JIMMA UNIVERSITY

COLLEGE OF NATURAL SCIENCES

DEPARTMENT OF INFORMATION SCIENCE

DEVELOPING A KNOWLEDGE BASED SYSTEM FOR HEALTH INSURANCE CLAIM PROCESSING: THE CASE OF THE ETHIOPIAN HEALTH INSURANCE AGENCY

BY

TIZITA ZENEBE

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DEDICATION

I dedicate this research to my family and friends who were by my side through the whole process.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abbreviations/ACRONYMS

AI : Artificial Intelligence

CBHI : Community Based Health Insurance

CP : Claim Processing

CRT : Current Procedural Terminology

ES : Expert System

KBS : Knowledge-Based System.

KBSMCP: Knowledge Based system for medical claim processing

SHI : Social Health Insurance

ACKNOWLEDGEMENT

First and for most, I thank God for blessing me with his love and kindness. I also wish to thank my family who supported me through my work. I am also vary grateful to my friends for being understanding and encouraging. I would sincerely like to thank my advisor Dr.Million Meshesha for his support throughout the study. I also thank my supervisor Mr.Amanuel Ayde for his guidance and support through the entire process. Lastly I want to extend my gratitude to Ethiopian health insurance agency head office employees for their cooperation and hospitality.

Abstract

Health insurance is insurance against the risk in occurring medical expenses among individuals .By estimating the overall risk of health care and health system expenses, among a targeted group, an insurer develops a routine finance such as monthly premium, to ensure that money is available to pay for the health care benefits specified in the insurance agreement. A service provider, having a contract with the insurer, sends medical claim that provides information on patient, the service provider, Treatments, procedures, and the medical bill for each service. Claim processing is a challenging process that requires an expert to analyze various claim information and make a decision free of error. It also takes the experts time and energy to analyze claims individually. Another challenge in medical claim processing is detecting fraud and burst billing. The aim of this research was to develop a prototype knowledge based system for medical claim processing. Three experts from Ethiopian health insurance agency were purposively selected and interviewed, using semi structured interviews, to acquire the domain knowledge .The knowledge was then represented using rule based representation. SWI-Prolog was used as a tool to develop the prototype system. The user's acceptance of the prototype system by visual interaction method that by showing the prototype system to the domain experts was conducted result is 83.3%. In addition, performance of the prototype system was evaluated using case testing method. The test result of a prototype system performance testing using f-Measure is 0.90. The prototype system certainly addresses the domain area and assists experts in making more precise decisions. However, further study should be done on integrating natural the system with natural languages and case based reasoning.

CHAPTER ONE

INTRODUCTION

1.1. Background of the study

Health insurance is a method to finance healthcare. The international labor organization (ILO,1996) defines health insurance as "the reduction or elimination of the uncertain risk of loss for the individual or household by combining a larger number of similarly exposed individuals or households who are included in a common fund that makes good the loss caused to any one member". To put it more simply in a health insurance program, people who have the risk of a certain event contribute a small amount (premium) towards a health insurance fund. This fund is then used to treat patients who experience that particular event e.g., hospitalization (Yellaiah, 2012).

Health insurance is among the solutions promoted in developing countries since the 1990s to improve access to health care services because it avoids direct payment of fees by patients and spreads the financial risk among all the insured. Many mutual health insurance organizations have been developed in sub-Saharan Africa, and over the past several years some African countries have set up national health insurance systems (Morestin, Ridde, & Montréal, 2009). However, in those countries that elect to give an important role to health insurance, it remains to be verified whether such insurance really reaches those who are most vulnerable in terms of access to services: the poor. In fact, lack of funds creates problems at two levels: when it comes time to pay the premium, and when the insured need to use health care services (Morestin, Ridde, & Montréal, 2009).

Ethiopia introduced a new health insurance program ratified by the House of People's Representatives recently (2010). The new program includes organizations which already provide health insurance for their employees. Permanent employees of private, governmental and nongovernmental organizations will contribute 3% of their salary to take part in the new health insurance program. Although organizations are allowed the option to provide another type of health insurance they have to participate in the program unless they have less than ten employees (Tekleberhan, 2012)

The health insurance system adopted by a country needs to be compatible with the socioeconomic situation of the nation. The Social Health Insurance and the Community Based Health Insurance schemes are considered to be important for achieving universal health service coverage in Ethiopia (Birara, 2014).

Knowledge-based System (KBS) is one of the major family members of the AI group. With the availability of advanced computing facilities and other resources, attention is now turning to more and more demanding tasks, which might require intelligence. The society and industry are becoming knowledge oriented and rely on different experts' decision-making ability. KBS can act as an expert on demand without wasting time, anytime and anywhere. KBS can save money by leveraging expert, allowing users to function at a higher level and promoting consistency. One may consider the KBS as a productivity tool, having knowledge of more than one expert for a long period of time. In fact, a knowledge based system (KBS) is a computer based system, which uses and generates knowledge from data, information and knowledge. These systems are capable of understanding the information under process and can take decision based on the residing information/knowledge in the system, whereas the traditional computer systems do not know or understand the data/information they process (Sajja & Akerkar, 2010).

The Ethiopian Health Insurance Agency was established in 2010 G.C to deal with the citizens' health problems. The health stations that provide the service have been selected and identified by the agency and they was able to render the service by the time the program is fully put in practice. Except for organ transplants, dialysis, drug-caused illness, and medication directed to be taken overseas all medical services given in the country will be available in the scheme. So far, the community-based health insurance has already started to take place as a pilot project in 13 different districts in Oromia, Amhara, Tigray and the Southern Nations and Nationalities and Peoples Regional States and results have been promising so that the program has been extended to 161 districts throughout the country (Reta, 2013).

1.2 Statement of the Problem

There are potential hindrances that the Health Insurance Agency expected in implementing the health insurance practices. Successful implementation of health insurance depends on the capacity and willingness of the community to regularly pay their contributions/premium as it is financed by the contributions regularly collected from its members. Collecting premiums timely and properly/ genuinely will be a problem in communities where individuals' income is hardly known (Birara, 2014).

Given the high level of poverty in Ethiopia, expansion of health insurance faces serious challenges if the premium is beyond the ability of the majority of the rural and urban poor to pay. Expanding health insurance coverage, particularly for the poor, requires tremendous resources, which could be beyond the capacity of the government and the community to obtain. Scaling up is unlikely without a concerted effort from all stakeholders. Hence, the regional and federal governments, in addition to increasing the share of health from their total budget, should create an environment conducive to the involvement of various stakeholders in the development of health insurance (Birara, 2014).

A report on an evidence brief by the Ethiopian public health institute (2014) says that Poor health care financing remains a major challenge for the health system of Ethiopia. It leaves households vulnerable to impoverishment from catastrophic health expenditures, and slows progress towards health improvements such as the Millennium Development Goals by limiting access to essential health services among the poor. It implied that Low government spending on the health sector, Strong reliance on out of pocket expenditure, Inefficient and inequitable utilization of resources and Poorly harmonized and unpredictable donor funding are significant barriers improved health care financing . Lack of awareness and negative perception towards health insurance, lack of trained personnel and adverse selection are also mentioned as barriers that need particular attention. Rural communities may not be aware of the benefits of health insurance. Therefore may not be interested in it as the benefits of insurance are not immediate. The study also states a concern on Planning, coordinating and monitoring health insurance schemes require new technical expertise, which may not adequately exist in the public sector. High-risk or sick individuals are more likely to buy health insurance than low-risk or healthy individuals (Tabor 2005), since most community based health insurance (CBHI) schemes are based on voluntary membership. (Dibaba & Mamuye, 2014)

As policy options, Community based health insurance and social health insurance were the two potential strategies to address the poor health care financing in the country. A combination of strategies was needed to effectively implement the proposed options. But there are Barriers that should be considered during the implementation of both options such as moral hazard, fraud and corruption and inefficiency in the health care delivery (Dibaba & Mamuye, 2014).

According to the federal ministry of health of Ethiopia (2010), one of the challenges of exposure expected during the implementation of the health insurance schemes was moral hazard. It happens when customers use their insurance coverage beyond their share. Therefore, this study attempted to develop knowledge based advisory system that assists health insurance workers in making necessary decisions in overcoming moral hazard.

Currently the Ethiopian health insurance Agency (EHIA) accepts medical bills in batches from health institutions monthly. The health institutions initially sign a contract with the EHIA that clearly states the services and treatments that are covered by the insurance packages, and the corresponding bill charged for each service. The agency is not obligated to pay any claim that included, excluded services or over billed treatments (Ethiopian health insurance proclamation, 2010). This greatly leads to fraud and burst billing which are the major problems in the health insurance business this day.

1.3. Research Questions

The study answers the following research questions to come up with the solution for the above mentioned problems for the success of knowledge based system development.

- ❖ What kinds of knowledge are required for health insurance claim decision making?
- ❖ What are the suitable techniques for knowledge modeling, knowledge representation and in developing effective prototype knowledge based system for health insurance claim processing?
- ❖ To what extent will the knowledge based advisory system get user acceptance?
- ❖ How precisely will the prototype system process medical claims?

1.4 Objective of the study

1.4.1 General objective

The general objective of the study is to develop a prototype knowledge based system that assists decision making in health insurance claim processing.

1.4.2 Specific Objectives

- To identify and acquire the knowledge needed for the knowledge based system development.
- To model and represent the acquired knowledge using appropriate methods.
- To develop a prototype learning knowledge based system for health insurance claim processing.
- To test and evaluate the performance and user acceptances of the new system .

1.5 Scope and Limitation of the study

The aim of this research was to develop a prototype knowledge based system that assists decision making in health insurance claim processing. There are various aspects of health insurance like financing and management, but the study concentrates on advising insurance workers in the claim decision making. For the accomplishment of this work, domain knowledge was acquired from Ethiopian health insurance agency employees and organizational documents such as proclamations and policy statements. The researcher collected all the data from the headquarters of the agency which is found in Addis Ababa because there does not seem to be any factor differentiating knowledge of employees in the headquarter of the company and its branches throughout the country.

1.6. Significance of the study

The immediate beneficiaries of the study are health insurance claim experts and the Ethiopian health insurance organization.

The knowledge based claims processing system for health insurance aims to show that expert knowledge can be efficiently used to make important decisions to assist organization processes and in its journey towards creating a healthier and well insured society.

The system is a good tool to the organization in making sure that the right health care services are provided to the right user. The system makes a decision on whether a claim is paid to the service provider or not. The system reduces the time and energy wasted by experts on assessing a number of claims. The system also solves the problem of the shortage of health insurance experts by substituting them where they are not available. The system helps the organization to avoid significant errors in decision making. This system also provides a way of individually assessing claims to minimize the existence of errors and detect any sign of fraud or burst billing.

1.7. Research Methodology

There are different approaches and tools that can be used for developing a prototype knowledge base system for health insurance claim processing. In order to achieve the objectives of this research, the following methods and techniques were employed for developing proposed knowledge based system.

1.7.1 Research Design

This research was conducted through experimental research design. The experimental method is the only method of research that can truly test hypotheses concerning cause-and-effect Relationships.

1.7.2 Sampling Techniques and Sample Size

Data gathering is crucial in research, as the data is meant to contribute to a better understanding of a theoretical framework. It then becomes imperative that selecting the manner of obtaining data and from whom the data will be acquired ,be done with sound judgment, especially since no amount of analysis can make up for improperly collected data (Bernard , 1986).

The purposive sampling technique, also called judgment sampling is the deliberate choice of an informant due to the qualities the informant possesses. It is a nonrandom technique that does not need underlying theories or a set number of informants. Simply put, the researcher decides what needs to be known and sets out to find people who can and are willing to provide the information by virtue of knowledge or experience (Bernard, 2002, Lewis & Sheppard, 2006).

Purposive sampling techniques are employed to select sample which can help to acquire the required knowledge from the domain experts. Domain experts are selected based on their educational qualifications related to the domain area, year of experience and willingness.

The claim adjustment division of the EHIA was purposively selected for sampling because the section specifically deals with medical billing, service provider issues and claim processing. This division has four employees from which two experts are selected based on experience and level of responsibility. One expert was selected from the health insurance communication division because of the respondent's participation in policy making, awareness creation and implementation of health insurance.

1.7.3 Method of Data Collection

For the purpose of this study, both primary and secondary data were needed to acquire the required domain knowledge. Primary knowledge was gathered from health insurance professionals (experts) in the main branch of the Ethiopian health insurance agency. In addition, knowledge was deducted from secondary sources, including journal articles, insurance manuals, and guidelines.

Semi-structured interview technique was employed to acquire the required knowledge from the selected domain expert. It allows the interviewer to change the order of the questions and add new question based on the participant response. Therefore, this interview focused on the concept, procedures, guidelines and experience which domain expert used while processing health insurance claims.

1.7.4 Knowledge Representation Methods

After the knowledge was acquired, it was represented using rule based knowledge representation method. For this research, the knowledge representation method, rule based is chosen; because, it clearly demonstrates the domain knowledge. In a rule based system, much of the knowledge is represented as rules, that is, as conditional sentences relating statements of facts with one another. As a result, rule based representation method is more appropriate to represent and demonstrate the real domain knowledge in advising health insurance. Health insurance packages have predefined set of rules. There are already defined set of requirements, packages, and restrictions that should be considered to make insurance coverage. Insurance proclamations also provide rules for accepting or denying and claim sent by a health institution. As a result, the rule based representation method was more appropriate to represented demonstrate the real domain knowledge in health insurance claim processing.

1.7.5 Implementation Tools

Prolog programming language was used to develop the prototype knowledge based system. Prolog (programming in logic) is one of the most widely used programming languages, especially in the artificial intelligence research, natural language processing, system development, and so on. It was very useful, especially on those mentioned areas to specify the situation (rules and facts) and the goal (query).

The reason of the selection of this programming language is the features and abilities of the language that incorporate it. Prolog is a declarative language, rather than how to solve it) and has the capacity to describe the real world. In addition, it is easy to learn the design tools and has a rule based programming and built in pattern matching features. Prolog has a comprehensive help system on each feature and it is readable code that will also make updating of the system a relatively manageable task.

SWI Prolog is the most inclusive and widely used Prolog development environment. It has a flexible and fast interface. In addition, it is portable to many platforms, including almost all UNIX/Linux platforms and Windows Vista. Additionally, it is non-commercial version of Prolog. So, it can be easily accessed. Therefore, the prototype knowledge based system was developed using SWI Prolog.

1.7.6 Testing and Evaluation

The developed prototype rule based system was evaluated thoroughly to ensure the performance of the system in meeting the established objectives. The evaluation process was more concerned with system user acceptance and system performance. User acceptance efforts were concerned with figuring out how well the system addresses the user needs, whereas validation efforts determine if the system performs the intended task effectively.

To assess issues in user and system interaction, questionnaire method was used to gather feedback. The questionnaire, including both closed ended and open ended Questions, was constructed using clear and objective questions.

In this research, system performance testing confusion matrix techniques was used and the performance of the system was calculated using recall, precision and F measure were used to measure effectiveness. The confusion matrix has four categories: True positive, false positive, false negative and True negative.

	Actual Positive	**Actual Negative**
Predicted Positive	**TP**	**FP**
Predicted Negative	**FN**	**TN**

Table 1.1: Confusion matrix

In the process of testing the performance of the prototype system, the domain experts classify correct and incorrect claim decisions by comparing the decision reached by the prototype system with that of the domain expert's decision reached on the same claim.

CHAPTER TWO

LITERATURE REVIEW

2.1 Concepts of Artificial Intelligence

The term Artificial Intelligence (AI) refers to the activity of building intelligent systems. It is a technology of making computers to simulate human beings intelligence (Raza, 2009). An intelligent system is a system that exhibits and possess some basic attributes such as performing some actions, reasoning about a particular domain, making decision and goal oriented problem-solving capability. A system or an agent can be said to be intelligent when the agent's performance cannot be distinguished from that of a human performing the same task (Honavar, 2006).

The prime goal of AI research is to increase human beings understanding in all aspects like in human being's perceptual, reasoning, learning, and creative processes (Honavar, 2006). The first major and successful AI research application technologies are expert systems1 or knowledge based systems (Pomykalski et al., 1999). Early efforts in building AI programs were intended to create general-purpose problem solvers.

The main examples of the Knowledge Based System (KBS) developed at the early stages of AI include PUFF (1979), MYCIN (1976), CADUCEUS (1984), QMR (1988), and DENDRAL (1960s and 1970s). Pulmonary function analysis (PUFF) was of the oldest KBS in the field of medicine. It was developed for the interpretation of respiratory tests for diagnosis of pulmonary disorders. Patient inhales/exhales through a tube connected to computerized instrument which measures flow rates and air volumes. PUFF accepts this data along with auxiliary data (age, sex, smoking history), and prints diagnosis in English. As for the knowledge base, a knowledge engineer sat down with an expert pulmonary physiologist at the Pacific Medical Center in San Francisco and developed rules (64 in all). A more recent version of PUFF had about 400 rules.

MYCIN, a precursor to PUFF, was developed for the identification of bacteria in blood and urine samples and prescription of antibiotics 1976. It uses IF-THEN rules (with certainty factors) to represent knowledge. It also interacts with a physician to acquire clinical data. The system asks questions based on current hypothesis and known data and reasons backward from its goal of recommending a therapy for a particular patient. It stores approx. 500 IF-THEN rules, and can recognize about 100 causes of bacterial infection. TEIRESIAS serves as a front-end to MYCIN. It was the first program to provide explanations of how conclusions were reached. TEIRESIAS can answer "why" questions by examining its internal tree of sub goals.

QMR (1988), referring to Quick Medical Record, Assisted physicians in diagnosis of over 4000 disease manifestations (uses the INTERNIST knowledge base). DENDRAL was also one of the first expert systems created. It identifies of molecular structure of organic compounds. The system Uses mass spectrogram and nuclear magnetic resonance (NMR) data.

2.2 Knowledge Based Systems

Knowledge-based System (KBS) is one of the major family members of the AI group. With the availability of advanced computing facilities and other resources, attention is now turning to more and more demanding tasks, which might require intelligence. The society and industry are becoming knowledge oriented and rely on different experts' decision-making ability. KBS can act as an expert on demand without wasting time, anytime and anywhere. KBS can save money by leveraging expert, allowing users to function at a higher level and promoting consistency. One may consider the KBS as productive tool, having knowledge of more than one expert for a long period of time. In fact, a KBS is a computer based system, which uses and generates knowledge from data, information and knowledge (Sajja & Akerkar, 2010).

These systems are capable of understanding the information under process and can take decision based on the residing information/knowledge in the system, whereas the traditional computer systems do not know or understand the data/information they process.

The KBS consists of a Knowledge Base and a search program called Inference Engine (IE). The IE is a software program, which infers the knowledge available in the knowledge base. The knowledge base can be used as a repository of knowledge in various forms. This may include an empty Workspace to store temporary results and information/knowledge pieces/chunks. As an expert's power lies in his explanation and reasoning capabilities, the expert system's credibility also depends on the Explanation and Reasoning of the decision made/suggested by the system. Also, human beings have an ability to learn new things and forget the unused knowledge from their minds. Simulation of such learning is an essential component of KBS. The life of KBS may vary according to the degree of such simulation. KBS may be either manually updated (manual update) or automatically updated by machine (machine learning). Ideally, the basic frame of a KBS rarely needs to be modified. In addition to all these, there should be an appropriate User Interface, which may have the Natural Language Processing facility. (Sajja & Akerkar, 2010)

According to the classification by Tuthhill & Levy (1991), there are main 5 types of the KBS exist: Expert Systems, Hypertext Manipulation Systems, CASE Based Systems, database in conjunction with an Intelligent User Interface and Intelligent Tutoring Systems.

2.3 Knowledge Based Systems Development

Mostly knowledge engineering, the process of building an expert system, involves some basic steps. The main phases of a knowledge based system development processes are planning, knowledge acquisition, knowledge representation and evaluation (Raza, 2009; Sajja & Shah, 2010).

The knowledge of the expert(s) is stored in his mind in a very abstract way. Also every expert may not be familiar with knowledge-based systems terminology and the way to develop an intelligent system. The Knowledge Engineer (KE) is responsible person to acquire, transfer and represent the experts' knowledge in the form of computer system. People, Experts, Teachers, Students and Testers are the main users' groups of knowledge based systems (Sajja & Akerkar, 2010).

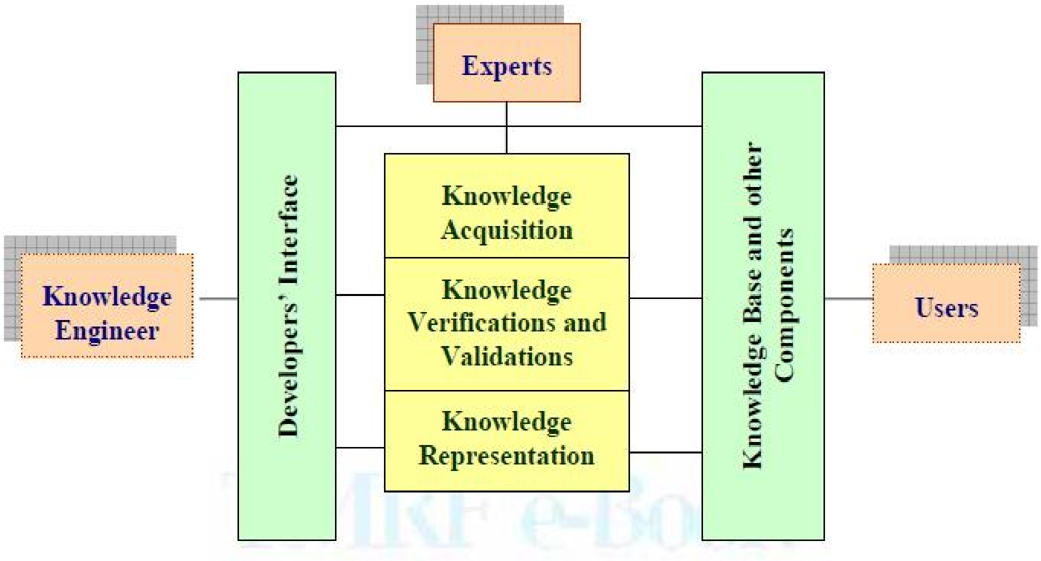

Figure 2.1: Development of a Knowledge-Based System (Akerkar, 2010)

2.3.1 Knowledge Acquisition

The knowledge acquisition process incorporates typical fact finding methods like interviews, questionnaires, record reviews and observation to acquire facts and explicit knowledge. However, these methods are not much more effective to extract tacit knowledge which is stored in the subconscious mind of experts and reflected in the mental models, insights, values, and actions of the experts. For this, techniques like concept sorting, concept mapping, and protocol analysis are being used (Sajja & Akerkar, 2010).

The acquired knowledge should be immediately documented in a knowledge representation scheme. At this initial stage, the selected knowledge representation strategy might not be permanent. However, documented knowledge will lead the knowledge engineer/ development to better understanding of the system and provides guidelines to proceed further. Rules, frames, scripts and semantic network are the typical examples of the knowledge representation scheme. It is the responsibility of the knowledge engineer to select an appropriate knowledge presentation scheme that is natural, efficient, transparent, and developer friendly. One may think for hybrid knowledge representation strategies like rules within the frames in slots like “on need” and “on request”; semantic network of default frames etc (Sajja & Akerkar, 2010).

2.3.2 Knowledge Modeling

Several key contributions made during the 1980s, including Allen Newell's notions of knowledge level, William Clancey's critical analyses and the broader wave of second-generation ES research, have shaped our current perception of the knowledge acquisition problem. Central to the current perception is the knowledge model, which views knowledge acquisition as the construction of a model of problem-solving behavior, that is, a model in terms of knowledge instead of representations.

The concept of knowledge-level modeling has matured considerably. The practical knowledge-level models incorporated in today's methodologies do not simply reflect the knowledge content of a system; they also make explicit the structures within which the knowledge operates in solving various classes of problems. This enables the reuse of models across applications.

The model structures provide a framework for knowledge acquisition and a decomposition of the overall acquisition task. Identified parts of knowledge-level models domain models or problem-solving methods can serve in different systems or in different roles in the same system. The main advantage remains: The knowledge level focuses attention on the knowledge that makes systems work rather than on the symbol-level, computational-design decisions that provide the operational framework. The knowledge modeling methods can be classified into three categories: manual, semiautomatic, and automatic.

Manual methods are basically structured around an interview of some kind. The knowledge engineer elicits knowledge from the expert or other sources and then codes it in the knowledge base. The three major manual methods are interviewing (i.e., structured, semi structured, unstructured), tracking the reasoning process, and observing. Manual methods are slow, expensive, and sometimes inaccurate. Therefore, there is a trend toward automating the process as much as possible.

Semiautomatic methods are divided into two categories: those intended to support the experts by allowing them to build knowledge bases with little or no help from knowledge engineers and those intended to help knowledge engineers by allowing them to execute the necessary tasks in a more efficient or effective manner (sometimes with only minimal participation by an expert).

In automatic methods, the roles of both the expert and the knowledge engineer are minimized or even eliminated. For example, the induction method, which generates rules from a set of known cases, can be applied to build a knowledge base. The roles of the expert and knowledge engineers are minimal. The term automatic may be misleading, but it indicates that, compared with other methods, the contributions from a knowledge engineer and an expert is relatively small.

2.3.3 Knowledge Representation

To build the knowledge base we have the problem of how to represent it. Knowledge representation concerns the mismatch between human and computer 'memory' .We call these representations, knowledge bases, and the operations on these knowledge bases, inference engine.

A knowledge representation (KR) is an idea to enable an individual to determine consequences by thinking rather than acting, i.e., by reasoning about the world rather than taking action in it. The knowledge acquired from experts or induced from a set of data must be represented in a format that is both understandable by humans and executable on computers. Good Knowledge Representation Languages should be Expressive, Concise, Unambiguous, and Independent of context, Efficient and effective (Kesarwani & Misra, 2013).

Knowledge Representation methods all have advantages and limitations. Production rules are popular in the design of the first-generation expert system. The object-oriented method has become very popular in recent years. Predicate logic provides a theoretical foundation for rule-based inferences. To navigate the problem associated with single knowledge representation technique the integrated knowledge representation came into the picture.

Sometimes, no single knowledge representation method is by itself ideally suited for all tasks. When several sources of knowledge are used simultaneously, the goal of uniformity may have to be sacrificed in favor of exploiting the benefits of multiple knowledge representations, each tailored to a different subtask. The necessity of translating between knowledge representations becomes a problem in these cases. Nevertheless, some recent expert system shells use two or more knowledge representation Schemes, e.g., the CORVID, KRYPTON, MANTRA, FRORL system (Kesarwani & Misra, 2013).

2.3.3.1 Frames based Representation

A frame is a node with additional structure that facilitates differentiated relationships between objects and properties of objects. Sometimes it is called as “slot-and-filler” representation. Frames overcome the limitation of semantic network that differentiates relationships and properties of objects. Each frame represents a class (set) or an instance (an element of a class). Frames are application of object-oriented programming for expert systems. The concept of a frame is defined by a collection of slots. Each slot describes a particular attribute or operation of the frame. Slots are used to store values. A slot may contain, a default value or a pointer to another frame, a set of rules or procedure by which the slot value is obtained (Sharma & Kelkar, 2012).

2.3.3.2 Semantic Networks

Semantic networks are an alternative to predicate logic as a form of knowledge representation. The knowledge can be stored in the form of a graph, with nodes representing objects in the world, and arcs representing relationships between those objects. Semantic network also called as Associative Network.

Semantic representation consists of 4 parts. Part one is Lexical. It tells which symbols are allowed in the representation’s vocabulary. Nodes denote objects, links denote relations between objects, and link-labels denote particular relations. The second part is Structural that describes constraints on how the symbols can be arranged. Nodes are connected to each other by links. The third is Procedural which specifies the access procedures (to create, modify, answer questions). Procedures are constructor procedure, reader procedure, writer procedure and erasure procedure.
The last part is Semantic that establishes the way of associating the meaning. Nodes and links denote application specific entities.

2.3.3.3 Case-Based Representation

Case-Based Representation is a computer technique which combines the knowledge-based support philosophy with a simulation of human reasoning when past experience is used, i.e. mentally searching for similar situations happened in the past and reusing the experience gained in those situations (Leake, 1996). The concept of case based reasoning is founded on the idea of using explicit, documented experiences to solve new problems. The decision maker uses previous, explicit experiences, called cases, to help him solve a present problem. He retrieves the appropriate cases from a larger set of cases. The similarities between a present problem and the retrieved case are the basis for the latter's selection (Gonzalez and Daniel, 1993).

2.3.3.4 Rule Based Representation

Rule based reasoning is a system whose knowledge representation in a set of rules and facts. Symbolic rules are one of the most popular knowledge representation and reasoning methods. This popularity is mainly due their naturalness, which facilitates comprehension of the represented knowledge. The basic forms of a rule, if<condition> then <conclusion> where <condition> represents premises, and <conclusion> represents associated action for the premises. The condition of the rules is connected between each other with logical connectives such as, AND, OR, NOT, etc., thus forming a logical function. When sufficient conditions of a rule are satisfied, then the conclusion is derived and the rule is said to be fired. Rules based reasoning was dominantly applied to represent general knowledge. Rule based expert systems have a significant role in many different domain areas such as medical diagnosis, electronic troubleshooting and data interpretations. A typical rule based system consists of a list of rules, a cluster of facts and an interpreter (prentzas & Hatzilygeroudis, 2007) .

There are two main inference methods in rule based reasoning mechanism. These are backward chaining and forward chaining. The former is guided by the goals (conclusions), whereas the latter one is guided by the given facts (prentzas & Hatzilygeroudis, 2007).

During forward chaining, the inference engines first predetermine the criterion and the next steps are to add the criterion one at a time, until the entire chain has been trained. With data driven Control, facts in the system are represented in a working memory which is continually updated.

Rules in the system represent possible actions to take when specified conditions hold items in the working memory. The conditions are usually patterns that must match with the items in the Working memory. In forward chaining, actions are usually involved adding or deleting items from the working memory. Interpreter of the inference engine controls the application of the rules, given the working memory. The system first checks to find all the rules whose condition holds true (Shaffer, 1991) and (Freeman-Hargis, 2012).Both data driven and goal driven chaining method follows the same procedures. However, the difference lies in the inference process. The system keeps track of the current state of problem solution and looks for rules. This cycle will be repeated until no rules fire or the specified goal state is satisfied (Merritt, 2000)

Backward chaining focuses its effort by only considering rules that are applicable to the particular goal. It is similar with forward chaining the difference is, it receives the problem description as a set of conclusions instead of conditions and tries to find the premises that cause the conclusion. Given a goal state and then the system tries to prove if the goal matches with the initial facts. When a match is found goal is succeeding. But, if it doesn't, then the inference engine start to check the next rules whose conclusions (previously referred to as actions) match with the given fact. Note that a backward chaining system does not need to update a working memory instead it keeps track of what goal is needed to prove its main hypothesis. Goal driven control is commonly known as top-down or backward chaining (Freeman-Hargis, 2012; Ghan, 2004).

2.4 Knowledge Based Systems Development Tools

A KBS tool is a set of software instructions and utilities taken to be a software package designed to assist the development of knowledge-based systems. Personal computers, typical programming languages like Java and framework like .NET can also be used in KBS development. These programming languages are general purpose and also being used to develop other application than AI applications. KBS shell with the ready-made utilities of self-learning; explanation and inference, etc. like Java Expert System Shell (JESS), GURU, Vidwan are more specific and can also be useful to develop KBS. Tailor made KBS can be developed using programming languages like LISP and Prolog (Sajja & Akerkar, 2010).

John McCarthy (1960) published a remarkable paper showing a handful of simple operators and a notation for functions, one can build a whole programming language. The language Lisp was called , for "List Processing," because one of his key ideas was to use a simple data structure called a list for both code and data. There are various versions of Lisp available, namely KLISP and C Language Integrated Production System (CLIPS).

Prolog is a logic programming general purpose fifth generation (AI) language. It has a purely logical subset, called "pure Prolog", as well as a number of extra logical features. Prolog has its roots in formal logic, and unlike many other programming languages, Prolog is declarative. The program logic is expressed in terms of relations, and execution is triggered by running queries over these relations. The language was first conceived by a group around Alain Colmerauer in Marseille, France, in the early 1970s. According to Robert Kowalski (1988), the first Prolog system was developed in 1972 by Alain Colmerauer and Philippe Roussel.

According to Stefan Robertson and John K C Kingston there are approximately 200 KBS tools. Alty (1989) groups the products into three main categories based primarily on functionality which also happen to differ markedly in the platforms on which they are available. These groups are Shells, Languages, and Toolkits. Inference ART and KEE were among the first commercially successful toolkits to develop KBS. Besides support towards knowledge acquisition and representational features, there are other features like price, flexibility, ease of use, user friendliness and vendor availability and support, and documentation support from the tool need to be considered before final selection.

2.5 Learning in knowledge based system

Learning is the most critical attribute of intelligence and an evolving knowledge base. The system should learn from experience about how the environment behaves and should create a model of this environment. The next time a query arrives, it should use this model to predict the most probable state of the environment. Further, if the environment changes, the system should be able to recognize the changing behavior and adapt to new behavior of the environment. Three broad approaches to learning can be applied in knowledge based systems depending on the task at hand (Sutton& Barto, 1998) .These approaches are briefly mentioned below.

Supervised Learning: Under supervised learning the system is provided with a target or a purely instructive feedback, i.e., the environment tells the learner about what exactly its output should be. The system then compares its response to the target and adjusts its internal memory in such a way that it produces a more appropriate response the next time it receives the same input.

The instructive feedback in this case is independent of the action taken by the agent and always tells about the correct action it should have taken. Thus, supervised learning is learning through several examples provided by an external knowledgeable supervisor.

Unsupervised Learning: This is the other extreme for learning where the system does not receive any feedback from the environment. The agent instead has to abstract the input information into clusters or categories or by using a reduced set of dimensions so that when a familiar situation is encountered, an output is generated based on that category of situations and is likely to cover slightly different problems as well. Unsupervised learning is based on similarities and differences in the input patterns.

Reinforcement Learning: This lies somewhere in the middle of the supervised and unsupervised learning techniques, however it is closer to supervised learning. In this technique the agent receives an evaluative feedback about the appropriateness of its response. Purely evaluative feedback indicates how good the action taken is, but not whether it is the best or the worst action possible. The evaluative feedback completely depends on which action was taken, unlike instructive feedback (Sutton & Barto, 1998).

2.6 Application of Knowledge based systems

According to Darlington 1996 and a survey conducted by Waterman in 1986 showed that, the majority of applications of expert systems that were built in the 1980's were in the field of medicine. Durkin suggested that expert systems in medicine still account for about 12% of those under current developments; However, other useful problem areas are emerging which lend themselves well to expert systems. These include: help desk systems, knowledge publishing, configuration and intelligent front-ends.

Knowledge Publishing

Knowledge Publishing is a growing application area of expert systems. The idea of knowledge publishing is encapsulated in the concept of a book. A book is a passive object in that it awaits us to read the part of interest. Knowledge Publishing delivers knowledge to the user actively, by providing what the user specifically requests. There are examples in common use that are disguised; that is, working within other systems. An example is GRAM@TIK the very popular grammar checker sold with WordPerfect software. (Darlington, 1996)

1. Help Desk

Help desk systems are likely to be a key growth area in the future. Most help desk programs are expert system based and growth in this market is predicted at 20% - 30% per annum. Large savings in time and costs can be achieved; because, people increasingly turn to the telephone when they have a problem rather than read manuals. The Compaq computer company now includes an online printer help desk program with all printers sold. The Quick source program includes 5000 cases of printer problems to help diagnose the printer fault and it is estimated that 20% fewer customers are telephoning the company for support. This has resulted in substantial savings for the company as well as a better service for its customers (Darlington, 1996).

2. Configuration

The configuration system XCON is one of the most well-known expert systems in use today. It was built by the DEC Corporation for turning customer orders into feasible VAX computer configurations. The system was completed in the early 1980's. It has been an enormously successful application and was followed by other large computer companies. Another new wave of configuration applications is beginning to emerge suited to 'mass customization’ (Darlington, 1996).

3. Intelligent front-end processors

An Intelligent Front-End (IFE) is software which sits between a user and a conventional software program. An IFE uses KBS or AI techniques to make more effective use of software packages. Classical examples are found with database software. An IFE would provide an easier to use interface with the database, for example, by permitting more flexible user dialogue. The IFE would do this by gaining an understanding of the user's requirements, and then using this specification to generate instructions for running the software package. The dialogue with the user will often be interactive. The IFE may also use a variety of techniques, particularly when carrying out the dialogue with the user to produce the specification of the user's problem. This idea has already been exploited in some commercial databases, such as ‘Super base'(Darlington, 1996).

2.6.1 Knowledge Based Systems in Health Care

Medical expert systems have been written to interpret pulmonary function tests; review clinical, pathological conferences in internal medicine; determine the appropriate chemotherapy for certain cancer diagnose rheumatological disease; and evaluate patients with suspected transient ischemic attacks. A recent prospective study showed that the diagnostic accuracy of one program was better than that of the ward team and equivalent to that of consulting physicians for inpatient diagnostic challenges, is Within the insurance industry, according to a report by Coopers and Lybrand, expert systems are being developed in the areas of marketing and sales, underwriting, claims adjudication, investments and data processing. Expert systems being used not for the use of the technology itself, but because the technology addresses a business need. In expert systems, this need is decision making (DeTore, 1989).

Expert systems allow for expert decision making to be programmed and electronically distributed. Consistent decisions can be made everywhere throughout an organization because the same principles of decision making apply in all situations. Scarce knowledge resources can be expanded without increasing personnel. Further, expert systems are also excellent training tools because while solving problems they demonstrate the thought process of experts to the users of the system. Such systems will never replace the need for experts, especially medical directors and underwriters. They are productivity aids to eliminate routine work and to provide decision assistance. With the increasing importance of expert systems in the insurance industry, because of their role in providing medical expertise, medical directors will have to direct their resources to assist in the development and evaluation of expert systems which can improve their own productivity as well as the productivity of those with whom they consult (DeTore, 1989).

Nowadays the use of computer technology in the fields of medicine area diagnosis, treatment of illnesses and patient pursuit has highly increased. Despite the fact that these fields, in which the computers are used, have very high complexity and uncertainty and the use of intelligent systems such as fuzzy logic, artificial neural network and genetic algorithm have been developed.

Physicians and hospitals nationwide increasingly are using supercomputers and artificial intelligence to analyze troves of data to better identify appropriate and safe patient treatments, Kaiser Health news/wired reports. The trend toward artificial intelligence comes in part from the affordable care act's push for the health care industry to leverage new technologies to lower costs and improve patient outcomes.

Some health provider practices already are utilizing the technology to identify patients at risk for adverse medication reaction, certain chronic disorders (such as kidney failure or cardiac diseases) and postoperative infections and hospital readmission.

Meanwhile, some physicians are turning databases that allow them to look up effective treatments for unfamiliar cases. For example, an online repository of medical data and insights, called modernizing medicine, analyzes treatment data from nearly 4000 provides and 14million patients to recommend potential therapy options to physicians (Ackerman, 2014).

Although the health care industry has made strides in integrating artificial intelligence into practices and hospitals, experts say several challenges remain. For example, they note that the systems are unable to read "unstructured" data, such as images, radiology reports and physician entered notes and not connected to the internet, making it harder to share or access data. However, privacy experts say the systems should remain offline to reduce the risk of a data breach. Meanwhile, experts also have raised questions about the gray area between computers and doctors, nothing that the line between making recommendations and making decisions could be blurred as artificial intelligence systems get smarter (Ackerman, 2014).

2.6.2 Related work

Sanjeev Kumar and Hemlata Jain from Ambedkar University of India designed and developed A Fuzzy Logic Based Model for Life Insurance Underwriting When Insurer Is Diabetic. Unlike hypertension or overweight, where risk assessment of the medical values is possible directly, the risk assessment of diabetes is a complex problem. If a person is diabetic then to find out the mortality of insurer for life insurance medical underwriting is a complex problem due to a multitude of medical risk factors. For life insurance medical underwriting to handle this complex problem, the developers insist that the insurance companies are in need to have a reliable expert system that can help them to evaluate the mortality of the applicants within the period of insurance. So they presented, which is based on a fuzzy expert system that will help insurance companies to find out the mortality of insurers in the existence of diabetes for life insurance underwriting.

A fuzzy logic system for the assessment of cardiovascular risk associated with diabetics is therefore of considerable significance for insurers' medical underwriting practice. Unlike hypertension or overweight, where risk assessment of the medical values is possible directly, the risk assessment of diabetes is a complex problem with a multitude of medical risk factors. Due to this complexity of this assessment, systematic evaluation of diabetes using a fuzzy expert system is highly advantageous. All expert systems which are based on fuzzy logic uses if-then rules.

Since all the three inputs have three fuzzy sets (LOW – L, NORMAL – M and HIGH – H) therefore 27 (3×3×3) fuzzy decisions are to be fired. There are three outputs: LOW RISK- LR, NORMAL RISK- NR and HIGH RISK- HR. Once all crisp input values have been fuzzified into their respective linguistic values, the inference engine will access the fuzzy rule base of the fuzzy expert system to derive linguistic values for the intermediate as well as the output linguistic variables. Output of the Decision of the Expert System in this case are LR, NR and HR. The specific features of each controller depend on the model and performance measure. However, in principle, in all the fuzzy logic based expert systems, we explore the implicit and explicit relationships within the system by mimicking human thinking and subsequently develop the optimal fuzzy control rules as well as a knowledge base (Kumar & Jain, 2012).

AktuarMed originated in collaboration with AXA Krankenversicherung AG and was developed between 1994 and 2000 by RISK-CONSULTING Prof. Dr. Weyer GmbH, an affiliated company of AktuarData GmbH. AXA Krankenversicherung AG is one of the few insurance companies which has been collecting digital anamnestic data for decades. The differentiated statistical analysis of this data produced the knowledge contained by AktuarMed. In this connection, the observation of benefit payments over a period of many years facilitated the development of accurate forecasts of future claims depending on preexisting conditions. AktuarMed, the underwriting system for health insurance, is a unique underwriting system designed for the field of health insurance. AktuarMed's basic philosophy is founded on claims-adjusted risk assessments. The risk loadings which are assigned by AktuarMed are suitable for the purpose of largely offsetting the additional benefits which are anticipated as a consequence of previous illnesses. This enables a health insurer to perform calculations on a cost covering and profit oriented basis. It is suitable for examining all types of health insurance products and including their specifications in the risk calculation process. AktuarMed's input masks are transparent, fast and easy to complete. AktuarMed is practically self-explanatory, meaning that little training is needed (Fründt, 2004).

The general advantage of all expert systems is standardized underwriter-independent risk assessment. However, conventional expert systems do not guarantee output quality. In particular, loadings are frequently inadequate, as the specialists' decisions integrated into these "empty shells" are often statistically inaccurate. In addition, in many cases, conventional systems are completely unable to reach any decisions at all. AktuarMed's knowledge base is founded on the evaluation and comparison of the data types including anamnestic databases, Master policy data and Benefit databases. Various health insurance companies provided all their current and previous relevant data for the purpose of identifying and quantifying the risk of increased claims depending on case history (anamnesis) and personal circumstances. The corresponding data analysis is performed by complex multivariate statistical calculations, neural networks and hybrid methods. The AktuarMed underwriting system is currently deployed by numerous national and international large, medium sized and small health insurers. Following appropriate modifications and taking into consideration the relevant health systems and typical national products, this underwriting system can be used globally in the local language. For the purpose of deployment in Asia, Africa and Latin America, infectious diseases which are rare in Europe are also taken into account (Fründt, 2004).

In Ethiopia, various knowledge based systems have been developed for agricultural, and medical purposes. Some of the rule based systems developed for medical purposes include KBS for anxiety order diagnosis (Seblewengel, 2011), KBS for blood transfusion (Guesh, 2012), KBS for pretest HIV counseling (Redeit, 2006) and self-learning KBS for diagnosis and treatment of diabetes (Solomon, 2013).

To conclude, several studies have been developed using a rule based representation technique to reason out solutions to real world problems. But, not much have been in the health insurance field. It is a newly introduced field to our country and this study strives to find solutions to certain problems in health insurance.

CHAPTER THREE

KNOWLEDGE MODELLIING AND REPRESENTATION

3.1 Knowledge Acquisition

Knowledge acquisition is one of the most difficult and error-prone tasks that a knowledge engineer does while building a knowledge-based system. The cost and performance of the application depend directly on the quality of the knowledge acquired. During this process, you must determine where in the organization the knowledge exists, how to capture it and how to disseminate this knowledge throughout the enterprise (Saxena, 2007).

Knowledge Acquisition (KA) is the process of acquiring relevant knowledge from domain experts and other sources of information such as books, databases, guidelines, manuals, journal articles, computer files, etc. KA is the process of eliciting, structuring and representing (formalizing) domain knowledge acquired from the different sources. The acquired knowledge can be specific to the problem domain, it can be general or it is meta-knowledge (knowledge about knowledge). Knowledge acquisition is the first step and critical task in the development of knowledge based system (Sagheb, 2009).

3.1.1 Knowledge Acquisition process

The knowledge acquisition process of this study consists of activities such as gathering essential knowledge, analysing the knowledge, identifying vital concepts and modelling the knowledge using decision trees.

In this study, to acquire the needed knowledge, both secondary and primary sources of knowledge are used. Before critical knowledge is gathered, a preliminary assessment was done to shade some light on the basic concepts of health insurance. Primary knowledge gathered from experts in the domain area, the Ethiopian health insurance Agency, using semi-structured interview.

All the experts replied similar information on health insurance claim processing and they implied that they used the 2010 health insurance proclamation as their guideline for claim processing. Due to this, the researcher purposefully selected three experts.

no	Educational qualification	Interview area	Role
1.	PHD	Medical Claim processing	Provider affairs and quality assurance director
2.	MSc	Health Insurance	Communication officer
3.	BA	Medical Claim processing	Provider affairs and quality assurance Expert

Table 3.1: Expert profile: specialization and role

In addition, secondary sources of knowledge have been gathered from the Internet, health insurance proclamations (2012), Claim Processing and adjustment Guideline, Manuals, Research Papers, and published Articles. Detailed interviews with health insurance specialists shows that the health insurance proclamation declared in 2012G.C acts as a guideline for all the activities in health insurance.

3.1.2 Health Insurance Concepts

Medical insurance, which is also known as health insurance, is a written policy that states the terms of an agreement between a policyholder an individual and a health plan with an insurance company. The policyholder (also called the insured, the member, or the subscriber) makes payments of a specified amount of money. In exchange, the health plan provides benefits defined by the Health Insurance Association of America as payments for medical services for a specific period of time. Because they pay for medical expenses, then, health plans are often referred to as payers (Rao, 2004).

Health insurance companies contract with certain hospitals, doctors, pharmacies, and other health care providers to deliver medical services for an agreed upon rate. These groups are known as a health insurance company's provider network. Health insurance companies use various provider networks to develop different health plan options to deliver care to plan members. It's important for consumers to carefully review provider networks before selecting a health plan to make sure the doctors they want to see participate in their selected health plan. Consumers are required to renew their participation in health plans every year.

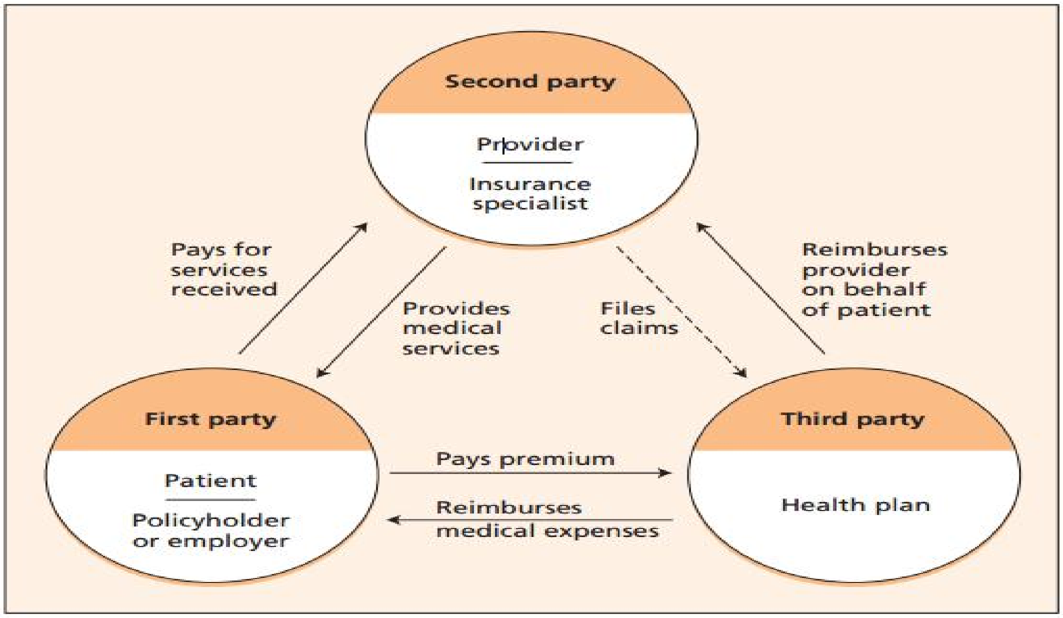

Figure 3.1: overview of health insurance (Rao, 2004)

Most people get health insurance through their employers or organizations to which they belong. This is called group insurance. Some people do not have access to group insurance. They may choose to purchase their own individual health insurance directly from an insurance company.

Group health insurance is typically offered by employers. Or, if you are a member of a union, professional association, or other group, a customer may be able to get group coverage through that organization. Some employers allow employees to choose between several plans, including both indemnity insurance and managed care. Other employers offer only one plan. Some group plans offer dental and/or vision benefits as well as medical benefits. So it is important to compare plans to find the one that offers the benefits you need most. Once you enroll in a health insurance plan, you usually cannot change to another plan until the next open season, usually set once a year.

3.1.3 Health Care Benefits

The medical insurance policy contains a schedule of benefits that summarizes the payments that may be made for medically necessary medical services which policyholders receive. The payer's definition of medical necessity is the key to coverage and payment. A medically necessary service is reasonable and is consistent with generally accepted professional medical standards for the diagnosis or treatment of illness or injury. Payers scrutinize the need for medical procedures, examining each bill to make sure it meets their medical necessity guidelines. The provider of the service must also meet the payer's professional standards. Providers include physicians, nurse practitioners, physicians' assistants, therapists, hospitals, laboratories, long-term care facilities, and suppliers such as pharmacies and medical supply companies (Bovbjerg & Hadley, 2007).

3.1.4 Types of Health Insurance

There are basically two types of health insurance under managed care: community based health insurance and social health insurance (Ethiopian health insurance proclamation, 2010).

Community Based Health Insurance Scheme

Community-based health insurance is an alternative to user fees to improve equity in access to medical care, particularly in those rural communities and the informal sector. It has the potential to increase utilization, better protect people against (catastrophic) health expenses and address issues of equity. The effects of community-based health insurance on decreasing catastrophic out-of pocket expenditure are uncertain. However, it may increase the utilization of health services.

The community based health insurance scheme uses households as a unit of membership as opposed to individuals- in social health insurance. Therefore, premiums are collected based on the number of family members, disregarding the income of t family. Any Family is obliged to pay a calculated sum of premium per family size unless it is classified under poor of poor category by community leaders. This contravenes the aim of the strategy to help the poor to have better access and use of health care services (Rao, 2004).

Social Health Insurance

Social health insurance is a form of mandatory health insurance for formal sector employees, including retirees and pensioners. It is meant to improve access to health services by removing catastrophic health expenditure at the point of service delivery. The effects of social health insurance both for decreasing catastrophic out-of-pocket expenditure and health service utilization is uncertain.

The Social Health Insurance Scheme Council Of Ministers Regulation No. 271/2012, Article 3 provides a list of health services a beneficiary will have the right to from health facilities.

1. Outpatient care and inpatient care;
2. Delivery services and surgical services ;
3. Diagnostic tests and generic drugs included in the drug list of the agency, and prescribed by the medical practitioners.

A member is eligible to enroll in the Social Health Insurance program with his or her spouse and children under 18 years of age. A member having more than four children and/or more than one spouse can register his or her dependents as beneficiaries, but with additional monthly premium costs per the additional family members.

The Social Health Insurance will be financed from payroll and pension contributions made by employers and employees. Contributions of each employee will be based on his or her level of income. The same percentage (flat or fixed rate) of contribution from the basic salary will be deducted from each employee to finance the scheme. An amount equal to employee's contribution is expected to be matched by the employer.

Non Covered Services

Notwithstanding the provision of the above health services for beneficiaries who have concluded the contract with the Health Insurance provider, the following services are excluded from the health services package (Ethiopian health insurance proclamation, 2010).

1. Any treatment outside Ethiopia,
2. Treatment of injuries resulting from natural disasters,
3. Social unrest,
4. Epidemics, and high risk sports,
5. Treatments related to drug abuse or addiction,
6. Periodic medical checkup unrelated to illness,
7. Occupational injuries,
8. Traffic accidents, and other injuries covered by other laws,
9. Cosmetic surgeries,
10. Organ transplants,

11. Dialysis except acute renal failure,
12. Provision of eyeglass and contact lenses,
13. In vitro fertilization hip replacement;
14. Dentures, crowns, bridges, implants and root canal treatments except those required due to infections;
15. Provision of hearing aids.

3.1.5 Claim Processing

Claim is a request for payment that a consumer or health care provider submits to the health insurance company for items or services they think are covered.The goal of claim processing is to pay the right amount to the right provider for the right service to the right beneficiary. Health care providers that have a contract with the insurance company sends medical claims to receive payments for the provided services. The claim form asks various questions about the patient, services provided, and prices. This information should be fully provided for the claim to be processed.

The medical insurance claims process starts when a health care provider treats a patient and sends a bill of services provided to a designated payer, which is usually a health insurance company. The player then evaluates the claim based on a number of factors, determining which, if any, services it will reimburse. When a patient receives services from a licensed provider, these services are recorded and assigned appropriate codes by the medical coder. International Classification of Diseases (ICD) codes are used for diagnoses, while current procedural terminology (CPT) codes are used for various treatments. The summary of services, communicated through these code sets, make up the bill. Patient demographic data and insurance information are added to the bill, and the claim is ready to be processed.

Once the claim data is in the system, pre-defined rules and product specific processes can be applied. After ensuring that all mandatory information is provided and is valid, the first step would be to match the claim against the prior authorization. The second step would be to conduct checks for medical appropriateness, compliance with provider contracts and variation from usual and customary practices. Much of this can be automated through the use of standard treatment guidelines embedded in the system to identify excessive or unwarranted billing item, therefore generating cost savings for the insurer. A very important subject in claim processing is fraud management. Due to this, medical audit is conducted on the service provider to avoid any inappropriate payments or denials. The life cycle of a claim is shown in figure 3.2 below.

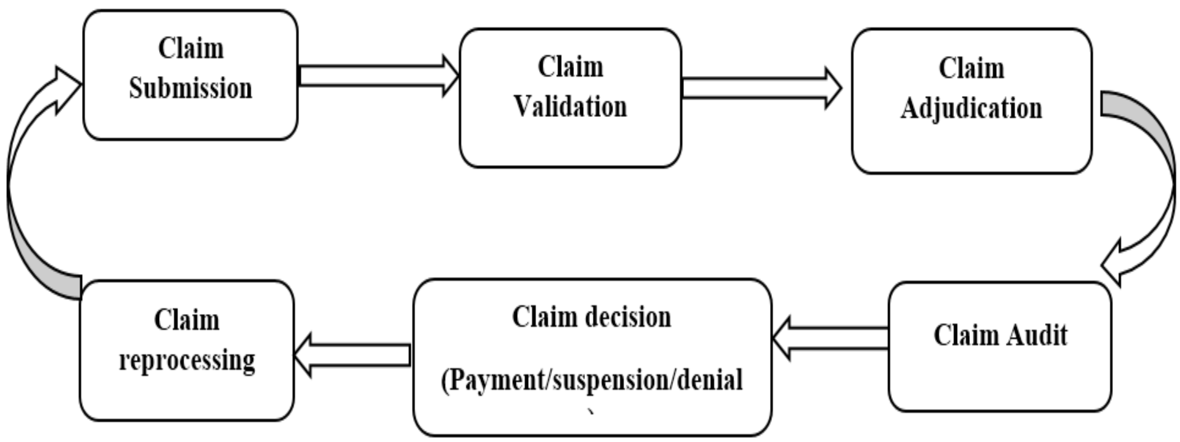

Figure 3.2: medical claim life cycle

In claim processing, the first step is collecting and verifying service and patient information. Information related to service provider and patient should be provided in the claim form submitted to the insurer. There are four classes of information on a claim: patient/member information, provider information, claim header and claim line details.

Patient information includes the patient ID number, age, Gender, region contents that identifies the insured person's or a dependents identity. Those information are so important in figuring out the eligibility of the patient and in claim adjustment. Service Provider information includes service provider identification code and other information that identifies the health care facility that submitted the claim. Claim header involves contract information, amount billed for each service, diagnosis list with the corresponding codes. Claim line details give details on each line in the claim which is used to itemize the claim for each procedure that was conducted on the patient.

All that information should be clearly stated and have to be consistent to the existing patient and service information.

Types of services

There are two types of patients in health care facility namely outpatient and inpatient.An outpatient is a patient who is not hospitalized for 24 hours or more but who visits a hospital, clinic, or associated facility for diagnosis or treatment. Treatment provided in this fashion is called ambulatory care. Sometimes surgery is performed without the need for a formal hospital admission or an overnight stay. This is called outpatient surgery. Outpatient surgery has many benefits, including reducing the amount of medication prescribed and using the physician's or surgeon's time more efficiently. More procedures are now being performed in a surgeon's office, termed office-based surgery, rather than in a hospital-based operating room. Outpatient surgery is suited best for healthy patients undergoing minor or intermediate procedures (limited urologic, ophthalmologic, or ear, nose, and throat procedures and procedures involving the extremities).

An inpatient (or in-patient), on the other hand, is "admitted" to the hospital and stays overnight or for an indeterminate time, usually several days or weeks (though some cases, such as coma patients, have been in hospitals for years). Treatment provided in this fashion is called inpatient care. The admission to the hospital involves the production of an admission note. The leaving of the hospital is officially termed discharge, and involves a corresponding discharge note.

Adjudication

Claims adjusting is the process of determining coverage, legal liability, and settling a claim. The claim function exists to fulfill the insurer's promises to its policyholders. Claim adjusting is integral to establishing an insurer's relationship to its policyholders. The reputation of the insurer in settling claims directly impacts the marketing and retention of policyholder insurance. The adjudication process is the process of passing the claim through the processing logic until the claim is settled (paid or denied).

There are four main components to the adjudication process. The adjudication process begins with a determination of whether or not the patient is eligible for benefits. Next, the adjudication process will determine whether the particular plan of benefits covers the patient's treatment. Then, the adjudication process will evaluate the status of the provider. Finally, there is Medical Audit. It is a way of checking the integrity of a claim with the insured's /dependent's medical history, similar cases and provider capability.

A claim must actually pass through a number of hurdles before proceeding to the next step. In determining whether or not the patient is eligible for benefits, the system logic must match the patient identification criteria from the claim, including identification number, date of birth, and Gender, with the membership enrollment data for the health plan. The start and termination dates of coverage are also compared with the date of service for the claim. The enrollment verification will ultimately attempt to match the patient with a particular Plan of Benefits administered by the health plan. The main reasons for claim's Denial includes the following:

1. Medical necessity
2. Missing or invalid CPT or healthcare common procedure coding system(HCPCS)code submitted
3. Incorrect patient identifier information submitted
4. Spelling of name, date of birth, subscriber number missing or invalid, insured group number missing or invalid
5. Place of service does not match surgery/procedure performed
6. Procedures that cannot be performed simultaneously or more than once
7. A claim submitted for non-covered services

Payment Mechanism

Provider payment mechanism is a method applied to transfer funds from the purchaser of health care services or procedures to providers of such services. The system used to pay for health care encompasses both the unit of service for which payment is made (the currency) and the price paid for that service. Many factors can be varied in the design of a payment system for health care, and the optimal design will depend on the objectives of the health care system.

For instance, payments can be made to the provider to:

1. Cover a range of services for a specified time period (block budget)
2. Care for a specific patient or population (capitation)
3. provide specific services (fee-for-service)
4. Provide a specified quality of processes or outcomes of care (performance-related pay).

Payments to providers may be made prospectively, as a fixed amount, based on an assessment of local patient needs and prediction of services needed by the population served. In these cases, agreements will be needed between commissioners and providers as to where the risk and benefit fall if actual provision is above or below the predicted level.

Block Budgets

The payment for all services to be provided is bundled together, and a prospective lump sum is paid to a provider at defined intervals, independent of the number of patients treated or the amount of activity undertaken. A block budget provides an overall spending limit that will constrain the volume and/or quality of the services provided. Under this arrangement, the provider bears the risk for increased demand and cost of care, and the commissioner for decreases, unless there are arrangements to share risk or surplus. The ability of a block budget to achieve policy objectives will be dependent on contractual conditions of the payment (for example, all-round quality, efficiency and volume) and also on the proportion of the provider's total revenue included in the block. Salary payments, in which the periodic lump sum for bundled services provided is paid to an individual, are similar to block budgets.

Capitation

Prospective, periodic, lump-sum payments are made to a provider or a network of providers per enrolled patient, for a range of bundled, specified services. Ideally, capitated budgets are 'weighted' (risk-adjusted) to take account of the fact that some patients require additional, or more costly, services.

Case-based Payments

Providers are paid a fixed sum for an episode of care, based on groupings of clinically similar diagnoses or procedures that entail similar costs. This method involves less bundling than capitation payments, as reimbursement is from an episode of care, rather than a period which may or may not include activity. Some bundling remains, however, as an episode may include multiple activities. Similarly, payments may be made for a defined pathway of care, for a patient with a particular diagnosis. Risk is apportioned between commissioners and providers: in principle, 'epidemiological' risk (arising from variations in the incidence of disease) falls on the commissioner; while 'clinical' risk (associated with what is done to the patient) falls to the provider. However, this distinction can break down in the presence of supplier-induced demand or billable readmissions caused by avoidable errors in care or complications.

Fee-for-service

Payment is made retrospectively to providers for each unit of service provided, that is for each activity or patient contact, according to a fixed price schedule. All the risk of increasing cost falls on the commissioner.

3.2 Conceptual Modelling

In broad terms, conceptual modelling is the process of abstracting a model from the real world (Kotiadis & Robinson, 2008). The modeler is presented with a problem situation that is amenable to simulation modelling and then has to determine what aspects of the real world to include, and exclude, from the model, and at what level of detail to model each aspect. These decisions should generally be a joint agreement between the modeler and the problem owners, i.e. the stakeholders who require the model to aid decision-making. The process of conceptual modelling requires decisions to be taken regarding the scope and level of detail of the model. It also requires assumptions to be made concerning the real world and simplifications to be made to the Model.

3.2.1 Concept of Claim Validation

Claim validation includes making sure that all the essential information are provided in the claim. The information is on insurance holder, service provider and provided services. The information provided in a claim should perfectly match the information the insurer has on insurance holder, the health care provider and services and procedures provided. Any mismatch will result the suspension or denial of the claim. Suspension is different from denial because it allows the expert to edit or correct claim information or make changes on the claim so that it can be reprocessed (Hsiao & Shaw, 2006).The details of claim information are shown Table 3.2 below.

no	Information Type	Properties
1.	Patient /insured information	✓ Patient ID. Number ✓ Gender ✓ Age
2.	Service provider information	✓ Hospital clinic(CRT) code ✓ Region ✓ Contract information
3.	Service information	✓ Type of service ✓ Number of procedures ✓ List of procedures ✓ List of Formularies

Table 3.2: patient and service provider information

3.2.2 Inpatient and Outpatient Services

The types of service that a care provider gives are either inpatient services or outpatient services. An inpatient gets only services s services that are in the inpatient service and an outpatient gets list of services allowed by provider /insurer contract. Any cross-section of services is not acceptable unless the service provider provides an acceptable explanation. The major inpatient and outpatient services are listed in table 3.3 below.

no	Service type	Services
1.	In-patient	✓ All services except non-Covered procedures
2.	Out-patient	✓ Ambulatory care ✓ Limited Urologic, ophthalmology, ear, nose, and throat procedures and procedures involving the extremities

Table 3.3: inpatient and outpatient services

3.2.3 Eligibility

The eligibility of a patient for a certain medication depends on whether or not he /she pass the requirements set by the insurer in the health plan. Issues such as premium follow through, dependent status, and a valid contract are keys for eligibility. A dependent of an injured person will be eligible if is either a life partner or a child of the insured person.in order for a child to be eligible for his parents' health plan ,his/her age should be under 18 years.

3.2.4 Plan Coverage

Every Insurance holders, signs a contract with the insurance company before buying an insurance coverage plan. The plan lists all the services that are covered by the health plan as well as non-covered services. The insurance holder only pays 10% of the service fee as a component to get any of the permitted services. Any claim requesting payment for non-covered services will be immediately denied. If a claim contains both covered and non-covered services only the covered services are paid for.

3.2.5 Concept of Medical Necessity

Medical necessity is defined as accepted health care services and supplies provided by health care entities, as appropriate to the evaluation and treatment of a disease, condition, illness or injury and consistent with the applicable standard of care. Issues with Medical Necessity are described in table 3.5 below.

No	Edit Category	Explanation
1.	Procedure to Procedure	Prevents payment for procedures that are contrary to the NCCI or procedures billed within a global period of another procedure.
2.	Procedure to Provider	Looks for procedures performed by specialty; i.e., Urology billing for Cardiac catheterization, or OB/GYN billing for kidney stone removal.
3.	Procedure to Gender, Age, or Diagnosis	Ensures that Gender-specific services are not paid inadvertently; i.e., pro state surgery for a female.
4.	Diagnosis to Procedure	Prevents payment of an unwarranted procedure for a given condition; i.e., tonsillectomy for foot pain.
5.	Procedure for Place of Service	Prevents payment for a procedure in an obviously wrong place of service; i.e., hip replacement surgery in an office setting.

Table 3.4: Concepts of Medical Claim Necessity

3.2.6 Concepts of Burst billing

Unbundling is sometimes called "burst billing" or fragmentation. It is the practice of breaking down a procedure (which is already described by a single CPT code) into components and billing for each component. There are two common variations of this practice. In the first which we call “Fragmentation un bundling’, a physician bill for a procedure under a CPT code that fully describes that procedure, and also bills for some of its components under additional CPT codes. In the second variation, which we call "miscoding unbundling", a physician bill for the component parts of a procedure as individual procedures instead of billing under a single CPT code that already includes all the components.

3.2.7 Non-simultaneous and Not-repeatable procedures

Some procedures cannot anatomically be performed more than once. However, some physicians are in the habit of billing them more than once - either by submitting the same code twice, or by submitting two or more codes which describe variants of what is essentially one procedure. Some procedures can anatomically be done twice, but in general clinical practice they are not done twice in one operative session. Similarly, some procedure combinations are generally clinically not performed at the same operative session simultaneously, though anatomically it is possible to do so.

3.2.8 Concepts of payment

After the claim goes through all the processes and gets accepted as a valid request, it finally gets paid.as discussed earlier in the acquired knowledge, there are different ways for the service provider to get paid for the provided services. The methods of payment are capitation, cased based payment, block budget and fee for service. From those only the two types of payments are implemented in Ethiopia for claim settlement. Fee for service with fixed schedule is used to pay for claims that comes from hospitals .For clinics, capitation is the preferred way of settlement.

The conceptual model of the prototype knowledge based system is provided in figure 3.3, figure 3.4, and figure 3.5and figure 3.6 below.

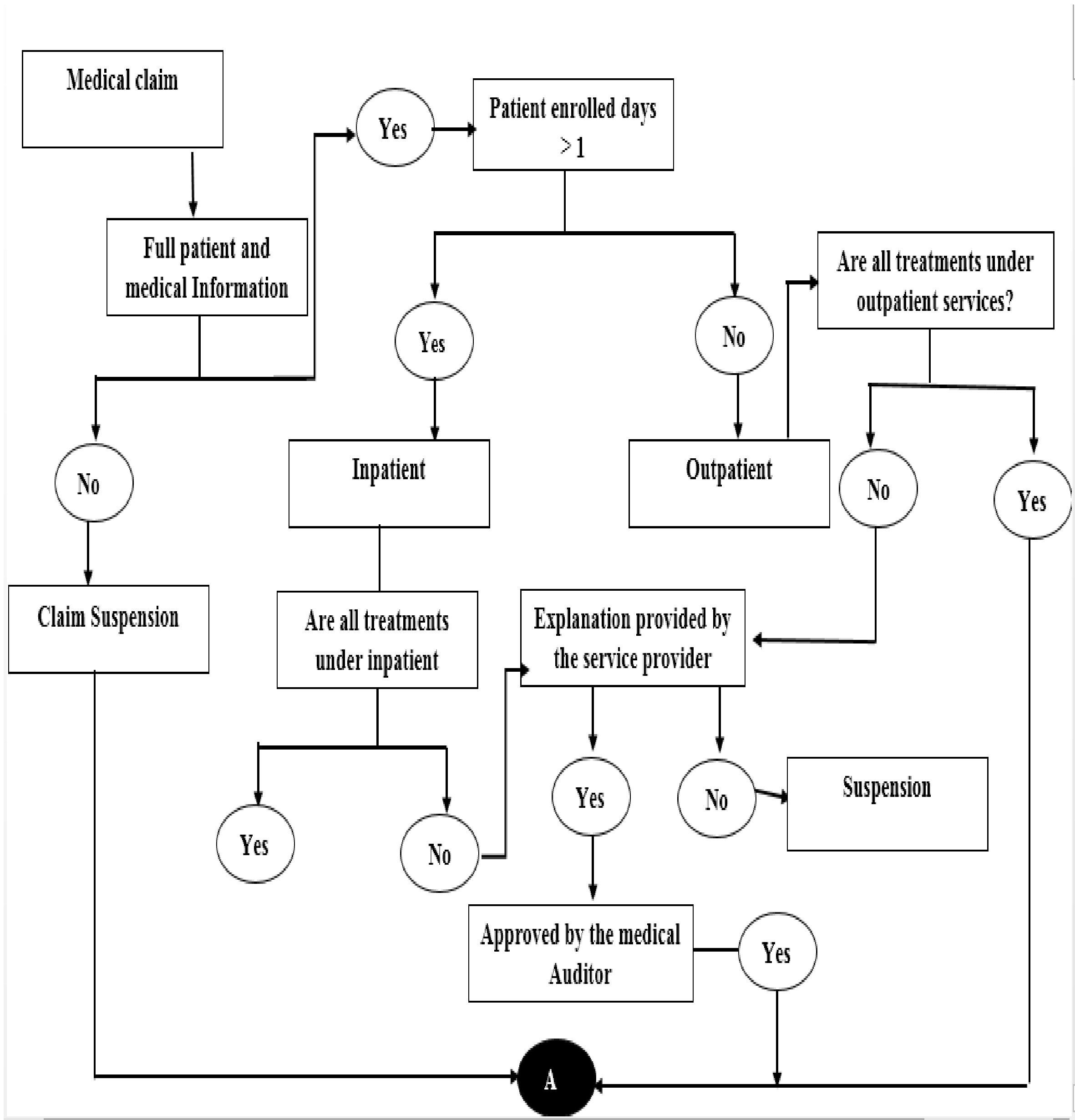

Figure 3.3: Initial stage of medical claim processing

The above figure shows in initial stage of claim processing .In this step a claim is initially checked for full information and type of patient and services provided for the patient. The system also checked if an explanation is provided for any inconvenience regarding the service provision.

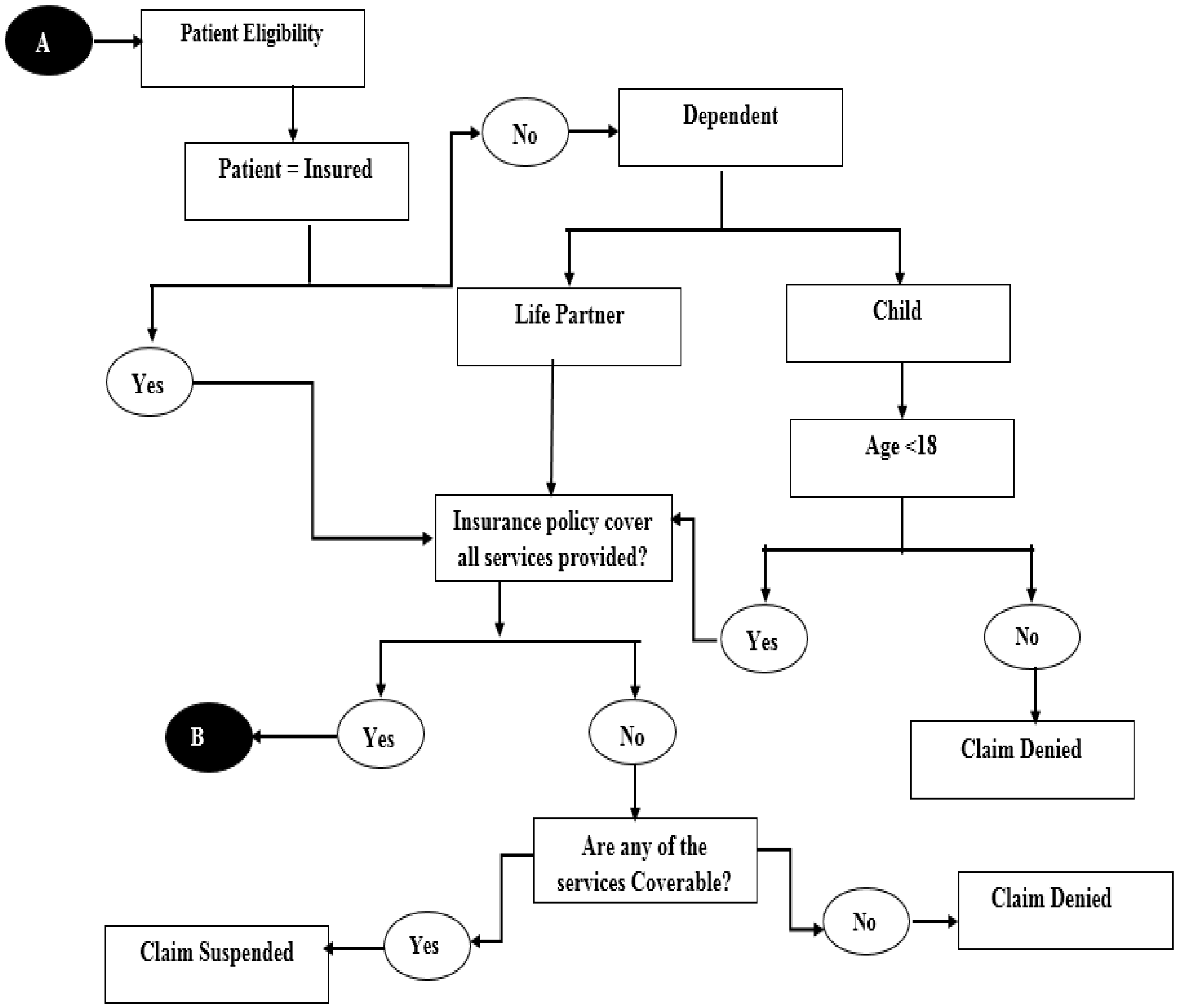

Figure 3.4: Second stage of medical claim processing

Figure 3.4 shows how the system checks for patient eligibility and coverage of the insurance package. This stage analyzes the treatment given to the patient and checks any of the procedures are excluded.

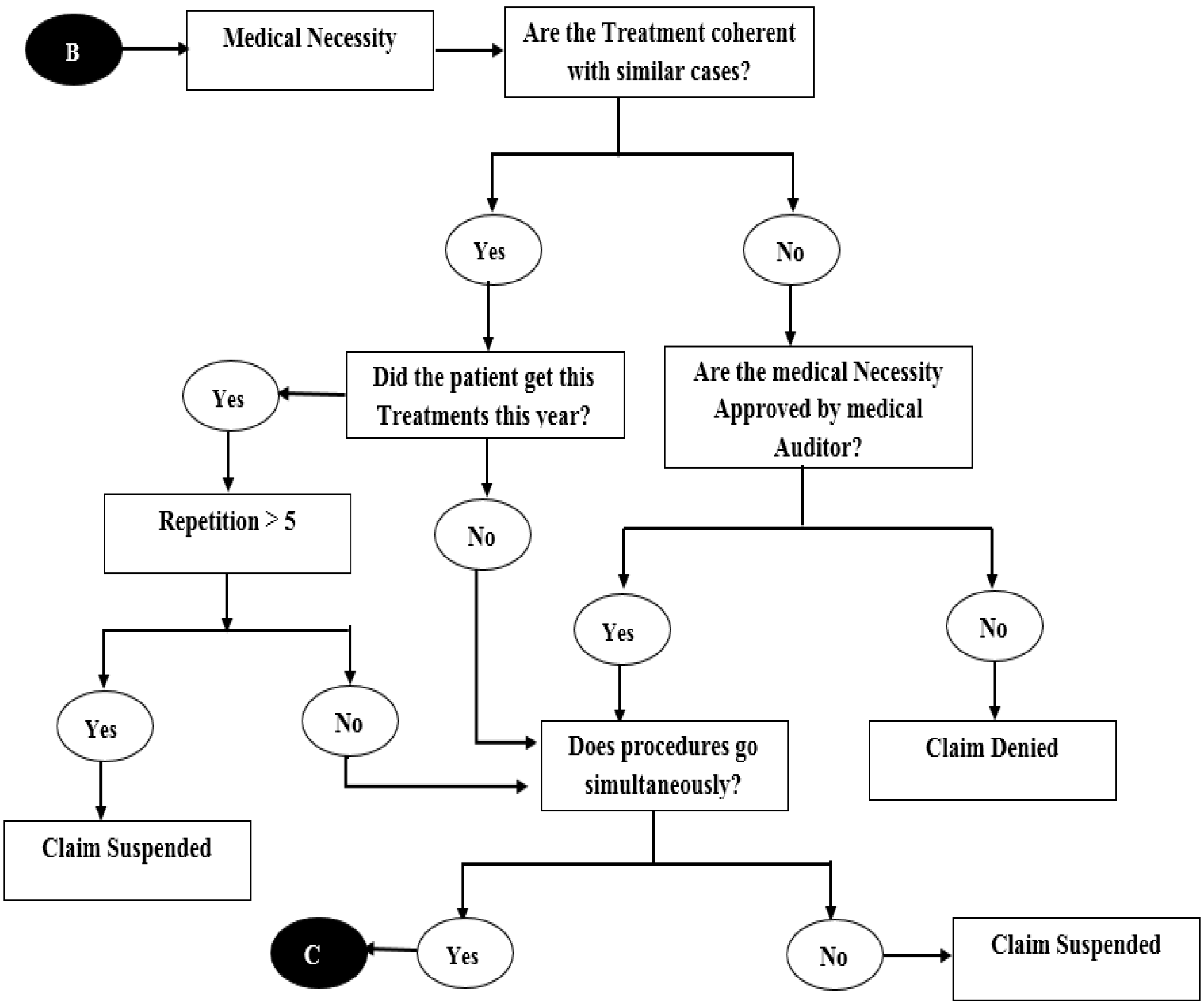

Figure 3.5: Second stage of medical claim processing

This figure (figure 3.5) shows how the system checks for coherence and if the patient got the procedure more than his share.it also asks for the medical necessity of non-coherent cases and the approval of that decision.

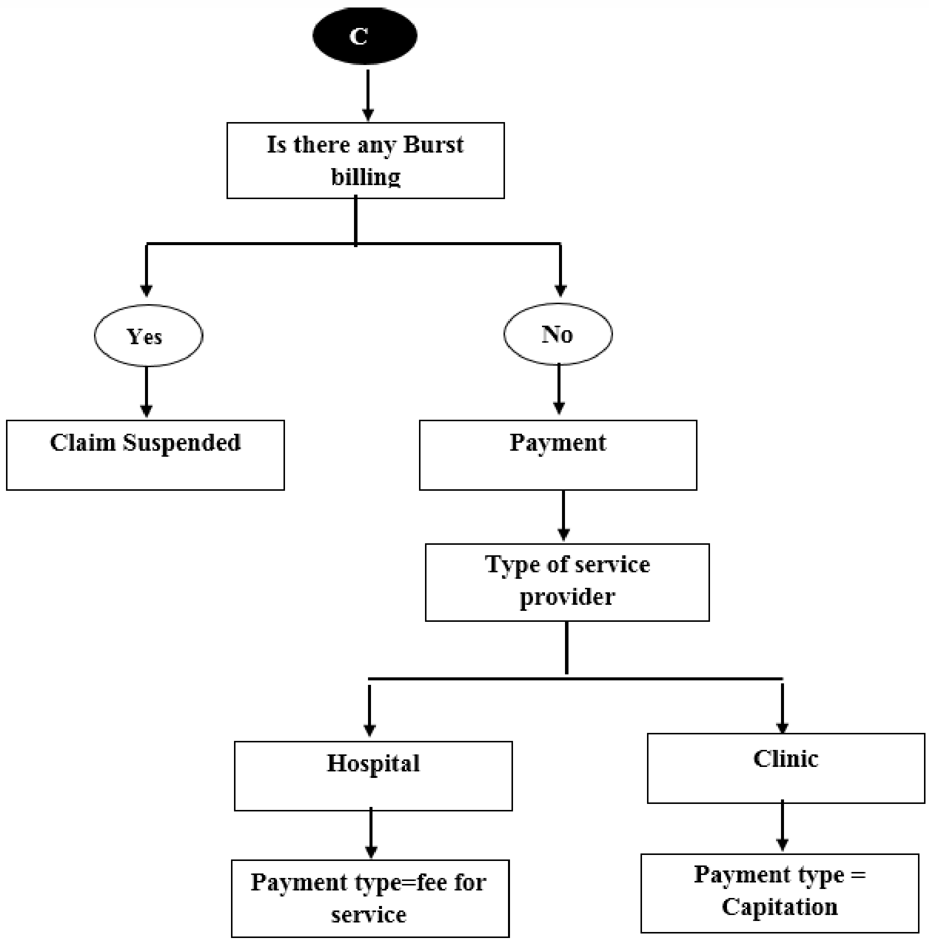

Figure 3.6: Second stage of medical claim processing

3.3 Knowledge Representation

Knowledge representation is the method used to encode knowledge in an intelligent system's knowledge base. The objective of knowledge representation is to express knowledge in computer tractable form, such that it can be used to help intelligent system perform well. The function of any representation scheme is to capture essential features of a problem domain and make that information available to a problem solving procedure. There are 4 schemes of knowledge representation that are Logical schemes, Networked schemes, Procedural schemes and structured schemes.

In this research, Procedural scheme was used for representation of the acquired knowledge. In procedural schemes, knowledge is represented as a set of instructions for problem-solving. That allows to modify a knowledge base easily and to separate a knowledge base from an inference mechanism. Production rule systems are based on the general underlying idea of condition-action pairs (also called if-then pairs, production rules, or just plain productions).A production rule is written in the form “if this condition holds, then this action is appropriate”. A production is a single chunk of problem-solving knowledge. The condition part of the rule is a pattern that determines when the rule maybe applied to a problem. The action part defines the associated problem-solving steps (Grundspenkis & Naumeca, 2012).

The production rules for the medical claim processing knowledge based system are listed below.

Rule 4.IF patient stays for one day, treatment is not fully outpatient, and no explanation provided **THEN** claim is suspended.

Rule 5.IF patient stay=1 day, treatment=not fully outpatient, explanation provided, explanation not approved **THEN** claim is suspended.

Rule 6.IF patient = Insured, the insurance policy does not cover full treatment, and one or more of the treatments are coverable ,**THEN** claim is suspended.

Rule 7. IF patient = Insured, the insurance policy does not cover full treatment, and none of the treatments are coverable, **THEN** claim is denied.

Rule 8. IF patient = dependent, dependent =life partner, the insurance policy does not cover full treatment, and one or more of the treatments are coverable **THEN** claim is suspended.

Rule 9. IF patient =dependent, dependent =life partner, insurance policy does not cover full treatments, and none of the treatments are coverable, **THEN** claim is denied.

Rule 10. IF patient = dependent = child, child age>18, **THEN** claim is denied.

Rule 11.IF patient = dependent = child, child age<18,the insurance policy does not cover full treatment, and one or more of the treatments are coverable **THEN** claim is suspended.

Rule 12.IF patient = dependent = child, child age<18, the insurance policy does not cover full treatment, and none of the treatments are coverable, **THEN** claim is denied.

Rule 20.IF a full claim information is provided, patient=inpatient, full treatment are not inpatient services, explanations provided, patient= insured, all services = coverable, treatment is coherent with similar cases, the patient did not get the treatment the current year, procedures go simultaneously, and no burst billing **THEN** claim is Paid.

Rule 21.IF a full claim information is provided, patient=outpatient, full treatment = inpatient services, patient = insured, all services = coverable, treatment is coherent with similar cases, the patient did not get the treatment the current year, procedures go simultaneously, and no burst billing **THEN** claim is Paid.

Rule 22.IF a full claim information is provided, patient=outpatient, full treatment not inpatient services, explanations provided, explanation approved, patient = insured, all services = coverable, treatment is coherent with similar cases, the patient did not get the treatment the current year, procedures go simultaneously, and no burst billing **THEN** claim is Paid.

Rule 23.IF a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent = life partner, all services = coverable, treatment is coherent with similar cases, the patient did not get the treatment the current year, procedures go simultaneously, and no burst billing **THEN** claim is Paid.

Rule 24.IF a full claim information is provided, patient=outpatient, full treatment = outpatient services, patient = dependent, dependent = life partner, all services = coverable, treatment is coherent with similar cases, the patient did not get the treatment the current year, procedures go simultaneously, and no burst billing **THEN** claim is Paid.

CHAPTER FOUR

IMPLEMENTATION AND EXPERIMENTATION

Knowledge-based systems are composed of several independent components. Figure 4.1 shows thin dependent components and how they work together to solve a problem within the problem domain. The arrows depicted in Figure 4.1 outline the flow of information throughout the system. The first component is the knowledge base in which heuristic knowledge of the domain experts as well as pertinent facts about the problem is stored. The second component is the inference engine that utilizes strategies from the searching and sorting domains to test the rules contained in the knowledge base on a particular problem. The inference engine accomplishes this by querying information from the knowledge base and applying the returned results. The knowledge acquisition module, the third component, facilitates the transfer of knowledge in the knowledge base for future use. The fourth component is the user interface that allows users to interact with the knowledge-based expert system by presenting the problem to the inference engine and viewing solutions. The fifth component is the working storage, which the knowledge-based expert system uses to store information while a specific problem is being solved and then contains the information pertaining to the solution.

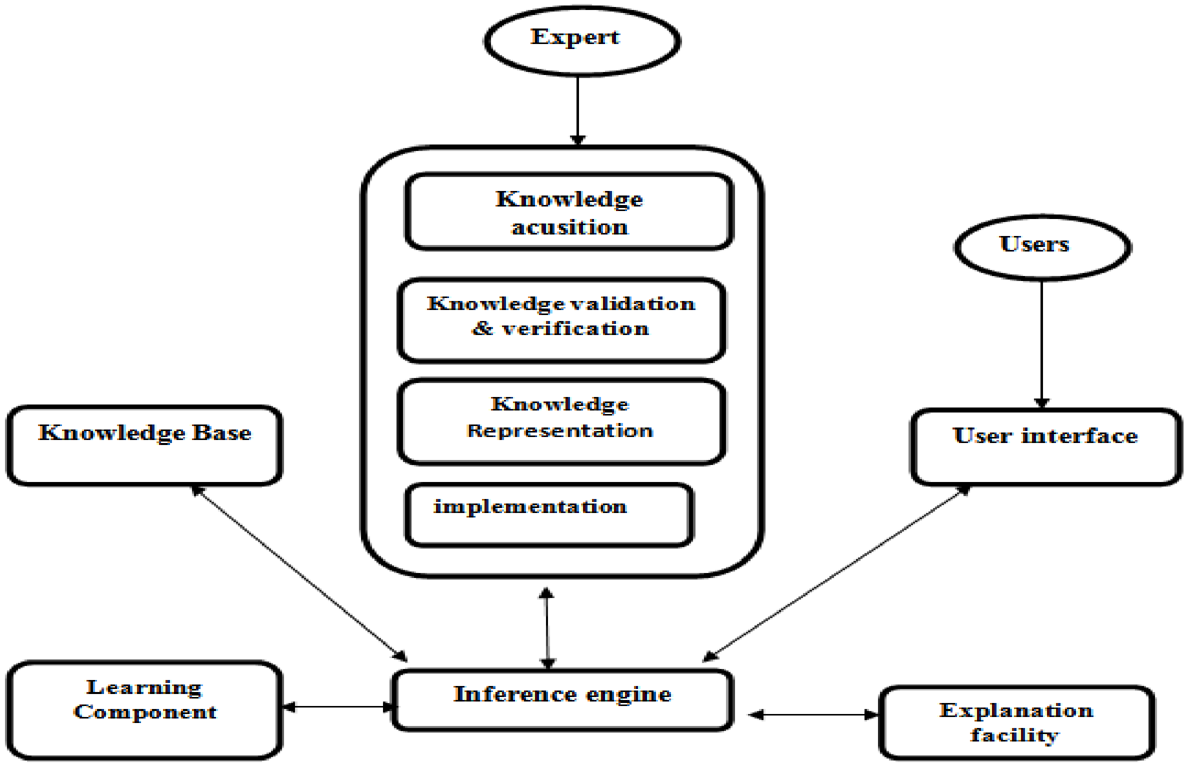

Figure 4.1: Architecture of KBSMCP

4.1 The knowledge Base

The Knowledge Base is Where the information is stored in the expert system in the form of facts and rules (basically a series of IF statements). This is where the programmer writes the code for the expert system. The knowledge base is a core component of expert system in AI. The knowledge base contains specialized knowledge on a given subject that makes the human a true expert on the subject. This knowledge is obtained from the human expert and encoded in the knowledge base using one of several knowledge representation techniques. One of the most common techniques used today for representing the knowledge in an expert system is rules. It is also described as a system which emulates human intelligence system by capturing knowledge and expertise from knowledge sources is known as an artificial intelligence system. Hence it is the need of the day to develop a Knowledge base System to work just like a consultant for Software Engineers for selection of a proper process model for software development.

4.2 The Inference Engine

The inference engine mimics the human experts" reasoning process. It works from the facts in the working memory (fact base) and the knowledge base to drive (or infer) new facts. It achieves this by searching through a knowledge base to find rules whose premises match the facts in the working memory (fact base). This process continues until the inference mechanism is unable to match any premise with the facts in the working memory.

As the decision tree of claim processing (chapter three) shows the claim specialist checks for claim information, patient and service type, patient eligibility, consistency, medical necessity, level of coverage, and burst billing. The inference engine of the prototype knowledge based system follows the same procedures with the claim specialist. The system initially asks the user to provide basic claim information about the user, including patient name, Age, Id number, Treatments, Procedures, and Year of service provision. Then the system starts to go through rules of payment and search for a rule that matches the information provided by the user. If a match is not found, the system goes through the rules of suspension. Finally, if both attempts fail, the system goes through the rules of denial and comes to the conclusion on whether or not the claim is paid, suspended or denied. The system also explains why the claim is suspended or denied and recommend how the claim should be paid.

Rule 1:paid :-

Full info, inpatient, fully_inpatient_service, insured, fully_coverable,

Coherence, not_got_similar_procedures, simultaneous,

no_brust_billing paid_response.

The above rule is for claim payment .It is satisfied if claim provides full information, the patient is an inpatient, all the services are fully inpatient services, the patient is insured, all the services are fully coverable, the procedures are coherent with similar cases, the patient did not get similar services the current year, the procedures are simultaneous with each other and burst billing does not exist. The system checks coherence by searching the system for similar cases using Id number, Treatment (condition) and procedures .If a match is found coherence is verified. The system also verifies if the patient did not get similar procedures the current year.

Rule 1 will clearly fail if Full claim information is not provided about the patient and the services provided. This calls for a suspension rule that requires this situation. A suspended claim is not entirely unplayable, but it is suspected of fraud and it needs to be reprocessed. The following rule is an example of claim suspension.

Rule 13: suspended:-

full_info, inpatient, fully_inpatient_service,insured,

fully_coverable, coherence, got_similar_procedures,frequency_high.

This rule is applied on claims in which the patient got similar procedures the current year and the frequency of the treatment is greater or equal to five. High frequency of similar treatment in the same year is one of the signs of fraud. The system provides explanation why the claim is suspended and how to reprocess it. When the system did not find a match through rules of payment and suspension, it goes through denial rules. The following example denies a claim that provides information on unauthorized services. This rule will be used if the patient is admitted as the child o f the insured person and his/her age is more than 18 years.

Rule 35: denied:-

full_info,inpatient,fully_inpatient_service,

child, over_age.

Generally, the inference engine starts from the top level goal and proceeds to the sub goal by backtracking the rules and the facts. To execute rule, the inference engine searching facts from the fact base and match these facts with the variables in the rules of the knowledge base. If the conditions are satisfied, the rule is fired (executed). If not, the inference engine searches the next rule to be fired or gives a conclusion accordingly .

4.3 The User Interface

A user interface is that portion of an interactive computer system that communicates with the user. The design of the user interface includes any aspect of the system that is visible to the user. The user interface is becoming a larger and larger portion of the software in a computer system and a more important portion, as broader groups of people use computers. As computers become more powerful, the critical bottleneck in applying computer-based systems to solve problems is now more often in the user interface. Because the design of the user interface includes anything that is visible to the user, interface design extends deep into the design of the interactive system as a whole. A good user interface cannot be applied to a system after it is built, but must be part of the design process from the beginning. Proper design of a user interface can make a substantial difference in training time, performance, speed, error rates, user satisfaction, and the user's retention of knowledge of operations over time.

The first page of the user interface welcomes users and describes what the system does and how to efficiently use it as shown in the figure below in figure 4.2.

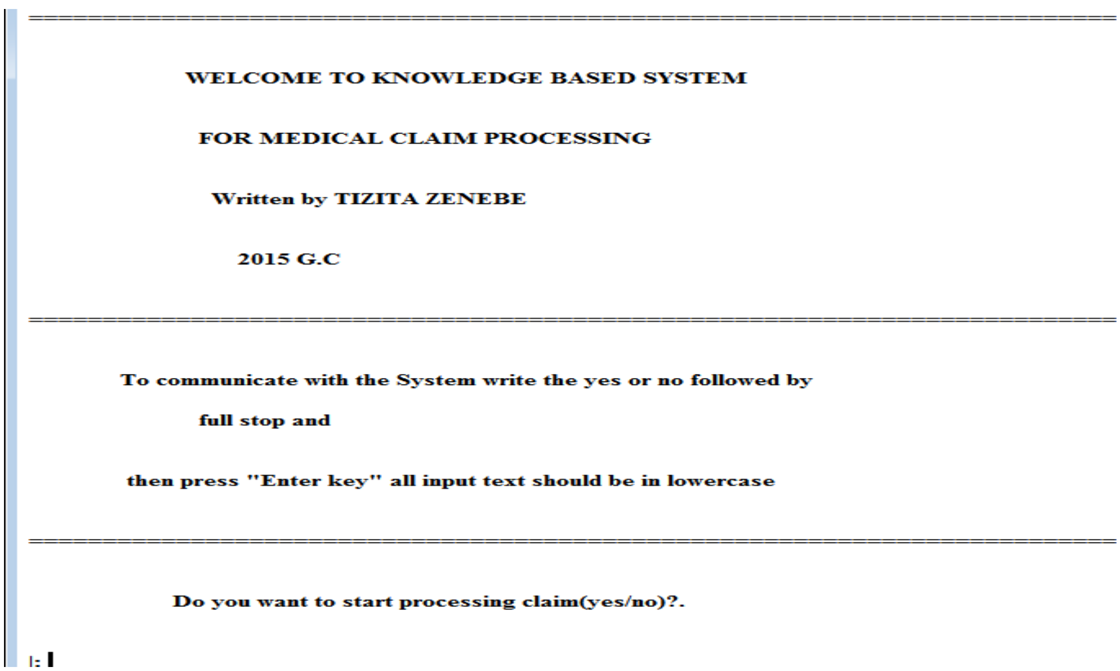

Figure 4.2: Welcoming Window of KBMCP

The welcoming window (at the bottom) asks if the user wants to process a claim. The user can start processing a claim by writing yes with a full stop and hit the enter key on the keyboard. However, if the user does not want to process any claim he can say no and exit the system. When the user agrees to proceed, the system asks for basic claim information such as the patient's name, Identification number, age, treatment (condition), procedures performed and year of service. The system accepts the input after checking its validity. If the input is not valid the system responds with an error message and requires the user to reenter the information. Figure 4.3 shows the basic claim information entry page.

```
==================================================================
==================================================================

                          Do you want to start processing claim(yes/no)?.

|: yes.
Enter patient Fname

|: abebe.
Enter patient lname

|: mamo.
Enter patient Age

|: 23.
Enter Gender

|: male.
Enter Id number

|: 3467.
Enter Treatment

|: cold.
Enter given procedures

|: x_ray.
Enter Year

|: 2007.
```

Figure 4.3: window for basic claim information entry

The system then starts processing the claim by going through all the rules by asking yes/no questions and using the claim information submitted previously.

Not all criteria for claim payment, suspension, or denial are provided by the user. For example, it is exhausting and time consuming for a user to find out how many times a specific user got similar procedures for the same condition in a specific year. That is why the system processes some of the criterias internally using the claim information and answers to previous question. The system intends to take the load off the user by processing some of the criteria by itself.

After the questions are answered, the system deploys the decision on claim, whether it is pay, suspended or denied. It also provides a reason for suspended and denied claims and recommends solutions for perceived problems.

4.4 The Explanation Module

Explanation modules, used in knowledge based systems, are a function that enables the knowledge worker to understand why the information explained and concluded by the domain expert is visible. While consulting the information provided by the expert, the explanation module elucidates why the knowledge based system reached its decision. The KBSCP explanation module explains why a claim is suspended or denied by the system. Since there are many reasons why a claim is not payable, each suspension and denial rule provides a different explanation for the decision made. A payment rule does not provide any explanation, but rather reflects on how the claim is paid.

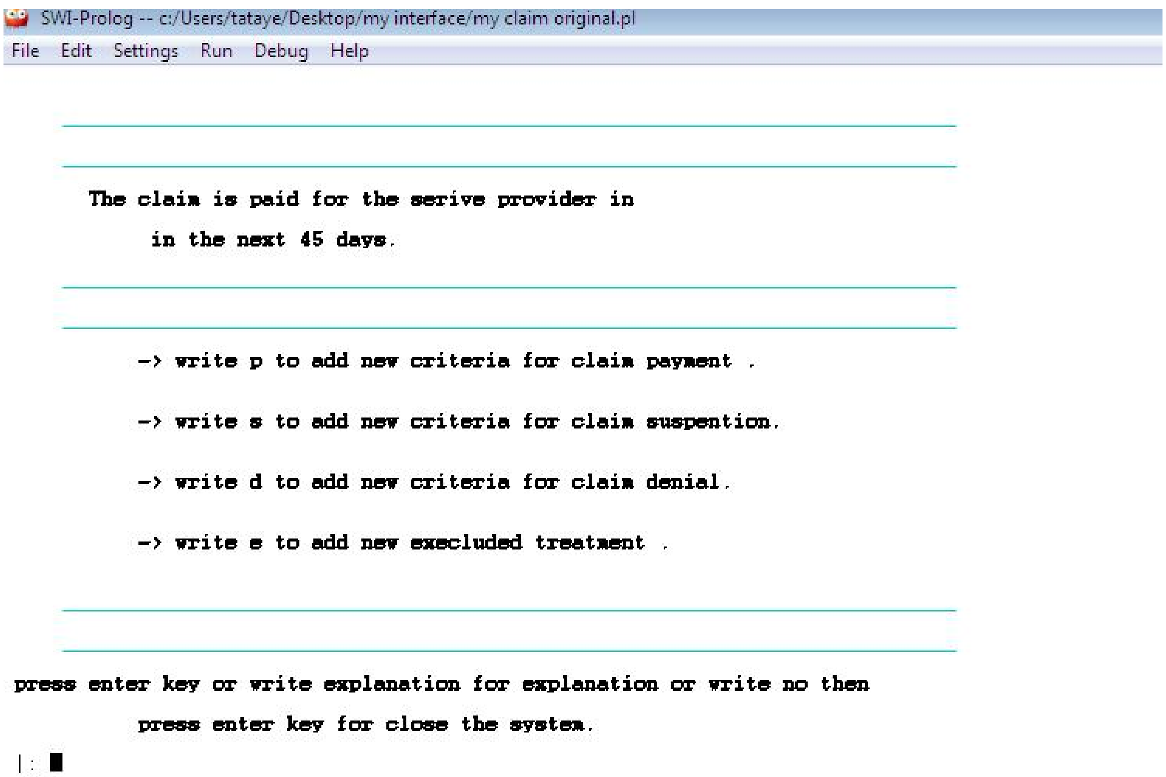

Figure 4.5: KBSCM window for a payable claim

The above window shows the status of a payable claim. But not all claims are going to be paid .a claim might be suspended if a claim does not provide full information or the system detects any sign of fraud .A suspended claim might be repossessed if further information is provided or a complaint is filed by the health institution.in such situations KBSCP explains the specific reason why the claim is denied and points out the way to reprocess the system if necessary.

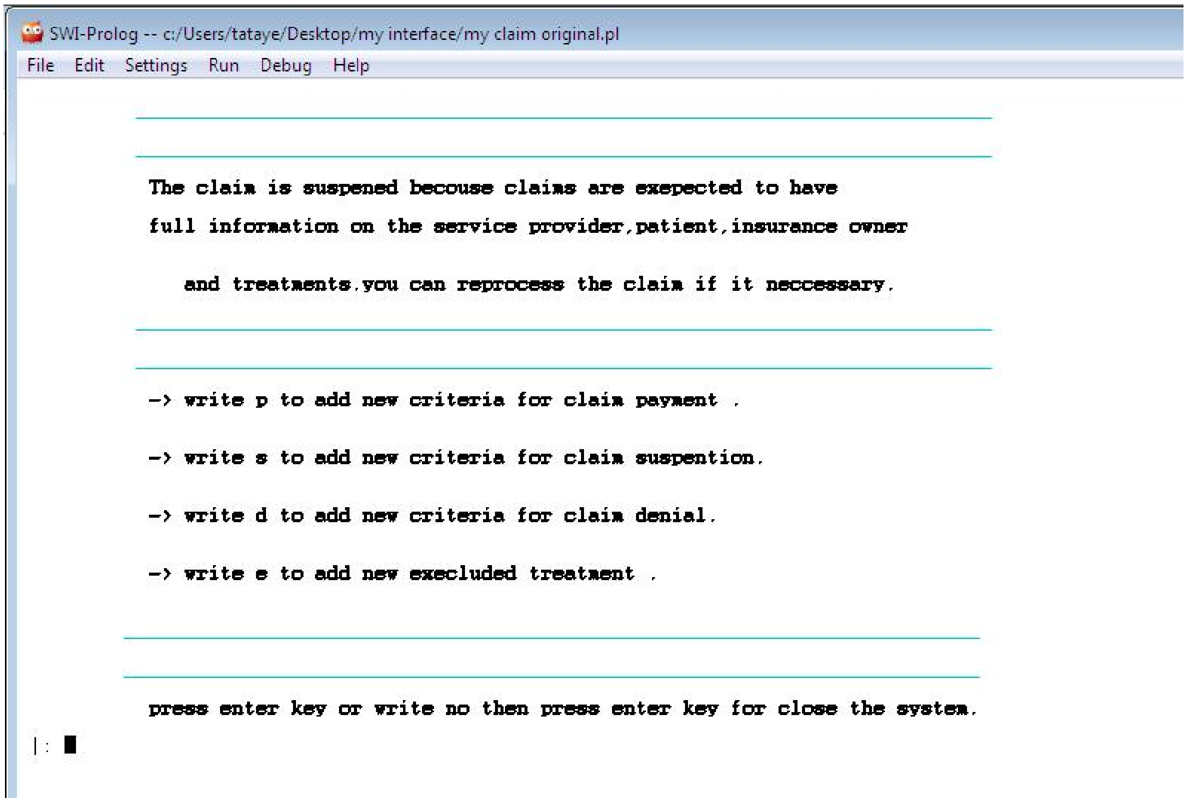

Figure 4.6: window showing a suspended claim

The system also provides an explanation for denying claims on why the decision is made. There are different reasons why a claim is denied. For example, if a patient is not insured, admitted as a child of an insured person and his age is more than 18 years, the claim is automatically denied. The system then provides an explanation and gives recommendations.

4.5 Learning Components of the System

KBSCP uses supervised Learning mechanism to improve its performance. The medical world is growing so fast and facts are changing rapidly. In order to keep up with this dynamics, health related systems should update their facts and rules frequently. The prototype system has the capacity to learn new criteria for claim payment, suspension and denial at run time without editing the code by knowledge engineering. It is possible to add excluded treatments and procedures that are not included in the insurance by the insurance package the inserted facts are stored on a separate knowledge base and become updated whenever the end-user ends the program. Since, the system use the updated rules later, the researcher assumed that the users provide correct and professional inputs only when it is required to add new knowledge. Figure 4.7 shows how new criteria is added to the system.

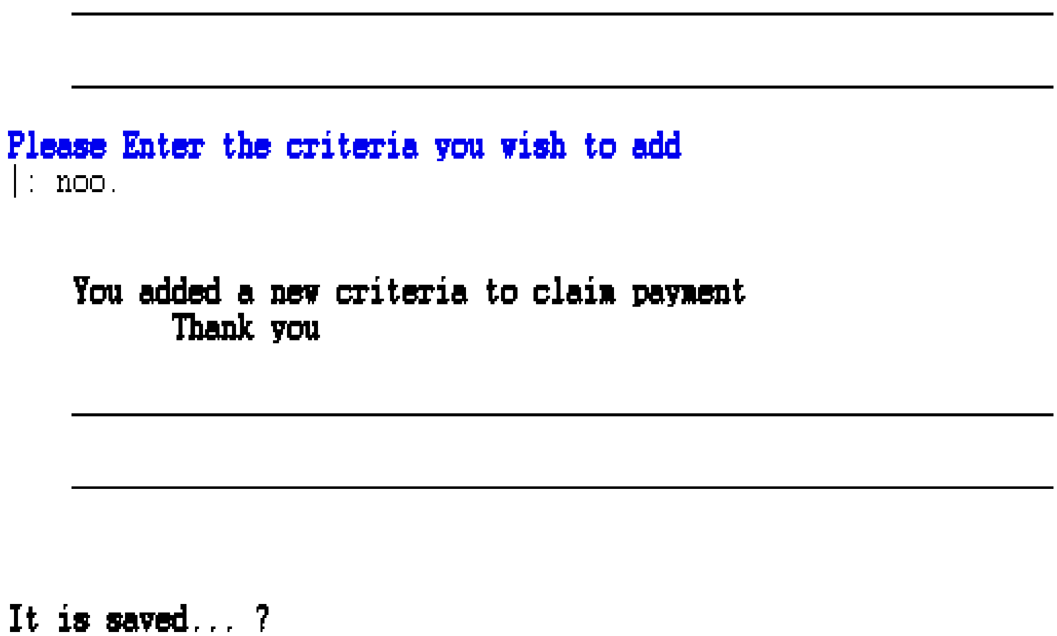

Figure 4.7: how to add new criteria for claim payment

In addition, the system can learn new excluded treatments and procedures which are used when the system checks for services that are coverable by the insurance package.

4.6 System Testing and Evaluation

The prototype knowledge based system for medical claim processing is tested and evaluated to check whether the objectives of the research are achieved or not. Six domain experts were selected; two of which are health insurance experts and four are claim processing experts; in evaluating the prototype system. Initially the experts were provided with claims (cases) that has patient and service information. The experts manually make a decision on the status of the claims and explain their decision. Soon after the experts used the system to process the claim using KBSMCP and filled the questionnaire provided by the researcher.

The scope of testing and evaluation that is accomplished and the significance involved to it relies on the size, complexity, and other features of the knowledge-based system. As the aim of testing and evaluation of the knowledge-based system is to assure that the prototype system does what it is required to do, we can test and evaluate a knowledge-based system as long as we already understand what to expect. Therefore, in this study testing and evaluation of the prototype system has two aspects. These are system performance testing, and user acceptance testing.

To address the issue of user acceptance, the researcher used visual interaction. Visual interaction used questionnaires, with both close ended and open ended questionnaires. The visual interaction evaluation method allows the domain expert to make comments by interacting with the system. It is used to evaluate the performance of the prototype from the users' point of view. Similarly, the questionnaires helped to assess and evaluate the acceptability and applicability of KBSMCP in the domain area.

The evaluation questionnaires are adapted from (Pu, Chen, & Hu, 2011) that used to evaluate the model called ResQue (Recommender Systems' Quality of user experience) with users' point of view.The adopted questionnaires are modified to some extent to fit them to the context of this study. These questionnaires are attached in Appendix III.System performance testing on the other hand was done by comparing decisions manually done by the experts with decisions provided by KBSMCP.

4.6.2 System Evaluation using Visual Interaction

System performance testing is the process of determining whether the prototype system is correct, that is, whether it meets the level of accuracy as required. It confirms whether the right prototype system has been built. This testing method is applied to evaluate the performance of the prototype KBSMCP using the parameter precision, recall and F-measure. These three parameters are used in order to measure the accuracy of the prototype system.

The type of questionnaires distributed for feedback collection from the evaluators was closed ended and open ended questionnaires focusing on easiness, attractiveness, time efficiency, and accuracy of the knowledge based system for medical claim processing(KBSMCP).

The evaluators were allowed to rate the options using checkbox questions. A check box question is similar to a multiple question except that it allows respondents to satisfy many of choices as part of their answer rather than just one choice. The options of the check box questions are excellent, very good, good, fair, and poor for these closed ended questions. Therefore, for easiness of analyzing the relative performance of the prototype based on the user evaluation after the interaction with the system, the researcher assigned numeric value for each of the options given in words. The values are given as Excellent = 5, Very good = 4, Good = 3, Fair = 2, and Poor = 1. The Table below indicates the feedbacks obtained from the domain experts (evaluators) on systems, interaction as calculated based on the given scale.

No	**Questions**	**1**	**2**	**3**	**4**	**5**	**Average**	**Percentage (%)**
1	Is the system easily accessible by the user?	0	0	1	2	3	4.17	83.4%
2	Is the system's attractive to users?	0	1	2	2	1	3.5	70 %
3	Is the system efficient in terms of time?	0	0	1	2	3	4.5	90 %
4	Is the system accurate in analyzing facts and decision making?	0	0	1	2	3	4.33	86.6%
5	Does KBSMCP incorporate sufficient knowledge of claim processing to use for decision making	0	1	1	3	1	4.17	83.4 %
6	Is the system accurate in providing an explanation and recommendation?	0	1	1	2	2	4.17	83.4%
7	Is the system significant to the health insurance and medical claim processing professions?	0	0	1	2	3	4.33	86.6 %
		Total Average					**4.17**	**83.3%**

Table 4.1: KBSMCP Performance Evaluation using Visual Interaction

As shown in the above table, 50 % of the evaluators scored the simplicity to use and interact with the prototype system criteria of evaluation as excellent and 33.3% as very good , 16.6 % as good . The second evaluation criteria was attractiveness of the prototype system and it was scored 16.6 % as excellent, 33.3 % as very good, and 33.3% as good and 16.6 as fear. In the efficiency of the prototype system with respect to time criteria of evaluation, 50 % of the evaluators scored as excellent, 33.3 % as very good, and the rest 16.6% as good.

Moreover, 50 % of the evaluators gave the prototype system an excellent score with regard to the accuracy of the prototype system in reaching a decision on a claim's status 33.3 % as vary good, and 16.6% as good. 16.6% respondents rated the ability of the system incorporate sufficient knowledge of claim processing to use for decision making with excellent,50% them believe it is very good ,16.6 % voted for good and 16.6% settled on fair. The ability of the prototype system in making right conclusions and recommendation criteria was rated by 33.3 % of the evaluators as excellent while 33.33%, 16.67% and 16.6 % of the evaluators scored it with good, very good and fair respectively. The significance of the knowledge based system to health insurance and medical claim processing was rated by 50 % of respondents as excellent while 33.3 % rated the prototype system as very good and 16.6 % as good. Finally, the average performance of the prototype system according to the evaluation results filled by the domain experts is 4.17 out of 5 or 83.3 %.

Discussion

In addition to the closed ended questions, the evaluators were provided with open ended questions to forward their suggestions and opinions. These questions focus on how the KBSMCP differs from the human experts in processing medical claims.

The next open-ended question the respondents were asked was to know if they believe KBSMCP can handle medical claim processing. All respondents agreed that the system can handle claims processing well, but it might need further development because medical claim processing is a very complicated and large area of knowledge. They implied further development of the system will be greatly assisted by the learning ability and flexibility of the system. The respondents also wrote perceived strengths and weaknesses of the prototype knowledge based system. Here are the strengths of the prototype system as mentioned by the respondents.

The system Saves the user's time and energy. It does not expect every input from the user because it does its own internal processing to take the load off the user. The system makes accurate and reliable decisions and reduces the chance of errors. Data will be efficiently stored for further reference. Stored data will be effectively used to detect fraud in claims. The learning ability of the system makes it more suiting with the dynamic medical world.
The perceived limitations of the system are that the user interface of the system needs improvement to make the system more attractive to users.

4.6.2 System evaluation using Test Cases

System Performance evaluation is about quantifying the service delivered by a computer or communication system. This testing strategy is used to validate the achievement level of the system and to measure the accuracy of it. To address the issue of validation, 14 cases were prepared by the researcher to be processed by the experts. The researcher prepared the cases because there are no documented claims in the agency that can be used for evaluation. The claim information provided in the cases was purposively selected to cover significant areas of the claim processing system. The accuracy of the system is measured by using confusion matrix which is shown in table 4.2.

	Actual correct claim decisions	**Actual incorrect claim Decisions**
Predicted correct by the prototype system	**9**	**1**
Predicted incorrect by the prototype system	**3**	**2**
Total	**11**	**3**

Table 4.2: Confusion matrix of the KBSMCP

From the above table the correct decision made by prototype system is 11and incorrect diagnosis is 3. This indicated the system performance is 80.6 %. The recall, precision and F measure were calculated depending on the above data in the confusion matrix.

	TP Rate	FP Rate	Precision	Recall	F-Measure
Results	0.89	0.25	0.90	0.89	0.89

Table 4.3 Cofussion matrix of the KBSMCP

As it was shown in table 4.3 the value of recall is 0.89 and precision is 0.9. the table also shows that the F measure of the prototype system is 0.89 which indicate that the prototype has a very good performance.

Generally, all the evaluation and testing results of the prototype show encouraging finding for further research work to fully implement and apply knowledge based systems technology in medical claim processing . Therefore, from the research findings, it is possible to conclude that the research achieves its objectives that are designed for.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Health insurance is insurance against the risk of incurring medical expenses among individuals. A person with health insurance coverage can easily get treatment from health institutions that have a contract with the insurance company. The health institutions send medical claims that provide information the services provided to the insured person or his family. Health insurers today are challenged to process high volumes of claims quickly and accurately. However, the reality is most insurance companies struggle with a system for claims that involves confusing, complex steps and manual procedures. This often results in an error-prone, inefficient structure with dramatic variations in performance. Another challenge facing insurance companies is fraud performed by patients, health centers and medical experts. Hence, in this study an effort has been made to design and develop a prototype of a knowledge-based system that can process medical claims and decides if the claim is paid to the health institution, suspended due to reasons like fraud or get denied .The system also makes recommendation on the actions to be taken after the decision has been made.

In developing the prototype system, knowledge was acquired using semi-structured interviews with domain experts and from relevant documents by using document analysis method to find the solution of the problem. The acquired knowledge is modeled using decision tree that represents concepts and procedures involved in diagnosis and treatment of diabetes. Then, the validated knowledge is represented using rule-based representation technique and codified using SWI-Prolog editor tool for building the knowledge-based system to provide decisions and recommendations to experts. The evaluation of the prototype was performed using Visual Interaction and user performance evaluation. A questionnaire composed of open and close ended questions was used to evaluate the system's performance and usability. This permits end-users to test the prototype system by actually using it and evaluating the benefits it provided to their field of expertise. System evaluators commented that the main strengths of the system include saving time and energy, processing some tasks internally and the learning component of the system. They also insisted that the user interface of the system needed further improvement.

As the evaluation result shows, the overall performance of the prototype system was registered to be 83.3%. Generally, the prototype system achieves a good performance and meets the objectives of the study.

5.2 Recommendations

The following recommendations are forwarded by the researcher for beneficiaries and further study. The developed knowledge based system for medical claim processing has clear significance for the Ethiopian health insurance agency in processing claims avoiding errors and fraud. So, the researcher recommends the agency to implement the system and use it.

The main issue raised as a weakness of this system was the user interface of the prototype system. Prolog by itself is not a flexible system for building user interfaces. It needs to be integrated with other languages like HTML and Java to have a more attractive look. Therefore, further research must be done on integrating Prolog with those languages or other languages that can make it easily adoptable.

The knowledge based system is learning components for adding criteria's to the system. This is a good start, but further research must be regarded self-learning. This research provides a prototype rule based system for medical claim processing. But a more commonly used and easier way of handling medical systems is case based reasoning. Further research should be done on integrating KBSMP with case based reasoning to make it more applicable.

One of the reasons the system achieved a low score on attractiveness is that it requires users to interact using prolog specific languages. Further studies can solve this problem by enabling the user to interact with the system using natural languages such as Amharic and Afan Oromo

The prototype system concentrates on health insurance medical claim processing. But there are other sections of health insurance that needs to be covered. Those include medical billing and insurance underwriting. Life insurance, Automotive insurance and property insurance are also areas in which knowledge based system can be implemented.

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APPENDIXES

APPENDIX I: Interview Questions

After introducing the objective of the study and requesting the respondents' participation in the study, the interviewer records their answers by using paper and pen for the following questions. The following are questions that are asked during the interview with domain experts.

1. What is Health Insurance?
2. What are the types of health insurance?
3. What is the level of coverage in each insurance package?
4. Describe the overall process of health insurance?
5. What is a claim?
6. What kind of information is provided in a medical Claim?
7. Describe the life cycle of a medical Claim.
8. What are the criterias for a claim to be paid?
9. What are the situations leading a claim to be denied?
10. What are the situations where a claim is suspended?
11. What are the treatments and procedures that are excluded?
12. What are the reasons for a suspended claim to be reprocessed?

Appendix III:production Rules

Rule 1.IF a full claim information is not provided **THEN** claim is suspended.

Rule 2.IF patient stays>1 day, treatment=not fully inpatient and no explanation provided **THEN** claim is suspended.

Rule 3. IF patient stays>1 day, treatment=not fully inpatient, explanation provided, explanation not approved **THEN** claim is suspended.

Rule 13.IF full treatment = coverable, all procedures coherent with similar cases, the patient got similar treatment the current year, and frequency >5, **THEN** claim is suspended.

Rule 14.IF full treatment = coverable, procedures not coherent with similar cases, medical necessity, not approved, **THEN** claim is denied.

Rule 15.IF full treatment = coverable, procedures not coherent with similar cases, medical necessity= approved, the patient got similar treatment the current year, and frequency >5, **THEN** claim is suspended.

Rule 16.IF full treatment = coverable, all procedures coherent with similar cases, the patient did not get similar treatment the current year, and procedures do not go simultaneously **THEN** claim is suspended.

Rule 17.IF full treatment = coverable, all procedures coherent with similar cases, the patient got similar treatment the current year, and frequency <5, and procedures do not go simultaneously **THEN** claim is suspended.

Rule 18.IF all treatments **=** coverable, all procedures coherent with similar cases, the patient did not get similar treatment the current year, procedures do not go simultaneously and no burst billing **THEN** claim is Suspended.

Rule 19. IF a full claim information is provided, patient=inpatient, all treatments are inpatient services, patient = insured, full treatment is coverable, treatment is coherent with similar cases, the patient did not get the treatment the current year, procedures go simultaneously, and no burst billing **THEN** claim is Paid.

Rule 25.IF a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent = child, child age < 18, all services = coverable, treatment is coherent with similar cases, the patient did not get the treatment the current year, procedures go simultaneously, and no burst billing **THEN** claim is paid.

Rule 26.IF a full claim information is provided, patient=outpatient, full treatment = outpatient services, patient = dependent, dependent = child, child age < 18, all services = coverable, treatment is coherent with similar cases, the patient did not get the treatment the current year, procedures go simultaneously, and no burst billing **THEN** claim is paid.

Rule 27.IF a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent = life partner, all services = coverable, treatment not coherent with similar cases, medical necessity approved, the patient did not get the treatment the current year, procedures go simultaneously, and no burst billing **THEN** claim is paid.

Rule 28.IF a full claim information is provided, patient=outpatient, full treatment not inpatient services, explanations provided, explanation approved, patient = insured, all services = coverable, treatment not coherent with similar cases, medical necessity approved, the patient did not get the treatment the current year, procedures go simultaneously, and no burst billing **THEN** claim is paid.

Rule 29.IF a full claim information is provided, patient=inpatient, full treatment not inpatient services, explanations provided, explanation approved, patient = insured, all services = coverable, treatment is coherent with similar cases, the patient got the treatment the current year, repetition<5, procedures go simultaneously, and no burst billing **THEN** claim is paid.

Rule 30.IF a full claim information is provided, patient=outpatient, full treatment not inpatient services, explanations provided, explanation approved, patient = insured, all services = coverable, treatment is coherent with similar cases, the patient got the treatment the current year, repetition<5, procedures go simultaneously, and no burst billing **THEN** claim is paid.

Rule 31.IF a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent = life partner, all services = coverable, treatment not coherent with similar cases, medical necessity approved, the patient got the treatment the current year, repetition<5, procedures go simultaneously, and no burst billing **THEN** claim is paid.

Rule 32.IF a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent = child, child age <18, all services = coverable, treatment is coherent with similar cases, the patient got the treatment the current year, repetition<5, procedures go simultaneously, and no burst billing **THEN** claim is paid.

Rule 33.IF a full claim information is provided, patient=outpatient, full treatment = outpatient services, patient = Insured, all services = not fully coverable, some of the services=coverable, **THEN** claim is suspended.

Rule 34.IF a full claim information is provided, patient=outpatient, patient = dependent, dependent = life partner, services = not fully coverable, services = some coverable, **THEN** Claim is suspended.

Rule35. IF full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent = child, child < 18 years, all services = for fully coverable, some services = coverable **THEN** claim is suspended.

Rule 36.**IF** full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent = Life partner, all services = coverable, treatment is coherent with similar cases, the patient got the treatment the current year, repetition>5, procedures go simultaneously, and no burst billing **THEN** claim is suspended.

Rule 37: IF a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent = child, child age <18, all services = coverable, treatment is coherent with similar cases, the patient got the treatment the current year, repetition>=5, procedures go simultaneously, and no burst billing **THEN** claim is suspended

Rule 38: IF a full claim information is provided, patient=outpatient, full treatment = outpatient services, patient = insured, treatment is not coherent with similar cases, and the services are not medically necessary, **THEN** the claim is suspended.

Rule 39: IF a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = insured, treatment is not coherent with similar cases, and the services are not medically necessary, **THEN** the claim is suspended.

Rule 40: IF a full claim information is provided, patient=outpatient, full treatment = outpatient services, patient = dependent, dependent= life partner, treatment is not coherent with similar cases, and the services are not medically necessary, **THEN** the claim is Suspended.

Rule 41: IF a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent = child, child age <18, all services = coverable, treatment is not coherent with similar cases, the procedures are not medically necessary THEN claim is Suspended.

Rule 42:IF a full claim information is provided, patient=outpatient, full treatment = outpatient services, patient = insured, all services = coverable, treatment is not coherent with similar cases, the procedures are medically necessary, the patient got similar procedures the current year and the frequency of treatments is high **THEN** claim is Suspended.

Rule 43:IF a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, patient=life partner, all services = coverable, treatment is not coherent with similar cases, the procedures are medically necessary, the patient got similar procedures the current year and the frequency of treatments is high **THEN** claim is Suspended.

Rule 44:IF a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, patient=child, all services = coverable, treatment is not coherent with similar cases, the procedures are medically necessary, the patient got similar procedures the current year and the frequency of treatments is high **THEN** claim is Suspended.

Rule 45: IF a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, patient=life partner, all services = coverable, treatment is coherent with similar cases, the patient not got similar procedures the current year and burst billing exists **THEN** claim is suspended.

Rule 46: IF a full claim information is provided, patient=outpatient, full treatment = outpatient services, patient = Insured, all services = coverable, treatment is coherent with similar cases, the patient not got similar procedures the current year and burst billing exists **THEN** claim is suspended.

Rule 47: **IF** a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent= life partner, all services = coverable, treatment is coherent with similar cases, the patient not got similar procedures the current year and burst billing exists **THEN** claim is suspended.

Rule 48: **IF** a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent= child, child age <18, all services = coverable, treatment is coherent with similar cases, the patient not got similar procedures the current year and burst billing exists **THEN** Claim is Suspended.

Rule 48: **IF** a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent= child, child age <18, all services = coverable, treatment is coherent with similar cases, the patient not got similar procedures the current year and procedures are non-simultaneous **THEN** Claim is Suspended.

Rule 49: **IF** a full claim information is provided, patient=outpatient, full treatment = outpatient services, patient = dependent, dependent= child, child age <18, all services = coverable, treatment is coherent with similar cases, the patient not got similar procedures the current year and procedures are non-simultaneous **THEN** Claim is Suspended.

Rule 50: **IF** a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = dependent, dependent= life partner, all services = coverable, treatment is coherent with similar cases, the patient not got similar procedures the current year and procedures are non-simultaneous **THEN** Claim is Suspended.

Rule 51: **IF** a full claim information is provided, patient=outpatient, full treatment = outpatient services, patient = dependent, dependent= life partner, all services = coverable, treatment is coherent with similar cases, the patient not got similar procedures the current year and procedures are non-simultaneous **THEN** Claim is Suspended.

Rule 52: **IF** a full claim information is provided, patient=inpatient, full treatment = inpatient services, patient = insured, all services = coverable, treatment is coherent with similar cases, the patient not got similar procedures the current year and procedures are non-simultaneous **THEN** Claim is Suspended.

Rule 53: **IF** a full claim information is provided, patient=outpatient, full treatment = outpatient services, patient = life partner, all services = not fully coverable, none of the services **THEN** Claim is Suspended.

Appendix III: Sample Rules from the Knowledge Base

suspended :-

```
    full_info,inpatient,fully_inpatient_service,
    child,under_age,fully_coverable,coherence,
    not_got_similar_procedures,brust_billing,nl,nl,
  ansi_format([bold,fg(cyan)],
'________________________________________________________________________________ ~w',
              [' ']),nl,
 ansi_format([bold,fg(cyan)],
'________________________________________________________________________________ ~w',
              [' ']),nl,
 ansi_format([bold,fg(cyan)],
       ' The claim is suspened becouse the system is suspecious of froud  ~w',
              [' ']),nl,
 ansi_format([bold,fg(cyan)],
       ' you can reprocess the claim if it neccessary.  ~w',
              [' ']),nl,

 ansi_format([bold,fg(cyan)],
'________________________________________________________________________________ ~w',
              [' ']),nl,
 ansi_format([bold,fg(cyan)],
```

```
'______________________________________________________________________________ ~w',
                    [' ']),nl,
ansi_format([bold,fg(black)],
        '* write p to add new criteria for claim payment .   ~w',
                    [' ']),nl,
ansi_format([bold,fg(black)],
        '* write s to add new criteria for claim suspention.   ~w',
                    [' ']),nl,
ansi_format([bold,fg(black)],
        '* write d to add new criteria for claim denial.  ~w',
                    [' ']),nl,
ansi_format([bold,fg(black)],
        '* write e to add new execluded treatment . ~w',
                    [' ']),nl,
ansi_format([bold,fg(cyan)],

'______________________________________________________________________________ ~w',
                    [' ']),nl,
ansi_format([bold,fg(cyan)],

'______________________________________________________________________________ ~w',
                    [' ']),nl,
ansi_format([bold,fg(black)],
```

```
          'press enter key or write explanation for explanation or write no then  ~w',
            [' ']),nl,
  ansi_format([bold,fg(black)],
          '         press enter key for close the system. ~w',
                      [' ']),nl,
  read(EXP),((EXP=p,addp),(EXP=s,addS),(EXP=d,addD),(EXP=e,addex);EXP=no,bye).
denied :-


    veriyc(full_info),inpatient,fully_inpatient_service,
    insured,verifys(not_fully_coverable),none_coverable,nl,nl,
  ansi_format([bold,fg(cyan)],
  '     ________________________________________________________________________________
~w',
                      [' ']),nl,
  ansi_format([bold,fg(cyan)],
  '     ________________________________________________________________________________
~w',
                      [' ']),nl,
  ansi_format([bold,fg(black)],
  '    The claim is denied becouse the service provider gave services that are
             not coverable by the insurance package ~w',
                      [' ']),nl,
   ansi_format([bold,fg(cyan)],
```

```
'_______________________________________________________________________________ ~w',
                        [' ']),nl,
 ansi_format([bold,fg(cyan)],

'_______________________________________________________________________________ ~w',
                        [' ']),nl,
  ansi_format([bold,fg(black)],
 '      The 5% fee that was initially paid to the health institution must be returnedd
        ~w',
                        [' ']),nl,
   ansi_format([bold,fg(black)],
 '              or get duducted from the payment.
        ~w',
                        ['']),nl,
  ansi_format([bold,fg(cyan)],

'_______________________________________________________________________________ ~w',
                        [' ']),nl,
 ansi_format([bold,fg(cyan)],

'_______________________________________________________________________________ ~w',
                        [' ']),nl,
 ansi_format([bold,fg(black)],
```

```
'* write p to add new criteria for claim payment .   ~w',
              [' ']),nl,
ansi_format([bold,fg(black)],
     '* write s to add new criteria for claim suspention.   ~w',
              [' ']),nl,
ansi_format([bold,fg(black)],
     '* write d to add new criteria for claim denial.  ~w',
              [' ']),nl,
ansi_format([bold,fg(black)],
     '* write e to add new execluded treatment . ~w',
              [' ']),nl,
ansi_format([bold,fg(cyan)],

'______________________________________________________________________________ ~w',
              [' ']),nl,
ansi_format([bold,fg(cyan)],

'______________________________________________________________________________ ~w',
              [' ']),nl,
ansi_format([bold,fg(black)],
     'press enter key or write explanation for explanation or write no then  ~w',
       [' ']),nl,
ansi_format([bold,fg(black)],
```

```
'          press enter key for close the system. ~w',

                 [' ']),nl,

read(EXP),((EXP=p,addp),(EXP=s,addS),(EXP=d,addD),(EXP=e,addex);EXP=no,bye).
```

Appendix IV: Questionnaires for user acceptance evaluation

1. Is the system easily accessible by the user?

    □ Poor □ Fair □ Good □ Very good □ Excellent

2. Is the system's attractive to users?

□ Poor □ Fair □ Good □ Very good □ Excellent

3. Is the system efficient in terms of time?

   □ Poor □ Fair □ Good □ Very good □ Excellent

4. Is the system accurate in analyzing facts and decision making?

   □ Poor □ Fair □ Good □ Very good □ Excellent

5. Does KBSMCP incorporate sufficient knowledge of claim processing to use for decision making?

   □ Poor □ Fair □ Good □ Very good □ Excellent

6. Is the system accurate in providing explanation and recommendation?

   □ Poor □ Fair □ Good □ Very good □ Excellent

7. Is the system significant to the health insurance and medical claim processing professions?

   □ Poor □ Fair □ Good □ Very good □ Excellent

8. Do you believe that KBSMCP can effectively handle medical claim processing?

   □ Yes □ No

   5. Please state your reason.

   ____

   ____

   ____

9. What makes KBSMCP difference from manually processing the claim?

   ____

   ____

   ____

10. What are the strengths of KBSMCP ?

____

Declaration

I declare that the thesis is my original work and has not been presented for a degree in any other university.

October ,2015

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

Dr.Million Meshesha(PhD)