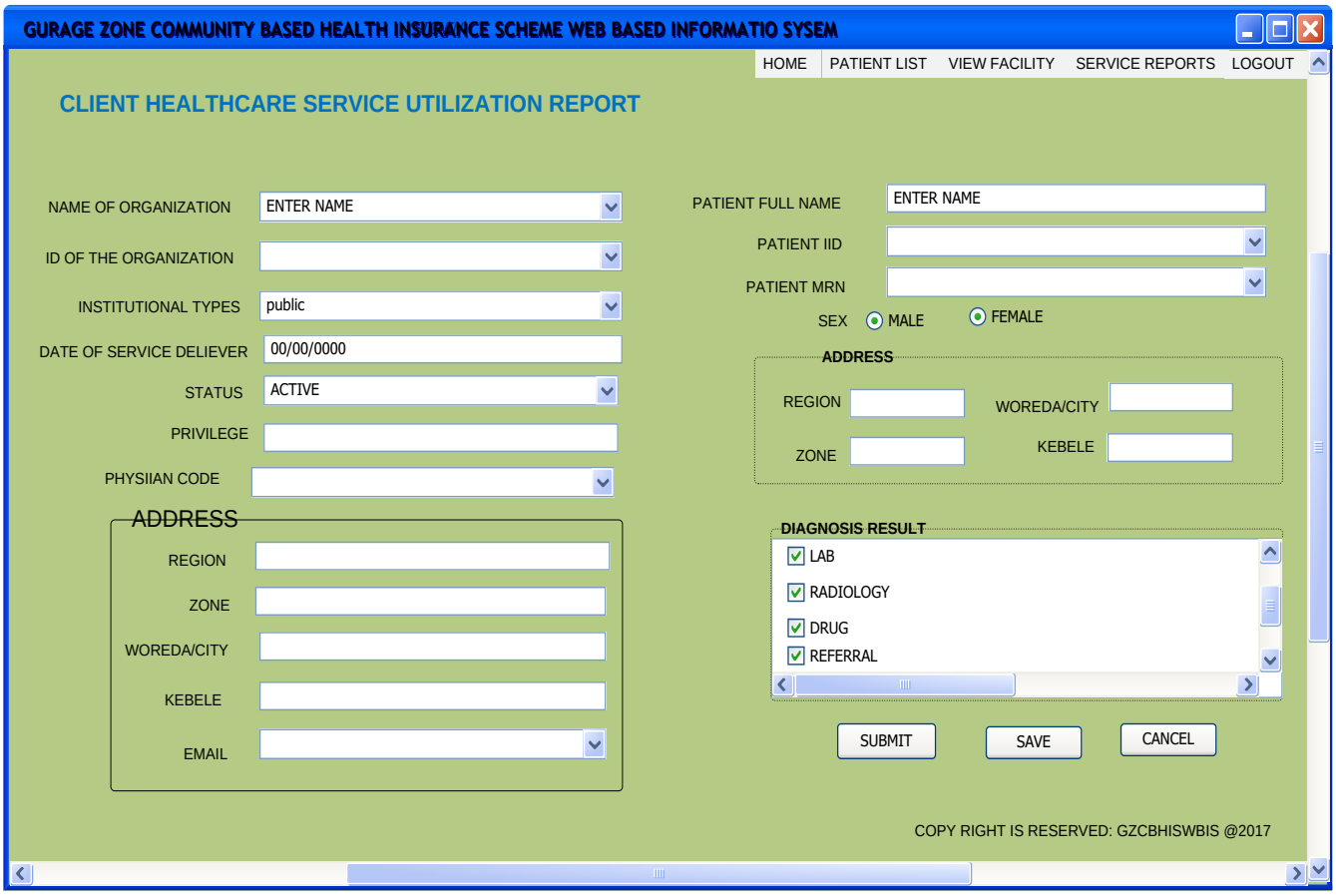

Figure 16: User interface for client service utilization reporting.

This interface enables healthcare service providers to present delivery service to the client from that health institution. This user interface helps the service providers to requests claim for the insurance scheme. The scheme identifies facility type which provides care and performs claim decision using patient information. This patient encounter registration user interface provides access to the registration of that essential different clinical information that the physician undertook during the provision of care. The international classifications of diseases code used to present service provision information. Having reported continuous service delivery by health facility helps the claim request to be processed by the claim processer or pre-authorization request to provide timely decision.

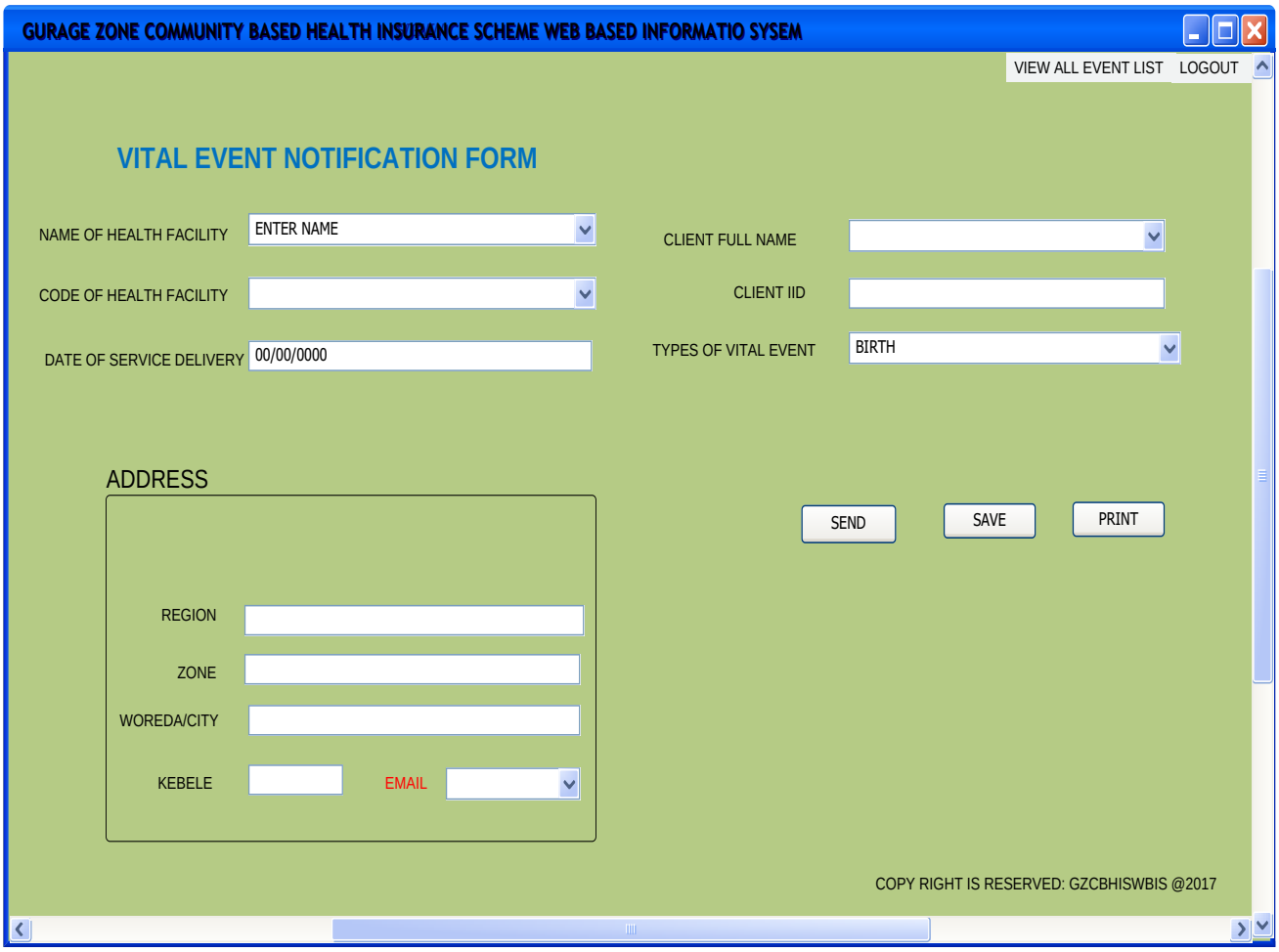

Figure 17: User interface for notifying vital event in time of diagnosis in healthcare facility

This user interface enables the health professionals to announce to insurance scheme if there is any new (death, birth, marriage and disability) that have happened to the insured members and their family at any time of the day. It also enables to delete the client when he/she pass away and add a family member during birth and update if any physical or mental disability happens to the insured.

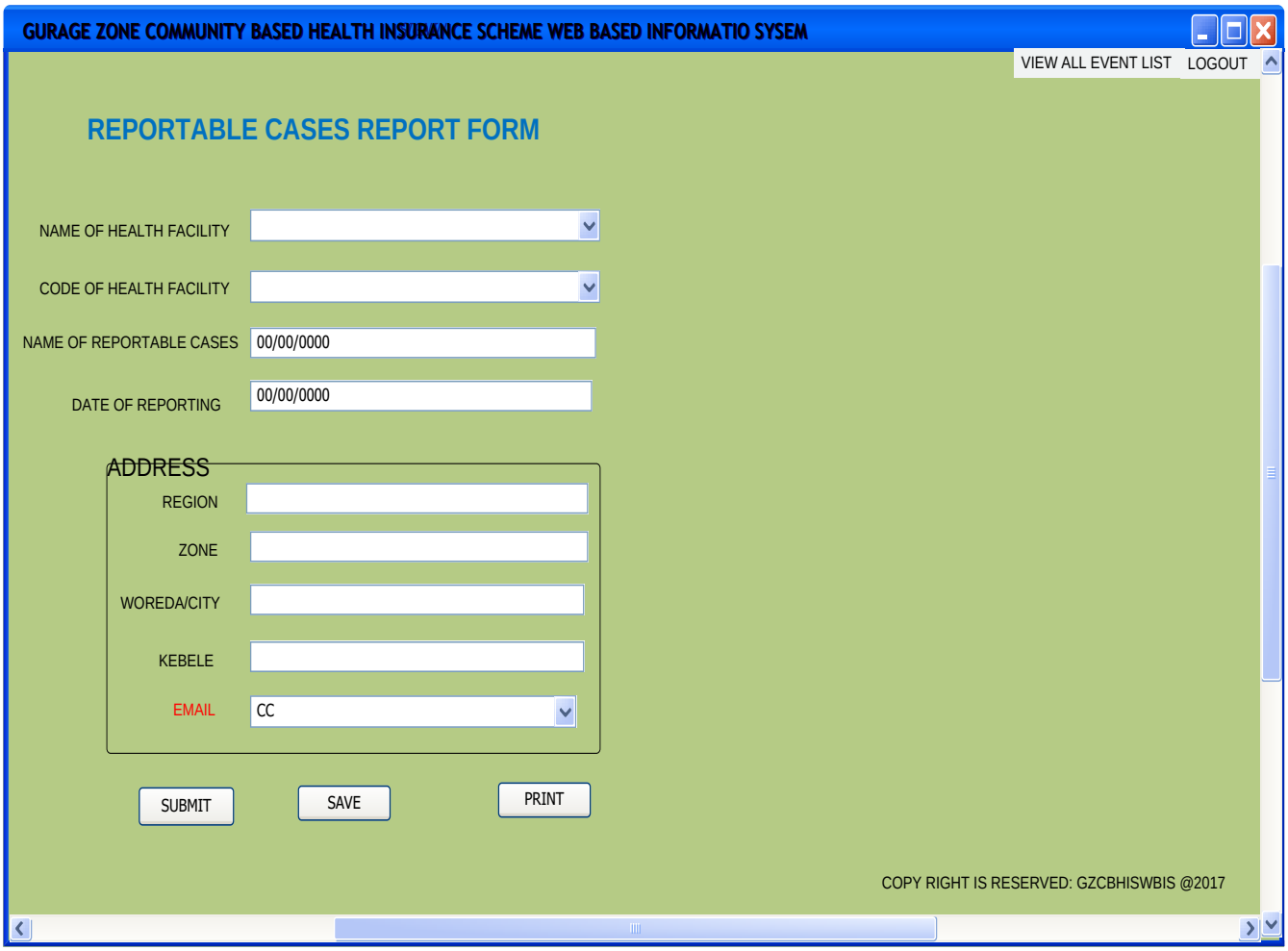

Figure 18: User interface for reportable cases reporting.

This user interface enables health service providers to announce new cases (epidemic) to the different health office (RHB, EMOH) during the time of diagnosis. In this interface the physician reports new disease case and outbreak of epidemic diseases that happened at some area that is reported by the physician working at some healthcare setting. This will enable the health office (RHB, EMOH) to take immediate action on time on that specific healthcare setting and specific individual who infected case is found.

5.2 System interface Evaluation

This part of the project would be used to evaluate the usability of the proposed system with the expected system users. It would help to investigate user satisfaction the system to be implemented. Usability is the extent to which users can use a computer system to achieve specified goals effectively and efficiently while promoting feelings of satisfaction in a given context of use. Usability evaluation consists of methodologies for measuring the usability aspects of a system's user interface and identifying specific problems. Usability evaluation is an important part of the overall user interface design process, which ideally consists of iterative cycles of designing, prototyping, and evaluating. Usability evaluation by itself is a process that requires many activities depending on the method employed [77].

Evaluation of user interface is most important aspects for software design and development of successful and usable user interface. Evaluation would help designers to answer how well users can understand the designed interface and interact with its systems' functionalities. The evaluation of the user interface for the web based information system for community based health insurance system is used a method of checklists (questions) to evaluate the interface for the prototype developed. Questionnaire method that has been adopted for use is cost effective. Heuristic evaluation examines the designed user interface by comparing to a set of principles or rules. The designer develops usability testing method (checklists) that asks system users or stakeholders to evaluate a user interface based on a set of principles or rules. This method was originally discount usability method that could be used to find problems early using prototypes and working products [76, 77].

To evaluate interface of the system the users should be usual representatives of users of application and the number should be of optimal size for the anticipated evaluation results. The tasks should represent a whole user task and will allow assessment of the interface for consistency between user's conceptual models of the tasks. The usability tests should be performed on real products or working prototypes [78].

To collect users' suggestion concerning the interface of the new system, we used questionnaires. A questionnaire is a measurement tool designed to assess a user's subjective satisfaction on a designed system. These lists of questions contain system attributes that will be answered by system users. The goal to evaluate the user interface is to identify how users adopted with new

system and to improve dissatisfaction concerning the interface. User evaluation of system's functionality presented below.

Table 16: the questionnaire for user interfaces usability evaluation of web based information system for community based health insurance system.

No	Functionality requirements					
	Put 'x' for your agreement to lists of statements with your choose of options from list of column	Strongly disagree	disagree	Neutral	Agree	Strongly agree
1	The different option menus of the system are clear to access			14%	29%	57%
2	It is clear to choose easily different menus option of the system			14%	43%	43%
3	It is clear for one to record the data on the system menus			14%	14%	72%
4	It is clear to save data on system database				14%	86%
5	It is clear for one to access required functionalities of the system with his/her privilege			14%	29%	57%
6	It is clear for one to retrieve required data using the system menus				29%	71%
	Questionnaire concerning the interfaces					
		never	Some times	Neutral	Most of the time	Always
7	The system provides adequate functions of registration and data retrieval				29%	71%
8	The way system responds to actions is consistent at the time use			14%	29%	57%

9	Is it clear that what different part of the system execute				29%	71%
10	Is the system flexible in allowing users to choose option			14%	14%	72%
11	The system interfaces are usable to the users			14%	14%	72%
12	The system displays success or error message to user				14%	86%
			Average results	0.0833	0.2380	0.67857
			Percentage of each average results	8%	24%	68%
					Total percentage of agree	92%

From the above table; we can see that the prototype user interface menus evaluation by expected respondents of system users. The responses for the requested questionnaire of user interface menus functionality 62% of the respondent strongly agree, 26% of the respondents agree and 12% of the respondents neutral. Users' interaction with designed user interfaces responses that for 7% of the responded neutral, 22% responded most of the time and 71% responded always. From the results of user interfaces evaluation most of the respondents (92%) agreed that the designed prototypes of user interface have good and clear functionality and would provide important explanation concerning information needs of users. Therefore, according to usability evaluation results, it indicates that implementation of the designed system provides important to change in existing insurance data quality, secured data storage, clear dissemination of information and dissemination of information between stakeholders with better speed and quality.

5.3 Discussions of Results

The designed system when compared to the existing paper based system it helps to minimize the various interoperability time and resource consuming business process in the service provision environment. It also helps to maintain organized, secured and fast information transfer, to stakeholders and make crucial administrative decisions in the institutions. It supports health

information management across system users and the secure exchange of health information between consumers, providers, payers, and quality monitors.

Handwritten reports or notes, manual order entry, non-standard abbreviations and poor legibility lead to substantial errors and injuries, according to the Institute of Medicine (2000) report. *A new health system for the 21st century*, advised rapid adoption of electronic patient records, electronic medication ordering, with computer- and internet-based information systems to support clinical decisions [73, 79]. Having the automated means of health insurance has to improve the coverage of preventative and curative medical services in the different areas in which the scheme was functional [79].

In the newly designed system different electronic business processes are integrated together include insurance member registration that registers different data and information. The electronically registered data and information stored in the client database possible to easily access and retrieve. The system users register the client information when they arrive to the service provision settings and check validated clients to provide the service upon the arrival to the health center. Checking the eligibility of the client for the services that are provided by the health centers is crucial. Further to the validation of the clients; the system enables assigning eligible clients (patients) to physician account of specific department. The data clerk (receptionist) executes these tasks in service provision centers. The clients can have these services from one service center without any up and down. The health professional in health service centers can serve many clients who requested the service within short period of time due to pure electronic data transfer from the receptionist. In addition to these the system can helps physician to reduce mistakes during treatment and diagnosis process.

In the automated system; claim processers can provide timely claim decision by accepting claims from service providers which facilitates the insurance health care service provision. Also it strengthens the interaction between insurance schemes and the health care service providers. This strengthens the path towards accomplishment of evidence based decision making. Claim adjudicator can also investigate accepted claim decisions timely and make claim decision. The health care service provided to insurance members should be based on signed agreement between insurance schemes and providers. This would confine increased coverage and usage of health services in the implementation environments.

From the Alma Ata declaration [4] and other health care agreements, everyone should get healthcare without financial risk or impoverishment. In order to facilitate these core business processes automating the manual process is crucial. With this automation the insured can get any medical treatment in 24 hour basis. Not only this, but also the health care service providers can use the system as a means of standardized registration module for diseases registration [80].

The physicians can register different diagnosis and treatment results in a way that it can be easily accessible and understandable standardized ways when he/she uses newly developed system. The international classification of diseases (ICD) is integrated to the system to make the registration standard, easy and understandable. During the time of patients' investigation in providers' centers; various new causes (diseases) may be identified. These new causes should be reported to EMOH to control the outbreak of diseases. In addition to these the reporting of the reportable diseases to the respective health institutions is also made possible at the instant the physician encounters any of those reportable diseases.

Health centers and hospitals other system users which mainly obliged to register clinical, demographic and vital event data on uniformly standardized documents which can help to forward evidence based decision. If any claim appeal from clients whenever occurs the insurer can go back and see the clients utilization review. This review can be used to provide the necessary decision. This has also made the decision on claims trustful, easy and sound by the clients.

The report generating process is other functionality of the system that has a function of generating report based on the informational requirement of the report viewer that makes the retrieval of the information from the database easy, flexible and appropriate.

All of the activities in the designed system starting from the registration up to the generation of report is done on a privilege based manner. That is, each of the users of the system will have a personal account and be provided with its own specific privilege by the administrator of the system according to the user's position in the insurance process. The privilege allows the users to able to use the specific functionality of the system at that level of authority or privilege. Besides that, it improves the security of the confidential information of the clients to be masked from unauthorized and illegal users.

Generally the system would help the different users of the system in registering, validating, recording, retrieving and processing different data and information regarding claim in insurance schemes. The implementation this project would help to solve different problems concerning data quality, confidentiality, and reliability for customers, users and other systems in the existing community based health insurance schemes. In the existing manual system to register individual client it takes more than 3 minutes and with the new system it takes only 40 second. To retrieve the client data from catalog data profile it takes more than 5 minutes but in the new system one can get client data within 30 second.

CHAPTER SIX

Conclusions and Recommendations

This chapter contains summary of the project, conclusions and recommendations concerning existing manual system and newly designed digital system.

6.1 Conclusions

From the existing manual community based health insurance system it is identified different problems concerning data and the business processes (basic work flows of the system). Based on information obtained from respondents participants and document review, it is identified that in the manual system different problems i.e.

- Duplication of records, incompleteness of record on the different formats, imprecise data records and poor quality of data.
- The business processes of the manual system time consuming and tiring clients' data registration, poor data management, difficult data retrieval and slow processing claims of members' requests.
- Inconsistent (un standardized) data definition, unsecure transaction of clients data between actors caused difficulty in making timely decisions.

The designed system would contribute to overcome problems and enhance or improve business processes to support evidence based decision making.

- Digital registration of client demographic and clinical data, fast checking of clients' validation to provide requested service, assigning patients to physicians of specific departments, announcing vital events to health institution and reporting new causes (death, diseases outbreaks) and secure transactions of data and information between stakeholders.
- To implement the new system in the study environment, it is important to fulfill the different hardware and software, infrastructure, electricity and network facilities. In addition, the national standards and guideline were used as an input in order to determine the requirements of the new system.
- From identified stakeholders (actors in the system) and gathered requirements i.e. the functional and non- functional requirements. The functional requirements include

registration, validation, processing claims of clients data, referring patients to higher health care service providers. The non-functional requirements were required to help the system keep working included security, scalability, portability and availability.

- The design system was done with object oriented analysis and design methodology. From the different types of UML tools, the interaction modeling tools (use case, collaboration and sequence) diagrams and association modeling tool (class diagram) was used. In order to implement the system three tier system architecture was proposed. These can enable a secure and networked web based system.
- Prototype of the system was designed to show the working model of the system. The user interface prototype consisted of the different functionalities and navigational links. The satisfaction of the users about the prototype system was assessed using checklist question. Technical evaluation result shows that 92% of the respondents were agreed that the prototype interfaces designed were usable. It identified using empirical (inspection methods with expected users).

6.2 Recommendations

From the designed web based information system for Gurage Zone community based health insurance scheme, the following recommendations were drawn for the scheme and the other stake holders. The recommendations should be considered to resolve the different constraints that were identified during the requirements collection.

Gurage Zone Insurance Scheme

- ✓ Should deploy the system in the main office and enhance its functionality.
- ✓ The scheme should deploy the new system thought Zonal level.
- ✓ Considering the benefits of the designed system, the scheme should publicize the system to the different system users i.e. employers in the woredas' and towns' schemes and health care service providers through capacity building training and panel discussion
- ✓ The scheme should facilitate to deploy the necessary system accessories that support for full implementation.
- ✓ The scheme should control and monitor the functionality of the system in different insurance schemes and health care service providers' settings.

Ethiopian health insurance agency and regional Health Insurance Agency

- ✓ Should work on the implementation of the system in various regions and zones
- ✓ Should control and monitor usability and full functionality of the system in the different zone of the regions.
- ✓ Should support installation generator where there is no electricity to support online data exchange .

EMOH, Regional Health Bureau, Zonal and Woreda Health Office

- ✓ They should work in collaboration with the agency in the implementation of the system in various health care settings
- ✓ Should work in collaboration with the insurance agency (schemes) and the healthcare providers.

Future work

- ✓ Researchers or students should continue the project to complete on the rest part of system implementation, by using this project as an input for software development process.
- ✓ The system has limited functionalities that do not handle financial transactions management. So the researchers/students should continue research to integrate the system functionality with other systems and to enhance the overall functionality of the system.

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Annex I

Implementation Strategy

The designed system is proposed to integrate the various insurance service stakeholders includes insurance members (insured), the insurance schemes (insure) and the health care service providers (health care settings). There are different business processes in the service provision institutions like registration, validation, referral patients and different data transfer between stake holders. Therefore the system should support these various business transactions that occur through stake holders so it should sustain interoperability. It should have to work for 24 hours/days and should be maintainable when it fails functionality.

To deploy the system technical persons are necessary like information technology professionals. In addition to technical persons the availability of important infrastructures such as electric power, internet connection and others networking facilities for fully functioning of the system is very important. Secured private internet connection that support secured transaction of the insurance service provision business process is also necessary.

The newly developed automated system can help the schemes in minimizing the amount of money required for prepare hard copies during the day to day working. Besides the minimized material resources usage, the system enables the scheme to use human resources efficiently offices. A secured environment for the transaction of secure medical and clinical data is mandatory so the designed system enables system users to be confidently using the system. Hardware and Software Requirements

Hardware and Software Requirement

Hardware Requirements

It is quite logical that in order to realize the functionalities of the system acquiring hardware is a mandatory. The minimum specification of the hardware required to implement the system are specified in two categories:

Machine specification for server and workstation

One server side computer

- ✓ Minimum of 2 dual core 2.4GHz

- ✓ A minimum of 3 GB of RAM and greater than 3 TB hard disk.
- ✓ Mouse, keyboard, Monitor
- ✓ Network interface card (NIC)
- ✓ Back up device

Client side computers

- ✓ Operating System Windows XP /7/8/10/ above
- ✓ Minimum of 3.4 GHz
- ✓ Pentium IV processor
- ✓ A Minimum of 1 GB RAM and 80 GB hard disk.
- ✓ Printer

Software Requirements

In order to obtain the required functionalities of WBCBHIIS system, it is important to have software such as:

Software needed for Server

- ❖ Operating System Windows 2003 Server (SP2) and above
- ❖ Apache server
- ❖ PHP
- ❖ Mysql Server
- ❖ Web Services providers operating system

Annex II

Guidelines and questions for requirement collection

Requirement collection standards

According to health metrics network and world health organization [80, 81] community wide health information data collection and management system can include the following functionalities:

1. **Client Management Services**

- ✓ Client specific tracking of intake process, including program entry and exit
- ✓ Socio-demographic data, including capacity to record family and household relationships
- ✓ Retention of client specific historical data
- ✓ Remote Client data Management:

2. Case Management

- ✓ Client specific assessment of needs
- ✓ preservation of client specific historical data
- ✓ Ability to track client specific goals and outcomes
- ✓ Ability to share client level data across agencies
- ✓ Flexibility for data sharing to accommodate scheme selected data element masking [ability to close part or all of a client record from other users], including the ability to enforce time limits on the sharing of all or part of a client record.

3. Service Tracking

Service Delivery Management:

- ✓ Ability to document and retain history of client specific services received by client, including ability to document planning, scheduling and follow up on delivery of services

Referral Management:

- ✓ Ability to document and retain history of client specific referrals, including follow up, reminder capabilities, and status/outcome

Information and Referral

- ✓ Real time link to community's Information and Referral database of available resources or capacity to build and maintain an integrated Information saving and retrieval within the community's HMIS
- ✓ Electronic submission of applications for mainstream resources
- ✓ Benefits eligibility assessments

6 Reporting Capacity

Capacity to generate program, if applicable, collaborative level reports.

- ✓ Standard, built-in reports and forms.
- ✓ Data validation reports, an unduplicated client count report, and basic client demographic reports.
- ✓ Integrated ad hoc reporting capacity that maintains user level security restrictions while allowing for user flexibility in choosing tables and fields as well as filtering and conditional report aspects.
- ✓ Capacity to import and export data through standard formats, including ability for regular, community initiated imports and exports and ability to securely strip data of identifiers and manage data transmission while insuring a high accuracy of un-duplication rate.

5. System Security

- ✓ Integrated technical safeguards to ensure a high level of privacy and security, including Back end server[s], including data encryption and transmission
- ✓ Administrator controlled user name and password access
- ✓ Automatic timeout/log-off
- ✓ Administrator controlled user level read, write, edit and delete capabilities
- ✓ Administrator controlled user level module and sub-module access
- ✓ Automated audit trail
- ✓ Information Security Industry Standard encryption and
- ✓ All technical safeguards required to be HIPAA compliant

Annex III

Requirement collection questions

The questions are devised by taking considerations of the above standards, templates and previously done projects and also by including the possible information system components that are important for system development. The number of people included in the interview are, all insurance scheme officers in the Gurage zone insurance scheme, three woredas' insurance scheme and focal personnel's from Gurage zone health office.

ADDIS ABEBA UNIVERSITY SCHOOL OF INFORMATION SCIENCE AND SCHOOL OF PUBLIC HEALTH MSC IN HEALTH INFORMATICS PROGRAM

My name is Ahmedin Hussen. I am post graduate student of health informatics program in Addis Abeba University. I am doing a research project on designing of web based information systems for community based health insurance scheme for gurage zone health insurance scheme. The following interview is designed in accordance to strengthen the informational need of the project on how to design, implement and achieving the organizational mission and goals of the scheme. Thus you are kindly requested to provide genuine and correct answers for the questions posed by the principal investigator. The information you provide are confidential and will be used only for the purpose of this study. Sir/madam, if you have anything, you want to be clarified do not hesitate to ask the investigator/the interviewer. Your full cooperation and participation until the completion of the interview is very necessary and crucial for the completion of the assessment. I kindly ask you to provide your genuine willingness. Besides, you have the right to turn down if you are not voluntary to participate on the interview, thus you can fill/mark the **NO** box

If you are voluntary or not mark '**X**' on your opinion **YES** NO

THANK YOU IN ADVANCE FOR YOUR COOPERATION

Interview questioning guideline for Designing of Web based Information System of community based health insurance scheme.

1. Data and process/Functionality

1. What types of information is processed in the current system?
2. What data are included in each type of information processed?
3. How are client data collected and stored?
4. How are data retained for any period of time?
5. What are the problems with the current existing forms?
6. How do you retrieve client information in the current system?
7. How do you get client history?
8. How do you record data during processing of insurance service in the current system?
9. Is that information included in the client's record?
10. Where do the health insurance data process started/initiated?
11. What are the current problems on data processing?
12. What types of error happen most in record and process?
13. What are the appropriate reactions to possible errors?

2. Interfaces

14. Is input coming from one or more other systems?
15. Is output going to one or more other systems?
16. For both input and output, is there a standard format of the data be?

3. Users/people

17. Who are the users?
18. How is client information accessing privilege provided for the professional?
19. Who is responsible for clients record error and how?
20. Who makes reports?
21. What is the skill level of each user?

4. Communications /procedure

22. Do you have guideline to help the different Insurance process?
23. What are client information recording procedures include?
24. How is problem on client information recording process handled?
25. Do you have any mechanism to trace the problem?

5. Software

26. Is there a planned approach to automate the current system?

27. Do you have any software used to prepare the reports? Which software?

28. Do you have computer network for sharing information?

6 Hardware

29. Do you have computer? How many?

30. For what purpose do you use it?

Annex IV

User interface Evaluation checklists

The table below was developed to collect the required response from respondent users (stakeholders) of the system to help in assessing and evaluating the user interface of newly developed prototype system. The questionnaire was modified after being adopted from *Siraj Sebhatu*, which is used to evaluate graphical user interface evaluation for messaging and directory Systems [82].

Table 5.1 the questionnaire for user interfaces usability e valuation of web based information system for community based health insurance system.

No	**Functionality requirements**					
	Put 'x' for your agreement to lists of statements with your choose of options from list of column	Strongly disagree	disagree	Neutral	Agree	Strongly agree
1	The different option menus of the system are clear to access					
2	It is clear to choose easily different menus option of the system					
3	It is clear for one to record the data on the system menus					
4	It is clear to save data on system database					
5	It is clear for one to access					

	required functionalities of the system with his/her privilege					
6	It is clear for one to retrieve required data using the system menus					
	Questionnaire concerning the interfaces					
		never	Some times	Neutral	Most of the time	Always
7	The system provides adequate functions of registration and data retrieval					
8	The way system responds to actions is consistent at the time use					
9	Is it clear that what different part of the system execute					
10	Is the system flexible in allowing users to choose option					
11	The system interfaces are usable to the users					
12	The system displays success or error message to user					
				Average results		
				Percentage of each average results		
						Total percentage of agree