ADDIS ABABA UNIVERSITY
ADDIS ABABA INSTITUTE OF TECHNOLOGY
SCHOOL OF MECHANICAL AND INDUSTRIAL ENGINEERING

SERVICE QUALITY IMPROVEMENT THROUGH INTEGRATED DEMAND MANAGEMENT IN THE ETHIOPIAN HEALTHCARE SECTOR

BY
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Abstract

Quality is a basic differentiator for manufactured products and for services provided. The Service sector constitutes a considerable part of the country's economy. Besides its economic contribution, the service sector such as the healthcare is an inseparable part of human life. The healthcare service needs to be accomplished with great care and speed to save lives and promote happiness by eradicating diseases and alleviating human suffering.

Efforts have been exerted by the Government, to improve the quality of life in the country through the expansion and development of manufacturing industries. Compared to manufacturing industries, the quality of service sectors has not advanced adequately. This is partly due to the fast rate of population growth. Much is expected to improve the service quality with the resources available. The complexity and wide coverage of the service sector do not make improvements to be achieved easily. Among the efforts worthy of mentioning to improve service quality in the sector is the implementation of Business Process Re-Engineering (BPR) and the Kaizen philosophy and principles especially in hospitals, though the results gained has not yet reached the standard expected. Owing to this, complaints in the health sector still persist and it is obligatory to find ways and means to deal with them. Therefore, the main objective of this research is to assess the existing problems by undertaking an in-depth study of different healthcare departments. To this end, it is necessary to develop an integrated demand management model. It is believed that this will be helpful in managing the demand within the sector and achieve an integrated method of channeling healthy delivery services in an efficient and effective manner.

To realize the dissertation's objectives, an in-depth literature review was conducted. The concepts and terms related to quality, supply chain and demand management in healthcare as well as different models and options were investigated with the help of mathematical and statistical tools to study quality improvement approaches. As a result, existing gaps were identified and further examined by using a combination of primary and secondary sources,

qualitative and quantitative data and with information gathered from focus group discussions to deal with improvements and approaches for the identified problems. By using the data obtained, a Fuzzy-AHP approach was selected and the necessary measures were prioritized for the purpose of implementation. The prioritization was also supported by sensitivity analysis. As a result, both emergency and referral cases in relation to inpatient and out-patient needs, as well as pharmaceutical distribution were examined in different sections.

In the assessment of the existing working situation in the selected areas of the sector, waiting time data were analyzed and the working procedures were also investigated. Core problems were selected and the patient flow of the existing system was studied with the help of system dynamics stock-flow diagrams. Pharmaceutical distribution networks were re-designed to minimize the delay of services.

Finally, an integrated demand management model which is aimed at improving the service quality in the sector to enhance the degree of responsiveness to patients' needs that would do away with delays was developed by using system dynamics and consultation of experts for the choice of parameters for application. The workability of the new model is theoretically validated and supported by experts in the area.

Key words: Service quality, Healthcare, Integrated demand management, System dynamics, Ethiopia

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List of Abbreviations and Acronyms

AADC	Addis Ababa Dispatch Centre
ALE	Average Life Expectancy
AHP	Analytic Hierarchy Process
BEM	Business Excellence Model
BEmONC	Basic Emergency Obstetric and Newborn Care
BPR	Business Process Re-engineering
CCS	Country Corporation Strategy
CD	Critical Disease
CEmONC	Comprehensive Emergency Obstetric and Newborn Care
DACA	Drug Administration and Controlling Authority
DHS	Demographic Health Survey
Dmnl	Dimensionless
EHRIG	Ethiopian Health Reform Implementation Guideline
ED	Emergency Department
EMS	Emergency Medical Service
FMOH	Federal Ministry of Health
GHO	Global Health Observatory
GHO	Global Health Observatory
GTP	Growth and Transformation Plan
HEP	Health Extension Program
HEW	Health Extension Workers
HMIS	Health Management Information system
HRH	Human Resource for Health
HSDP	Health Sector Development Plan
IMR	Infant Mortality Rate
LMICs	Lower Middle Income Countries
MDG	Millennium Development Goal
MIC	Middle Income Countries
MMIC	Middle Middle Income Countries
MMR	Maternal Mortality Ratio
MoFED	Ministry of Finance and Economic Development
MOH	Ministry of Health
NCD	Non-Critical Disease
NGO	Non-Governmental Organization
NMR	Neonatal Mortality Rate
OECD	Economic Co-operation and Development
OPD	Outpatient Department
PDCA	Plan Do Check Act
PFSA	Pharmaceutical Funds and Supply Agency
RHB	Regional Health Bureau
SC	Supply Chain
SCM	Supply Chain Management

STPHMMC	St. Paul's Hospital Millenium Medical College
TASH	Tikur Anbessa Spepcialized Hospital
UMICs	Upper Middle Income Countries
U5MR	Under five Mortality Rate
WB	World Bank
WHO	World Health Organization

Chapter One

Introduction

Ethiopia is the tenth largest country in Africa, covering 1,104,300 square kilometers in the region commonly known as the Horn of Africa. According to the Ethiopian Health Sector Development Plan's projection and the population census of 2010, Ethiopia is inhabited by a total of 84 million people. The population is growing at an annual rate of 2.6 % (HSDP-IV, 2010) and it is estimated that it had reached around 90 million.

With such a high population and a rate growing faster than expected, the improvement and application of quality theories, principles and strategies in manufacturing and service areas are of crucial concern. As a result, especially in the manufacturing different attempts have been made to ameliorate the quality of manufactured products and attain a high standard of excellence. In this regard, there has been an appreciable stride in enhancing an activity towards making the concept of quality familiar to organizations through certification and continual training, conducting different studies and developing appropriate interventions. Even though studies were conducted on quality, most of these studies have focused on manufacturing industries. By contrast, quality improvement has been generally overlooked in service sector.

This study represents a shift from the manufacturing to the service sector in order to fill the existing gap. It covers ten chapters altogether. This preliminary chapter explains the approaches to the study of the existing situation prevailing in the Ethiopian Healthcare sector and contains eight major parts. The first part introduces the content of the work. The second explains the background of the study. The third and fourth parts elaborate on the statement of the problem and explain its general and specific objectives while the fifth part discusses the significance of the study. The scope, limitation and organization of the study are explained in the last three parts respectively.

1.1 Background and Justification

The concept of quality at its very inception began as a way of meeting technical specifications in manufacturing industries. The first concept of expanding quality to services is defined as meeting the expectations of the customer (Parasuraman, *et al.*, 1985). A frequently used definition of quality is "delighting the customers by fully meeting their needs and expectations". These include performance, appearance, availability, delivery, reliability, maintainability, cost effectiveness and price (Ganiyu, *et al.*, 2012). It is, therefore, imperative that organizations should know what these needs and expectations are. In addition, having identified them, organizations must understand them and measure their own ability to meet them. Thus, every encounter either in service or in production area aims at achieving or exceeding the quality of a service or product.

In all service and manufacturing areas, enhancement of quality transfers waste of man-hours and of machine time into the manufacture of good products and better services. Quality is considered to be one of the management's topmost competitive priorities and a prerequisite for sustenance and growth of firms (Babu, 2015). The quest for quality improvement has become a highly desired objective in today's intensively competitive markets and quality management. It has been reckoned as the prime mover towards enhanced business performance and many researchers have underlined the quality improvement initiatives resulting in a sustainable competitive advantage.

Organizations need to improve what they are currently doing by changing operations to what they should be and measuring the outcomes. This helps to search for improvements on other new approaches. Every improvement requires a change either in small scale or in large scale and every change requires an act of creation (Sommers, 1998).

Effective supply chain management emphasizes the proper utilization of an integrated system of suppliers, producers, customers, buffers, information channels, and logistics lines of distribution (Ang, 2008 and VanVactor, 2011). Managers across a broad spectrum can develop a shared view of effective supply chain management by designing a distribution network emphasizing

minimizing costs while maximizing service. Traditional views of supply chain strategy continue to embrace an organizational structure based on vertical integration (top-down) designed for work-efficiency. Contemporary thought leans more toward horizontal integration where in organizations are mutually supportable through ongoing interdependencies aimed at organizational success (VanVactor, 2011).

Healthcare today is a vast web of complexities and contradictions. It offers astounding advances in technology and treatment, but is often overburdened by inefficiencies, errors, resource constraints and other issues that threaten the accessibility and safety of patient- care (Taner, *et al.*, 2007). To improve quality in healthcare, the concept of patient flow management and supply chain management should be given special focus. From a supply chain management and demand management in patient flow perspective, our knowledge still seems to be rather fragmented. Although many health care organizations have recognized the importance of supply and demand management practices, the application of techniques, methods and best practices originally developed in an industrial setting clearly is often vague. Health supply chains can be characterized by different modes of integration such as integration and co-ordination of processes, information flows, planning processes, integration of intra and inter organizational processes, integration of market-approach and of market-development. From the patient flow perspective, improvement activities in the process of the patient flow aiming at minimizing the waiting time have been considered in this study.

Related to health service providers, supply chain management often refers to the information, supplies and finances involved with the acquisition and movement of goods and services. It starts dealing from the supplier to the end user in order to enhance clinical outcomes while controlling costs. In doing so, supply chain management focuses on the integration of processes. Within the healthcare sector, processes refer to physical products like pharmaceutical, medical devices and health aids and refer to activities associated with the flow of patients. In both cases, the basic rationale of a supply chain management approach is founded in the belief that intensive co-ordination and integration between operational processes can lead to a better health service delivery (Tarafdar, *et al.*, 2012).

In the country's Growth and Transformation Plan (GTP), enhancing expansion and quality of social development has got great attention with regard to education, training, expansion and improvement of health services (GTP, 2010). The focus under the GTP continued towards primary healthcare and preventive services and improving the effectiveness of services in relation to availability of drugs. Furthermore, the government planned to strengthen its measures to improve the number, skills, distribution and management of health workers, through accelerated training of physicians (specialists and general practitioners). New systems of healthcare financing, including drug revolving funds are planned to be explored and implemented to overcome the bottlenecks in the sector. Incentive package are expected to be further developed in order to domestically produce pharmaceutical products (GTP, 2010).To achieve the target in GTP, the government is working on diversifying the number of primary hospitals and health extension programs . The major objective in the GTP for the health sector is to improve access to healthcare and improve quality of health services. As a strategic direction to meet the objective and the target plan in the GTP, Health Sector Development Program IV is designed in line with the overall directions of the government until the end of the planned period. The most priority areas of the health sector development program are based on maternal and newborn care, child health, halt and reverse the spread of major communicable disease such as HIV/AIDS, TB and Malaria.

Service quality of the Ethiopian Healthcare Sector could be improved either through supplies management or demand management or both. The government of Ethiopia has embarked so many projects and important plans to improve the supply side of the healthcare for service quality in the country. However, up to now, only limited or no effort underway to manage the demand. Whatever investment is channeled to the supply side of the Ethiopian healthcare, it would be either difficult or impossible to solve quality-related problems if the demand side cannot be addressed. The aim of this study is to investigate the potential of demand management for healthcare service quality improvement in Ethiopia. In addition, important inputs for the demand like the pharmaceutical supplies are addressed in the study.

This study assessed the existing problem related to the retarded responsiveness in these services by focusing on areas of; emergency, referral and inpatient cases of healthcare services and

pharmaceutical distribution in the sector. Due to the existence of delayed responsiveness in service provision and in pharmaceutical supplies, patient-treatment is delayed and led to aggravated customer complaint in healthcare sector especially in the areas mentioned. The major delay in the pharmaceutical is in the distribution by Pharmaceutical Fund and Supply Agency (PFSA) and has been studied in detail. The study proposed a means of mitigating the problems and worked on how to take part on the improvement of quality of service provision in healthcare which has a significant part in the economy of the country. As a result, integrated demand management model is proposed as a means of mitigating the responsiveness problem especially in the mentioned areas and pharmaceutical distribution redesigning of network has been done to enhance the existing pharmaceutical products supply chain management of the sector.

1.2 Problem Statement

The importance of service economies and companies is significant and still increasing. In order to improve quality, cost and time of production and service activities, it is necessary to know the source of the sectors' problems. However, to find the problems, it is important to define and understand the source and core of the problems. In addition, it is usual to hear customer complaints in service areas. But, there are no significant studies which focus on service sectors though service sectors are dominant in the economy of the country. Moreover, the effective implementation of quality improvement initiatives in service operational environments is still lagging behind compared with that of manufacturing. This may be attributed to the common misconception that quality improvement initiatives are, either inapplicable or, at best, very difficult to implement in service operational settings (Natarajan, 2006).

Among the service areas where customer complaints are common, healthcare sector is the major one. From the reports in Growth and Transformation Plan (GTP) and Health Sector Development Plan Four (HSDP- IV, 2010), it is clearly seen that the focus on the improvement activities in health sector is strengthened and given due attention. As a result, significant improvements in the achievements of the plans have been met. But the sector is still beset by many complaints of customers. Among the major areas where there are numerous complaints, the emergency service is a major one. The referral case service is also of problematic and needs immediate solution.

For inpatient service requiring continuous treatment in the hospital is also said to be less responsive to their needs. Similarly, the supply of pharmaceutical products is also considered to be less responsive to patients' needs due to lack of effective distribution. The problems have been previously mentioned in different studies. In his Ph.D. dissertation, Birhanu (2012) stated that there are problems in the responsiveness of service provision in the healthcare sector. Researchers Mesfin (2013) and Ibrahim (2014) in their M.Sc. theses also showed the problem of lack of responsiveness of the sector. In these two studies, quality improvement models were proposed focusing on Kaizen and lean principles. Implementation of Business Process Re-engineering (BPR) was also made in the healthcare sector in the country. Both Kaizen and BPR were aimed at achieving efficiency in the sector. A study conducted previously on the sector by the author as part of preliminary effort towards this dissertation also proved the existence of delay in service delivery. Although appreciable activities were tried to solve the problem the sector still remains the same and the situation seems, in fact to have aggravated in certain cases. The focus of the previous studies was more of a general approach to improve quality. Such an approach cannot fully address specific problems related to emergency, referral, inpatient and pharmaceutical cases. Study with specific focus on the mentioned areas is helpful to manage the demand issue of patients and supply of pharmaceutical.

This provides a good opportunity to solve the common complaints by working on the dominant problem areas in the sector. This study is aimed at devising a mechanism on how to mitigate the quality problem in these areas by focusing on the demand management side in addition to the supply side as the previous attention given to managing the demand side in healthcare is low.

Basic Research Questions

The research deals with the following questions:

- What is the existing situation in the service provision mechanism of the Healthcare Sector in Ethiopia especially in areas of emergency, referral and inpatient cases demand as well as pharmaceutical products supply chain managements?
- What are the major problems observed in the areas assessed within the sector?

- What are the previous and existing quality improvements attempts to mitigate the identified problems?
- What are the means of bridging the identified gaps helpful to enhance the service provision?
- What are the relevant models that should be developed to the problems?

1.3 Objective of the Study

General Objectives

The main objective of this research is to assess the existing service provision status in the Ethiopian healthcare sector by taking the case of the emergency, referral and inpatient cases demand management and supply chain issues of pharmaceutical products in Addis Ababa, and to devise relevant models to deal with the existing lack of responsiveness in the sector.

Specific Objectives

The specific objectives of the research are to:

- Assess the service provision mechanism of healthcare.
- Assess the healthcare sector's service quality with regards to responsiveness and supply chain.
- Investigate the demand management of emergency cases, referral cases, inpatient cases and pharmaceutical products distribution problems and gaps.
- Devise a solution that mitigates the identified problems and gaps in the areas of responsiveness, supply chain and demand management.
- Develop supply and demand models that can integrate the demand management service in healthcare and thereby minimize the sector's responsiveness problems.

1.4 Significance of the Study

The first significant point of the research is to provide solutions to existing problems and to create practical results aimed at enhancing responsiveness and dealing with delays and inefficiency. The second is to add knowledge to the theoretical aspect of the service industry. As regards, the first, both internal and external customers become beneficiaries with increased satisfaction. Better results means, better demand management, improved quality and workers motivation and generally, a conducive working environment. As regards, the second point, new ways can be found with the help of the research to manage the growing demand in the health sector, the new knowledge facilitates the use of appropriate tools to represent the service system.

1.5 Scope and Limitations

The research examines key problems of the service sectors in Ethiopia with particular reference to quality, demand management and supply chain management in the healthcare sector. Thus, the existing service provision and supply chain management of the sector is studied in detail to identify the core problems in the sector. The studied areas are, emergency case, referral case and inpatient case demand management and supply chain management of pharmaceutical in Addis Ababa. This is done through examining previous studies and existing improvement measures. By analyzing the results of the assessment, solutions that are helpful in enhancing the service quality of the sector have been proposed for implementation.

The major limitation during the research was gathering accurate data. The process is hampered due to the urgency to save lives, in addition to lack of detailed record of customer service report containing reliable information. The uncertainty that can arise from each data gathering mechanism has also its own impact in the quality of the data. These problems have been solved by the use of systematic data gathering and giving support to the correctness of secondary data with discussion with representative- workers in the sector.

1.6 Organization of the Study

The research consists of ten chapters. Chapter one introduces the research by discussing the main problems of the study and different approaches to it. Chapter two comprises the literature review and the theoretical background. The third chapter deals with the methodology used to collect data for the research. The fourth chapter gives insight into the healthcare system by focusing on the existing situation of healthcare service in Ethiopia. The fifth chapter clarifies the selection of priority focus areas in the research by using Fuzzy-AHP methodology while the sixth and seventh chapters represent the existing service provision in emergency referral and inpatient service demand management as well as the support services in the sector. In addition, the existing situation is depicted by using system dynamics. Chapter eight studies the pharmaceutical distribution by Pharmaceutical Funds and Supply Agency in Ethiopia. The concept of integrated demand management by using system dynamics and the proposal of integrated demand management model for service quality improvement for the healthcare sector are dealt in Chapter nine. The tenth chapter gives conclusions and recommendations with proposed future research works. Finally, References and Annexes are included in the last part of the research.

Chapter Two

Literature Review

All research needs to be informed by existing knowledge in a subject area. The literature review identifies and organizes the concepts in relevant literature. It distills the existing literature in a subject area and helps to summarize the state of the art in the studied subject field. From the review of earlier and recent work, it becomes possible to identify areas in which further research would be beneficial. Indeed, the concluding paragraphs of the literature review should lead seamlessly to research propositions and methodologies (Rowley, *et al.*, 2004).

In this chapter, pertinent topics are discussed in line with the study area to get basic theoretical information and knowledge to strengthen the research output. The literature review focused on; general service quality, healthcare service quality, healthcare supply chain management and previous related studies for service quality improvement in healthcare sector. As a result of the review, existing gaps which need further research are identified.

2.1 Definitions and History of Quality Concept

Quality is defined differently by different scholars. According to Revees (1994), the term "quality" has been defined as value, conformance to specifications and to requirements, excellence and meeting and/or exceeding customers' expectations. One of the most important aspects of Revees' definition is meeting or exceeding customers' expectation which is also the central idea of this study. McLaughlin (1994), states quality considerations answer varieties of questions including 'meeting or exceeding the customers' expectations'.

Approaching the definition of quality from a mathematical point of view, Choi (2001), stressed that quality 'can be quantified as the ratio of performance and expectations'. This means if the performance of the product or service is better than the expectations, then the customer has a good feeling about it. Still looking at quality from the customers' view point, Zeithaml (1990) notes services are typically produced in the presence of the customer and customers often

participates in the production process. All these ideas of various scholars show that the customer is a central component of quality.

The definitions given by different scholars were formulated at different times in history. This was illustrated by Feeney (1996). He emphasises that quality has passed through different steps starting from inspection to total quality management. During the early days of manufacturing, an operator's work was inspected and a decision made whether to accept or reject a product. As businesses became larger, so, too, did this role and full time inspection jobs were created. According to Feeney, accompanying the creation of inspection functions many problems arose such as technical problems, requirement of specialized skills and lack of skills on the part of inspectors. Developing on the ideas of Feeney, Peter elaborates the fact that these problems led to the development of the quality control department. Peter further explains that, in the 1920's, statistical theory began to be applied effectively to quality control, and, in 1924, the first sketch of a modern control chart was introduced by Shewhart. Following a step by step development, Total Quality management is now part of a much wider concept that addresses overall organizational performance and recognizes the importance of quality processes (Peter H, *et al.*, 1995).

Another aspect of quality is its significance as a factor of growth and development. According to Feigenbaum (1991), quality has been described as the single most important force leading to the economic growth of companies in international markets. As already stated, the concept of quality has been examined throughout history and continues to be a topic of intense interest today. It is presently addressed in numerous academic and trade publications, by the media, and in training seminars. It is perhaps the most frequently repeated word among managers and executives in contemporary organizations. In a recent survey, executives ranked the improvement of service and product quality as the most critical challenge facing businesses (Zeithaml, *et al.*, 1990).

Yet another aspect is that explained by McLaughlin. He indicates that quality considerations answer varieties of questions such as 'Are there defects in the product? Does the product work? Was the service appropriate? Is the treatment reliable? Was the service on time? Was it delivered

in a friendly manner? Was it the right service and was it of value? Did it meet the customers' needs? Was the customer delighted or were the product or service attributes exceed the customers' expectations? (McLaughlin, *et al.*, 1994). The answers to such questions about expectations by customers are influenced by their experiences, perceptions and values. The questions themselves, though mostly subjective, demonstrate the range of issues which quality raises.

In general, an essential building-block for theory development about quality is an understanding of numerous definitions and their origins. Different definitions of quality have been proposed at various times in response to the evolving and constantly changing demands of business. New definitions have not replaced old definitions; rather, all of the quality definitions continue to be used today. No one definition of quality is "best" in every situation because each definition has both strengths and weaknesses in relation to criteria such as measurement and generalization, managerial usefulness and customer relevance (Rogelio, *et al.*, 2001).

2.2 Dimensions of Quality

Some generalizations about quality suggest certain dimensions of quality. There are eight basic dimensions of quality of products, namely, 1. performance (Will the product do the intended job?), 2. feature (What does the product do?), 3. reliability (How often does the product fail?), 4. conformance (Is the product made exactly as the designer intended it?), 5. Durability (how long does the product last before replacement?) 6. serviceability (How easy is it to repair a product, speed of repairs, courtesy and competence of repair person?), 7. aesthetics (What does the product look like?) and 8. perceived quality (What is the reputation of the company or its product?) and recently, the concept of 9. environmental friendly is added as a ninth dimension. Service quality consists of five dimensions: 1, tangibles (Appearance of physical facilities, equipment, personnel and written materials), 2, reliability (Ability to perform the promised service dependably and accurately), 3. responsiveness (Willingness to help customers and provide prompt service), 4. assurance (Knowledge and courtesy of employees and their ability to inspire trust and confidence), and 5. empathy (Caring and individual attention that the firm provides to its customers). Reliability is considered as the vital core of service quality. Other

dimensions will matter to customers only if a service is reliable, because those dimensions cannot compensate for unreliable service delivery (Berry, *et al.*, 1994).

It is common knowledge that, with the conversion of the world into a global village, more dimensions of quality are unfurling and forcing organizations to work on these to survive in business. Some of the emerging dimensions are human values corporate social responsibility, corporate governance, inclusive growth, sustainability and harmony. Quality management has thus changed from being reactive to being preventive, while moving from inspection to statistical quality control, to quality assurance, to total quality management, and to business excellence models. Its focus is gradually shifting from the final product to daily tasks and processes. Also, with the addition of ethical, social and environmental aspects, a global perspective of the organization is emerging, with increasing integration of various aspects of quality through business excellence models. The objectives and core values of most of the Business Excellence Models (BEMs) are similar, and focus on enhancing the global competitiveness of companies of their respective countries (Talwar, 2009).

2. 3 Quality in Manufacturing and Service Sectors

Donabedian states that over the past four decades preceding 1990, numerous scientists have attempted to define either in a narrow or broad sense what a service actually is. However, no single universal definition has been established due to different perspectives Nowadays, the quality concept is becoming useful in both manufacturing and service industries (Donabedian, 1988).

Currently, studies are focusing on standardizing the processes in different activities of manufacturing and service giving industries. This can be justified by the consistent trial of companies to be certified and the focus of service areas towards implementation of business process re-engineering to help them improve their service quality and responsiveness. Though this is a good beginning for a radical change of quality and productivity of companies, it needs a study that leads towards continual improvement. Thus, the current state of activities of companies implies that there is a great need of devising a mechanism for the continuation of the change that has been started.

Service sectors include healthcare, education centres, communication and mailing sectors and a host of many others. Research in service quality has gained much prominence in recent years but its nature of intangibility makes it extremely difficult to define and measure. It leads to different interpretations by various stakeholders. The definition of quality in all these sectors is different but centrally focuses on having a satisfied customer.

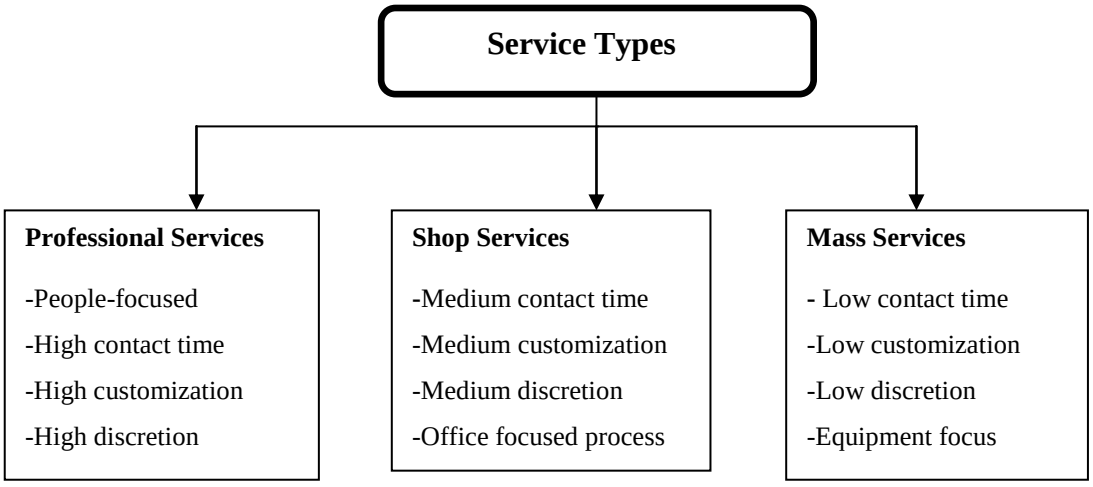
Service organizations generate value through the delivery of intangible services, which are difficult to describe to new customers. It is likewise difficult for customers to express precisely what they expect from the service. Because there is no agreed objective standard about the service to be delivered, the only criteria available to evaluate service quality are subjective comparisons of customers' expectations to their perception of the actual service delivered (Zeithaml, *et al.*, 1990). Furthermore, customers do not evaluate service quality solely in terms of the outcome of the interaction; they also consider the process of service delivery. Service quality, a multidimensional concept encompassing all aspects of service delivery, is difficult to assess and communicate. Second, services, as already indicated above, are typically produced in the presence of the customer, and customers often participate in the production process. The simultaneous provision and consumption of services bring employees and customers physically, organizationally, and psychologically close, blurring the boundary between employees and consumers and enabling each to influence the other's perceptions and expectations (Rogelio, *et al.*, 2001).

Product quality differs from service quality by the fact that quality usually includes features, performance, defects, etc. But service quality includes delivery time, knowledge of delivery personnel, etc. Thus, service quality focuses more on the responsiveness and is the cumulative effect on subscriber satisfaction of all imperfections affecting the service. It includes the application and the human factor in the assessment, and demands an appropriate weighting of diverse objective measures, while product quality focuses more in defect prevention relative to service quality.

In an effort to classify and bring mental ordering across the broad range of service industries, academics develop service typologies. The purpose of such typologies is to address the

complexities of services by developing service criteria that reflect core service aspects that go beyond narrow industry boundaries.

Service typologies, therefore, assist practitioners in developing meaningful strategies for particular service contexts while giving researchers a foundation for developing theories within a specific service classification. The service typology forwarded by Silvestro *et al.* (1992) categorizes services into three categories, namely professional services, service shops, and mass services as shown in Figure 2.1.

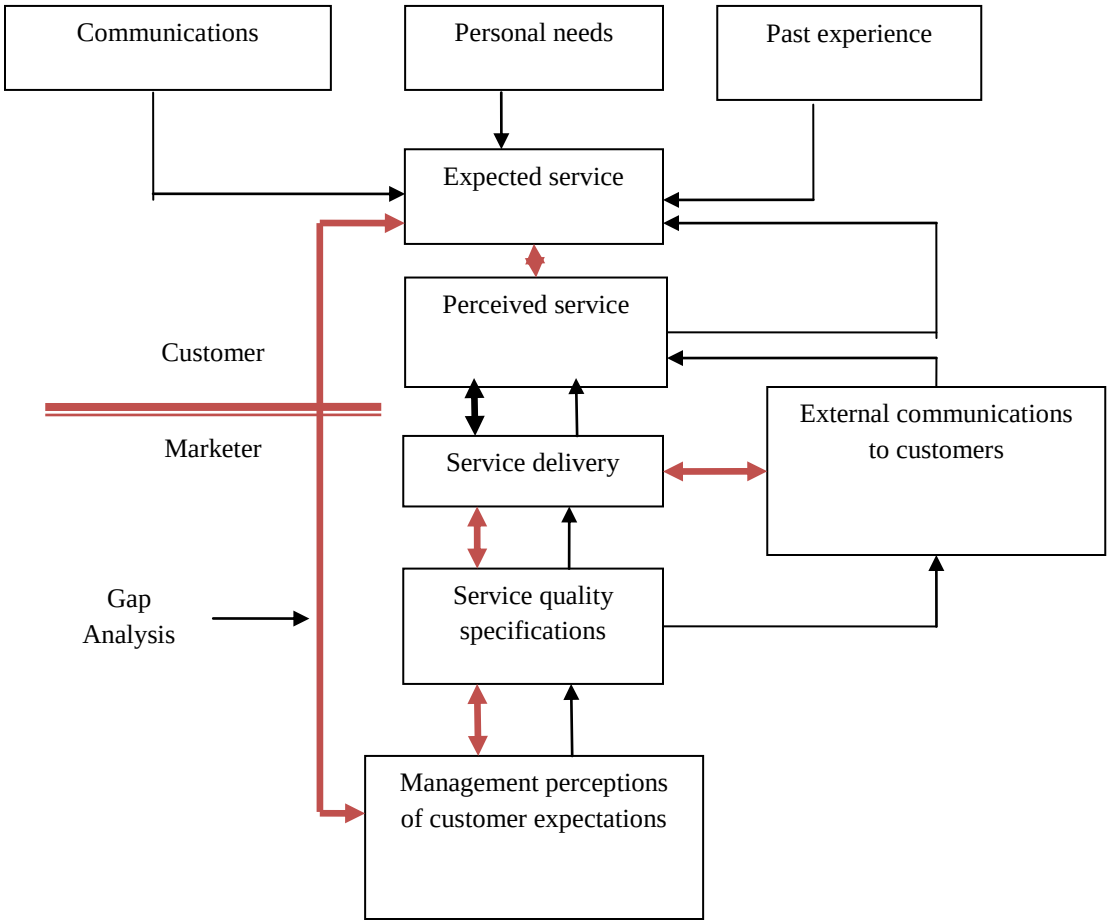


Source: Silvestro, 1992
Figure 2.1 Types of Services

2.4 Service Quality Models

During the past few decades, service quality has become a major area of attention to practitioners, managers and researchers owing to its strong impact on business performance, lower costs; customer loyalty and profitability (Lasser, *et al.*, 2000). There are different service quality models. They include : technical and functional; quality model, gap model, attribute service quality model, synthesized model of service quality, performance only- model, ideal value model, evaluated performance quality model, etc. All the models have different implications and quality improvement aspects. But in many application areas, the conceptual

model of service quality (Parasuraman, *et al.*, 1985) or the gap model is commonly accepted by many researchers and used in practical application.



Source: Parasuraman, *et al*., 1985
Figure 2.2 Conceptual model of service quality

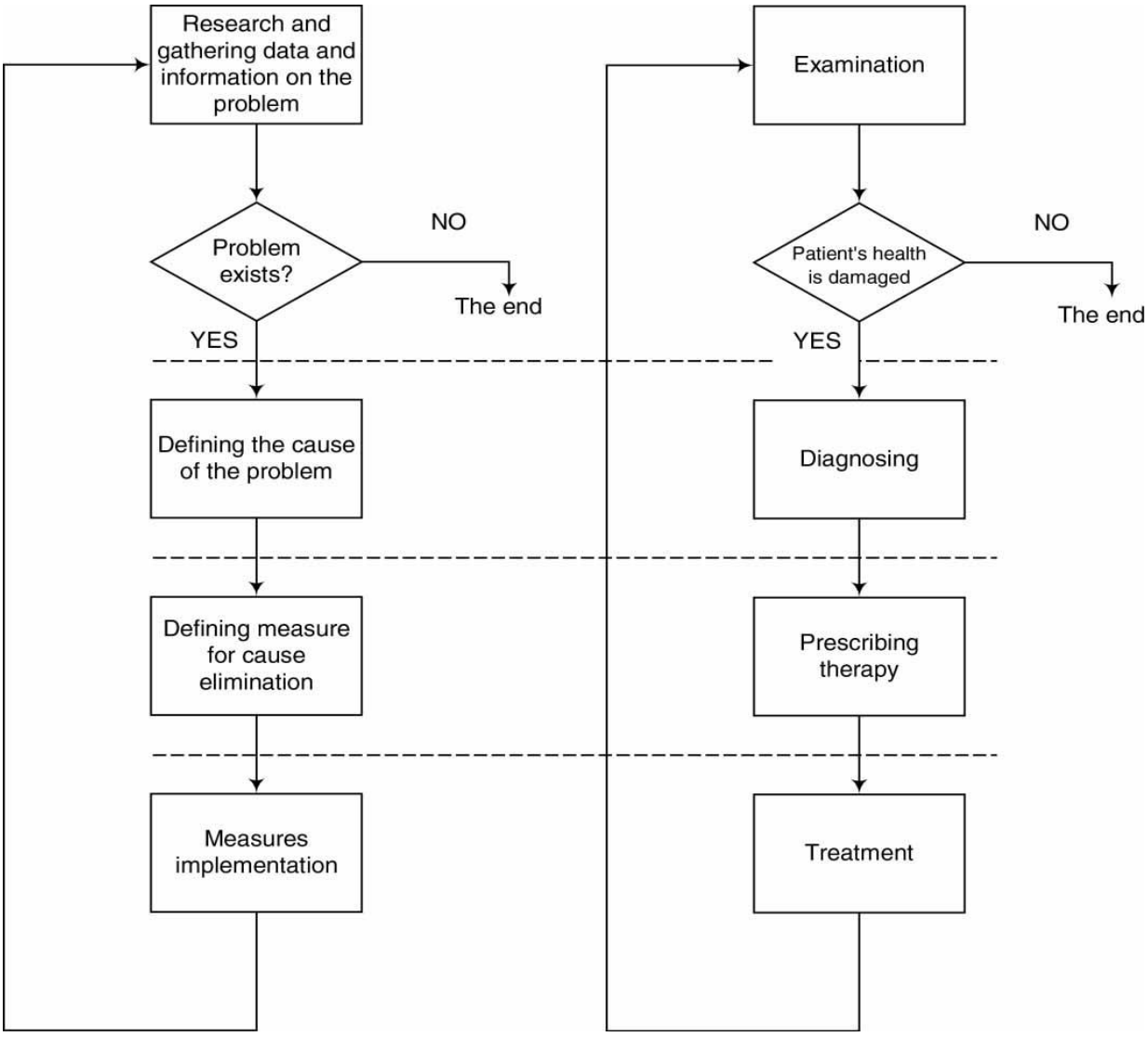
2.5 Quality in Healthcare

The healthcare industry is an integral and inseparable part of every society and every country. It consists of organizations, people and actions whose primary intent is to promote, restore or maintain health. According to government industry classifications mostly based on the United Nations system (World Health Organization and United Nations Children's Fund, 1978) and the

International Standard Industrial Classification (United Nations Statistics Division, 2001), health care generally consists of hospital, medical and dental practice, and other human health activities. These activities are conducted within the healthcare organizations. The activities could be delivered depending on the type of services (primary, secondary and tertiary) and the available facilities in hospitals such as equipment, human resource, pharmaceutical etc. (WHO, 2007).

Quality in health is defined as 'doing the right thing, the first time, in the right way, and at the right time. The *Framework for Managing the Quality of Health Services in* NSW (University of New South Wales), provides the structure for Area Health Services and clinicians to effectively govern the quality of care and to ensure that the clinical care and services provided are safe, effective, appropriate, consumer focused, accessible and efficient. The framework challenges health care organizations, clinicians and managers to undertake rigorous evaluation of processes and outcomes of services in a manner that is transparent and leads to sustained improvement.

Historically, quality departments have been an important part of hospitals since the 1950s, but only recently; Quality Management theory transformed the role of these departments, renewed their original quality mandate, and empowered them to logically restructure fundamental hospital processes to produce better quality. Hospitals have historically modeled quality according to a systems paradigm, but only recently have been able to benefit from benchmarking important new management theory from other industries. As a result, the rate of adoption of quality management within healthcare has been almost uniform in every state and even the smallest hospitals. The common flow of activities in healthcare is represented in Figure 2.3.



Source: Zivaljevic, *et al.*, 2011
Figure 2.3.The path in healthcare service classification

2.6 Supply Chain in HealthCare

During the last four decades, the focus within industrial companies has gradually shifted from a strong orientation on individual processes towards a chain orientation (Samuel, *et al.*, 2010). Supply chain (SC) is an integral part of providing quality care to the patient in the healthcare

system. SC refers to a set of organizations directly linked by one or more of the upstream and downstream flows of products, services, finances, and information from a source to a customer.

In recent years, Supply Chain Management (SCM) has drawn significant attention in the healthcare industry, since SCM shows a significant impact on hospital performance in terms of reducing waste, preventing medical errors, improving quality of care and service, then increasing operational efficiencies. SCM in hospitals include the internal chain (e.g. patient care unit, hospital storage, patients' flow, etc.) and the external chain (e.g. vendors, manufacturers, distributors, etc.). A hospital receives products and services from suppliers and stores and distributes them to each care unit based on the hospital's operation processes. Therefore, SCM includes business activities (e.g. purchasing, distribution and management of suppliers) and operations that integrate a continuous, seamless flow of materials and services for healthcare delivery. Healthcare SCM processes have three types of flows: "physical product, information, and finance." The physical product flow manages customized products and services for the treatment of patients and their needs. Information and financial flows are related to SC design decisions for effective product flow and improved organizational performance (Singh *et al.*, 2006).

Currently, health care has become one of the critical issues in the world along with the increased concerns for medical errors, patient safety, and spiraling of medical costs. Also, in today's intensively competitive global market, effective SCM plays a critical role in improving organizational performance and competitive advantage. The competitive environment requires organizations to provide high quality products and services, deliver rapid service response, and develop dynamic capabilities that are congruent with the rapidly changing business environment. Accordingly, organizations strive for efficient operations such as value-added process improvement, reduction of delivery costs, and improved quality of products and services while maintaining close cooperation with their suppliers.

Many researchers have stressed the importance of effective SCM in the healthcare Industry. Healthcare service involves comprehensive and complex systems that treat and prevent diseases

including medical consumables, laundry and cleaning, medical exercise equipment, home-care products, information systems, wheelchairs, vehicle fleet management, and general materials. For effective SCM, organizations need to innovate their business processes while considering their suppliers' processes.

Within the healthcare industry, the supply chain associated with pharmaceutical products is critical in ensuring a high standard of care for patients and providing adequate supplies of medication for pharmacies. In terms of cost, it is estimated that supply accounts for 25-30 percent of operational costs for hospitals. Therefore, it is essential that this is managed effectively in a way that both services and cost objectives are met (Lee, 2004).

2.7 Demand Management in Healthcare

Response to demand uncertainty in the field of healthcare services is a very timely research issue because of ongoing changes in demand patterns that are driven by demographics and recent changes in the delivery of these services (Powers, *et al.*, 2009). Long waiting time is a major concern in many healthcare settings and this is making admissions to be lengthy, and progress through the system to be slow.

One comparably new Supply Chain Management dimension that has become increasingly popular in industry, but has not yet been extensively analyzed in academic literature with respect to its impact on supply chain performance, is demand management (DM). In its broadest sense, DM can be interpreted as the ability of a company to understand customer demand and requirements and balance them against the capabilities of the supply chain. Traditionally, DM has been understood as "demand forecasting". A number of new practices have been identified that constitute the DM dimension. Examples of such practices include customer and product segmentation as well as integrated sales and operations planning (Rexhausen, *et al.*, 2012).

Demand management is also a supplement of the distribution management, the purpose of which is to deliver goods to the final consumer "client" according to the conditions of time, quality and

lowest cost. The results showed that there is significant relationship between demand management and performance of supply chain management. Thus, based on this, it was achieved to examine factors affecting performance of demand management such as forecasting, segmenting, sales and operations planning and management support by the researcher. There are also significant positive relationships between forecasting and performance of demand management (Mansuri, *et al.*, 2013).

Demand management can be conceptualised as the process of identifying where, how and why people demand healthcare and the best methods of curtailing, coping with or creating this demand; such as the most cost-effective, appropriate and equitable healthcare system (Georgios and Dimitris, 2004).

According to Georgios and Dimitris, (2004) various demand management strategies have been developed for: The market itself, the consumer, the disease management and the efficient alignment of supply and demand.

1. **Market mechanisms**: in health policy accept that demand management is as important as supply management and ensure regulatory efforts seek to better align supply and demand. Among the proposed regulatory efforts are: (a) Consumer co-payments: Healthcare is purchased like any other commodity either directly or indirectly through insurance. The consumer co-pays a portion of the fees. (b) Parallel market : The rationale for a parallel private market to the public healthcare system is a culture supporting individual responsibility. (c) User fees: Specific market incentives discourage use of specific points of the care system (an example would be the introduction of a fee to discourage emergency room visits). (d) Managed care: Demand management strategies include managed competition with a variety of approaches including third party management of providers (effective reinforcement of treatment guidelines to reduce cost), staff-model HMOs (contracts with group of physicians for the provision of care) and risk-bearing gatekeeper models (primary care physicians reduce the cost by controlling referrals and prescriptions).

2. **Consumer mechanisms**: in demand management require that the patients (users) and citizens (potential users) exert pressure on the system with the services they demand. That demand may be derived from a need or from a want. In fact, there is an association between the health of a specific population and the socio-demographic correlates of health. Studies have identified gradients in mortality, disease, self-reported health and other health measures with different levels of education, social status, income, employment and other socio-economic variables. Interventions from an early age (infant nutrition, parental smoking prevention, etc) have been shown to have an impact on both health outcomes in childhood and in the long-term prevention of adult-onset diseases.

3. **Disease management**: is a way of systematising the prevention of and early intervention in chronic diseases. It is defined as the 'systematic, population-based approach to identify persons at risk, intervene with specific programs of care, and measure clinical and other variables'. These programmes, often sponsored by pharmaceutical companies, are designed to improve both the quality and outcome of care and the efficiency and effectiveness of healthcare delivery.

4. **Efficient alignment of supply and demand**: suggests that demand is modified so that the health needs of the European citizens are best served with available resources. Among the strategies developed are the introduction of Telemedicine, the introduction of nationwide homecare programmes and the introduction of performance measurements for ensuring public accountability and transparency.

It becomes obvious that knowledge will play an essential role in determining the success of any demand management strategy. Integrated knowledge of the society (such as their fears and expectations), evidence from valid, relevant and accessible research and current knowledge on available facilities and resources will provide the backbone of the society demand management strategy. Studies conducted in the field of demand management in the supply chain generally are insignificant and many existing studies are only related to the "supply chain". However, in the research undertaken for this dissertation the emphasis is on demand management.

2.8 System Representation and Analysis Tools in Healthcare

For a better analysis, systematic representation of the work to be studied is necessary. For for such representations,system indicative and representative tools are highly needed. In this research, process flow analysis is used to indicate the flow of the patients in hospitals. The conditions of uncertainity in the sector and weights for decision-making are also represented by using (analytic hierarchical planning) AHP and Fuzzy representations to consider the uncertainities. Finally system dynamics with stock and flow is used to see the change of the behaviour in the whole system. Therefore, the three tools are discussed in the next sections.

2.8.1 Process Flow Analysis in Healthcare

In a health care environment, the focal activity of the process is the patient flow. Patient flow can be described by two complementary approaches: clinical and operational. Regardless of approach, all patient flows share four common characteristics: an entrance, an exit, a path connecting the entrance to the exit, and the random nature of the health care elements. Obviously, patient flow begins at a point when a patient is first diagnosed with a particular medical condition, or at a place where the patient first entered or is admitted to a health care facility. Likewise, after the medical condition has run its course, or the patient is discharged from a healthcare centre are signals of the existance of a patient flow. Between these two points is a set of conditions, activities, services, or locations that the patient may encounter. Within these points, the patient requires a variety of healthcare resources e.g., beds, examining rooms, physicians, nurses, or medical procedures. Thus, process flow analysis clearly shows the flows and steps followed in healthcare. This implies that patient flow can be depicted as a network (Murray, 2000). Using a similar pattern, patient flow in case of emergency services can be represented by process flow starting from the point of calling to service centres to get an emergency service. The referral and inpatient cases service can also be traced in the same way including the pharmaceutical products distribution from hubs to pharmacies of hospitals.

2.8.2 Fuzzy-AHP

In many practical cases, the linguistic assessment of human feelings and perceptions are vague and it is not reasonable to represent it in terms of precise numbers. It feels more confident to give interval judgments than fixed value judgments. Customer needs are different in nature and difficult to understand. Especially in case of healthcare services, the need and service types given to patients are different and create complexity as well as vagueness for tracing.

In order to act on such vague human thoughts, Zadeh (1965) first introduced the fuzzy set theory, which was oriented to the rationality of uncertainty due to imprecision or vagueness. A major contribution of fuzzy set theory is its capability of representing vague data. The theory also allows mathematical operators and programming to apply to the fuzzy domain. A fuzzy set is a class of objects with a continuum of grades of membership (Kahraman, *et al*., 2003). In addition, AHP (analytic hierarchy process), (multiple criteria decision making)MCDM theory proposed by Saaty (1989), is applied in the service quality measurement process. Thus, the case of fuzzy extended AHP approach adequately handles the uncertainty of the human preferences: this method is more desirable and helpful for evaluation. The fuzzy extended AHP methodology extends Saaty's AHP by combining it with the fuzzy set theory pioneered by Zadeh (1965) (Buyukozkan, *et al.*, 2011). In this research, Fuzzy-AHP is used to prioritize improvement needs of the healthcare sector.

2.8.3 System Dynamics

Health care is the fastest growing service in both developed and developing countries. The primary goal of healthcare is to offer services to people that help to improve the quality and health of their daily lives. Patients are the primary focus of healthcare systems (Dey, *et al.*, 2006).

Health care is a complex system of systems and includes elements that interact in highly intricate and variable ways. There are various stakeholders in healthcare. The quantity of the stakeholders is also increasing. This drives complexity in healthcare. The primary stakeholders

in healthcare include patients, physicians, nurses, hospitals, healthcare organizations, pharmacies, government regulatorygroups, licensing and funding agencies, and insurance companies. The World Health Organization emphasizes the importance of comprehending complexity in healthcare (Faezipour, *et al*., 2013).

Health care organizations function in a complex, non-integrated setting, yet the coordination of information, tasks, and equipment across multiple units is essential for productive operations (Konrad, *et al.*, 2009). Patient flow is the progression of activities a patient undergoes through the hospital. Flow information provides better matching of hospital resources to fluctuating demand levels and reduces ambulance diversions (Cameron, *et al*., 2002; Fatovich, *et al.*, 2005, and Schull, *et al.*, 2003) reduces periods of under and overstaffing.

System dynamics helps individuals to understand the dynamic behavior of complex systems. This method was developed by Forrester in 1961. The major feedback mechanisms of a model are captured by causal diagrams. Elements (factors) and arrows (causal links) are included in a causal diagram. Each link is assigned a sign (either + or -) which represents an increasing or decreasing relationship between the factors. The relationship between factors may have various time delays. However, the time delay is not normally shown in a causal model. A logical next step following a causal model is to develop a simulator that represents the causal model factors and relationships. The simulator would contain a quantification of the factors and relationships.

System dynamics modeling can help individuals to betterunderstand the healthcare system and its factors and relationships. This method can also be utilized to comprehend sustainability considerations. System dynamics can help individuals realize the effect of changes. This approach can also help individuals make better decisions related to healthcare systems and sustainability challenges (Faezipour, *et al.*, 2013). In this research, system dynamics is used to represent the patient flow through different levels of healthcare services by using the stock- flow diagram and the causal relationships.

2.9 Quality Improvement Models and Approaches in Healthcare

Towards quality improvement, different studies have been previously conducted as discussed in this section of the dissertation, review of the efforts made to improve quality of healthcare by assessing the existing healthcare quality improvement models are done to approach alternative directions for future research in the area. Service quality improvement approaches in healthcare and the existing models of quality improvement are reviewed from published research papers of different international journals. Totally, 38 articles were reviewed only in this section case and based on the relevance with the research topic, 15 articles were screened out for further examination and analysis of their contents. In the literature survey, different approaches of quality improvement in healthcare were reviewed. The focus of most of the approaches was on a holistic way of improvement. Accordingly, general improvement models were provided to enhance quality in healthcare. This is a good input for improvement. But the need of an explicit focus on major activities in the sector were identified as a gap such as: healthcare demand management, supply chain management, emergency, referral and inpatient demand management, pharmaceutical products supply chain management in healthcare and others need further study as they help in bringing better and focused quality improvement in the sector than following a general approach.

2.9.1 Literature Review Approach on Quality Improvement Models

To meet the aim of this study, literatures have been reviewed from different well-known international journals. The detail content of the articles regarding the healthcare quality improvement approaches and the models used for the improvement were critically assessed, analyzed and summarized. Among various literature survey methods, content analysis is selected. Content analysis is a research method for systematic, qualitative and quantitative description of the manifest content of literature in an area. In this study, this method is used as it is found to be relevant to clearly understand the output of the improvement activities done up to now to improve quality in healthcare (Marasco, 2008). The search includes two steps; definition of sources and procedures for the search of articles to be analyzed and definition of categories

instrumental to the classification of the collected articles. Based on this approach, review of the content of the referred articles was assessed accordingly as discussed in the next section.

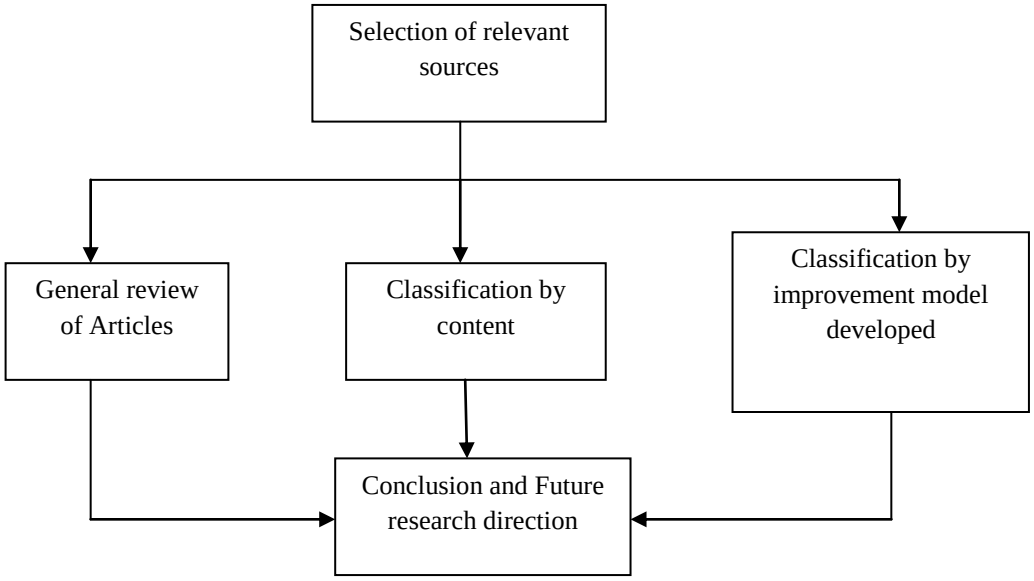
2.9.2 Definition of Sources and Selection of Articles

The first step of the analysis consisted of searching for articles relevant to the purpose of the study and the search was limited to academic journals. The articles were gathered from well-known websites such as: Emerald, Elsevier, Taylor and Francis and IEEE. Majority of the articles for this study were collected from Emerald. Key words "healthcare Quality" and "Quality Improvement Models" which are mostly related with quality improvement activities in healthcare were used to gather related articles. The reviewed articles are those published between 2004-2012. Though there are high numbers of published articles in the international journals related to quality improvement in healthcare, the focus of this study is entirely on the models and approaches adopted in healthcare quality improvement process. As a result of the search, 38 related articles were found. By scanning further through reading the full text of the articles to eliminate those articles that are not strongly related to the study, 15 articles were found to be more relevant to the survey. The relevancy of the articles was checked by their purpose, by their findings and by their concluding remarks with provided models for quality improvement in healthcare. Thus, the most related titles and contents were chosen for further analysis. The analysis includes an in depth exploration of the purpose, the findings and models developed for quality improvement in the sector.

2.9.3 Definition of the Content Classification and Models

As a major means of refining the articles, the overall content of the articles and the quality improvement models developed as a result of the articles are critically assessed. For further explanation, the method used for the study is critically studied and finally the result achieved by the study is analyzed. In the selection of relevant resources, the search was limited to academic journals. In the general review of articles, the overall content of the articles was revised to help in screening out the most relevant materials. In the classification by content, the overall content of the selected articles was assessed and categorized into four related areas. In the classification

by improvement model developed, the reviewed articles were classified into seven core areas. Finally, a concluding remark and a direction for further study is given based on the analysis from the above discussion which is represented in Figure 2.4. By this process, the following fifteen articles are found to be more related to the existing research the overall content is represented in



Source: Author's classification
Figure 2.4 Analysis approach of the selected articles

2.9.4 Articles on Quality Improvement Approaches in Healthcare

Different quality improvement activities have been applied in healthcare sectors with a variety of approaches having the same focus area which is improving the service provision in the sector. Among the high number of the studies in this area, the most related studies with quality improvement and model development in healthcare sector are reviewed and shown in table 2.1. The order of representation of the studies is from the studies published previously up to the recent one.

Table.2.1 Selected articles for a detail content analysis

No.	Author	Title	Purpose	Method	Result
1	Huseyin Arasli and Lillia Ahmadeva (2004)	No more tears! A local TQM formula for health promotion	To show the way that public and private hospitals function, and answer the question of how to increase total quality using public opinion in the healthcare industry in developing countries	Qualitative and quantitative data were collected through interview and questionnaires, ANOVA and SPSS were used for data analysis.	A new quality improvement model incorporating seven factors of patient satisfaction in new dimension was proposed to implement TQM with continuous preventive actions.
2	R.Nat Natarajan (2006)	Transferring best practices to healthcare: opportunities and challenges	To analyze the opportunities and challenges in the healthcare sector for learning and transferring from other sectors the concepts, best practices, and tools for improving quality, safety and productivity.	Assessment on 21healthcare sectors was taken on the various approaches of quality improvement in healthcare and application obstacles.	Among the various approaches of improving quality applied in industries and in healthcare, more attention should be given to avoid internal obstacles as the characteristics of healthcare can promote or hinder the implementation.

3	Prasanta Kumar Dey, Seetharaman Hariharan, St Augustine, Trinidad) (2006)	Integrated approach to healthcare quality management	To develop an integrated quality management model, which identifies problems, suggests solutions, develops a framework for implementation and helps to evaluate performance of health care services dynamically.	Uses Logical Framework Analysis (LFA), a matrix approach to project planning for managing quality by developing integrated QI model.	The study came up with a conclusion of LFA is an effective method of quality management of hospital-based healthcare services
4	Charles R. Gowen III, Kathleen L. McFadden, Jenny M. Hoobler, William J. Tallond (2006)	Exploring the efficacy of healthcare quality practices, employee commitment, and employee control	To examine healthcare quality program practices, employee commitment and control initiatives, and perceived results by surveying hospital's quality programs.	By surveying sample the hospital's quality programs	Quantitative and qualitative quality Program results are highly related to employee commitment and control initiatives than they are related to quality practices.
5	Jafar Alavi, Mahmoud M. Yasin (2008)	The role of quality improvement initiatives in healthcare operational environments	To shed some light on the utilization of quality improvement initiatives in healthcare operational environments.	A literature survey-based research methodology is utilized in this study	The studied organizations have achieved both operational and strategic benefits due to the effective implementation of quality improvement initiatives

6	Ann Scheck McAlearney (2008)	Using Leadership Development Programs to Improve Quality and Efficiency in Healthcare	To assess opportunities that might exist to use leadership Development programs to improve quality and efficiency	Uses data from three qualitative studies of leadership development in healthcare with Interviews from 200 individuals conducted between September 2003 and December 2007 with hospital and health system managers.	The analysis showed that Leadership development programs provide Important opportunities to improve quality and efficiency in healthcare.
7	Drew Helmer, ,Usha, Sambamoorthi ,Yujing Shen, Chin-Lin Tseng Mangala Rajan , Anjali Tiwari, , Miriam Maney ,Leonard Pogach (2008)	Opting out of an integrated healthcare system: Dual-system use is associated with poorer glycemic control in veterans with diabetes	To test for an association between quality of care and patient choice to obtain care Outside an integrated healthcare delivery system.	Administrative data to define dual-system use (Veterans Health Administration (VHA) and Medicare) for VHA users with diabetes over 65 years old.	Dual-system use was associated with higher values, suggesting that veterans who chose to receive care outside the integrated VHA may have worse intermediate clinical outcomes than those who received care exclusively within the system.
8	Denis R. Towill (2009)	Enabling effective change in healthcare delivery systems	To provide health leaders with a clear unambiguous description of a proven modus operandi (way of doing) for analysis, design, planning, implementation, and start-up of effective and efficient healthcare delivery systems.	A survey in different companies was taken to assess the existing quality improvement activities.	Taking a holistic approach of problem solving & use of PDCA for better healthcare delivery was recommended

9	Siti Norsazlina Haron,Md Yusof Hamid Anuar Talib (2010)	Towards Healthcare Service Quality: An Understanding of the Usability Concept in Healthcare Design	To review the literature on "usability concept" in built environment and healthcare design, and suggest a possible conceptual framework in achieving quality service by focusing: efficiency, effectiveness and user's satisfaction.	19 previous studies were reviewed focusing on usability studies of healthcare design and on user satisfaction in hospital service.	Focus on efficiency, effectiveness and user's satisfaction (usability) is useful in improving outpatient area service outcome, which is more valuable to the end users.
10	Sameer Kumar, Neha S. Ghildayal, Ronak N. Shah(2011)	Examining quality and efficiency of the US healthcare system	To offer insights on quality reformation efforts, contemporary healthcare policy and a forthcoming change in healthcare quality improvement.	Process maps, cause and effect diagrams and descriptive data statistics are used to understand the existing situation in the system.	Major drivers of the healthcare costs are identified and application of IT was recommended as a way of supporting the improvement efforts and minimizing costs.
11	Col Abhijit Chakravarty (2011)	Evaluation of service quality of hospital outpatient department services	To ascertain any service gap between consumer expectations and perceptions in respect of the hospital outpatient department (OPD) services.	A cross-sectional study was conducted using SERVQUAL as a survey instrument, the instrument being validated for use in the hospital environment. Consumer ratings across 22 items of the survey instrument were collected in paired expectation and perception scores and then service quality gaps were identified and statistically analyzed.	Service quality gaps were identified to exist across all the five dimensions of the survey instrument, with statistically significant gaps across the dimensions of 'tangibles' and 'responsiveness
12	S.Rakich, Jonathon (2012)	Continuous quality Improvement in healthcare Modus	To provide appropriate improvement in healthcare from the two contemporary	Theoretical assessment of implementing BPR and CQI was done.	CQI is likely to remain the dominant approach to QI in healthcare service organizations

		Operandi	approaches(BPR or CQI)		
13	Eriksson H, Bergbrat M, Berrum L,Morock B(2012)	Reducing queues: demand and capacity variations	To investigate how waiting lists or queues could be reduced without adding more resources; and to describe what factors sustain reduced waiting times.	Cases were selected according to successful and sustained queue reduction.	As a result, a guide line for each activities and continuous measure of the key factors was provided as a recommendation to reduce queue.
14	Andreea- Oana Iacobuta (2012)	Patients' evaluation of access and quality of healthcare in EU countries.	Aims at providing an assessment of access and quality of healthcare in EU countries from a bottom up perspective.	Two indicators were used to analyze quality of healthcare system; the percent of positive evaluation for the overall quality of healthcare and health Consumer index were used.	The results show that citizens of developed countries have a positive opinion about quality of healthcare in their country while patients from developing countries evaluate it rather negatively.
15	Abdulaziz A. Saddique(2012)	Development of Clinical Pharmacy services at King Khalid University Hospital and its impact on the quality of healthcare provided	To evaluate the impact of clinical pharmacy programs on the patients' care as well as its perception by the Medical staff that came from different parts of the world.	Data were collected by involving Seven Clinical Pharmacists and two Clinical Pharmacy residents in the data collection for the study over a three month period and analyzed in order to assess the merit of the action in terms of the therapeutic, financial and direct cost impact	The study showed a positive impact on the patients' care as well as on the economy of the drugs prescribed. Meanwhile, the service was very much appreciated by the Medical staff as well as other healthcare providers.

2.10 Summary of the Reviewed Articles

The reviewed study types are case studies, literature reviews, view points, concept papers and general reviews collected from different websites mentioned in the methodology. The analysis and discussion of the articles is carried out based on their context, the structures and methods used for the study, and the outputs of quality improvements and models.

2.10.1 Summary of the articles based on their context

Based on the overall context of each study, the reviewed articles can be categorized into four groups as represented in Table 2.2.

Table 2.2 Summary of the selected articles based on their context

Articles by Authors	**Purpose of the articles**
Huseyin, *et al.*, (2004), Dey, *et al.*, (2006) ,Towill, (2009), Chakravarty,(2011) S.Rakich, (2012), and Eriksson, *et al.*, (2012)	To improve the internal system's quality in healthcare under the light of TQM,BPR and CQI to help in reducing waiting time
Natarajan,(2006), Alavi, *et al.*,(2008), McAlearney,(2008) and (Oana,2012)	To Analyze opportunities and challenges of healthcare quality improvement and to assess access and quality of healthcare in EU countries.
Gowen, *et.al.*,(2006), Helmer, *et.al.*,(2008),Kumar ,*et.al.* ,(2011), and Saddique,(2012)	To Examine impact of quality in healthcare service and on other stakeholders to examine healthcare quality program practices and to test association between quality of care and patients' choice
(Haron, *et.al.*, 2010)	To Revise literatures on the efficiency of service and customer satisfaction in healthcare.

Thus, the contexts of the reviewed articles can be generalized into four categories as:

- ✓ Improving quality of healthcare in general.
- ✓ Analyzing opportunities and challenges of healthcare quality improvement.
- ✓ Examining impact of quality in healthcare service and on other stakeholders.
- ✓ Revising literatures on the efficiency of service and customer satisfaction in healthcare.

2.10.2 Summary of the Articles Based on the Structure and Method

In the reviewed articles, the common methods followed to gather and analyze data were questionnaire survey, theoretical assessments of basic quality improvement concepts, case study, use of SERVQAL, survey of previous studies, use of process map, cause effect analysis and descriptive statistics in the proportion shown in Table 2.3. Similarly, it is clearly understood from the methods used for these studies that the methods guide to tracing the general condition in service delivery of the sector which can only come up with a general result. More or less, the internal structure of the reviewed areas was also deeply studied.

Table 2.3. Summary of the methods used in the selected articles

Method used	**Number of articles**
Literature survey	5
Case study	7
Process map	1
Logical framework analysis	1
Analysis of opportunities and challenges	1

2.10.3 Summary of the Articles based on Outputs of Quality Improvement and Models

From the selected 15 articles, different analysis and discussion points have been raised regarding service quality improvement in healthcare starting from a general conclusion of better improvement needs to suggestion of specific improvement models as shown in table 4 below.

Table 2.4. Results and models developed from the selected articles

Result	**Number of articles**
Development of holistic continuous quality improvement model	4
Use of Plan, Do, Check ,Act (PDCA)	1
Use of Process map	1
Identification of service gap	1
Application of IT(Information Technology)	1
Provision of a guideline for each activity	1
General conclusion about better improvement needs in the sector	6

Generally, the first four articles have come out with a quality improvelment model which can be applied in a holistic manner. These models were inclusive type and do not clearly show which specific activity should be modified in the whole activities of the service delivery in the hospital. Five articles come out with provision of a guideline for each activity, the need of application of IT, identification of service gap, process map and use of PDCA. These five outcomes are similarly of a general type of IT implementation to the whole healthcare . It doesn't prioritize the area which benefits more from IT for a holistic service gap identification in the system and doesn't identify specific area for futrther study. The last six articles have come up with a conclusion for the need of better improvement in the sector which can be clearly understood from the context of the sector.

2.10.4 Summary of the Quality Improvement Models

From the above literature survey on quality improvement models and approaches, it can be concluded that different studies have been done to improve service quality in healthcare by considering that quality cannot be compromised especially in this sector. Most of the studies focused on a general approach of improving service quality for better customer satisfaction. In addition, the reviewed studies focused more on minimizing the service provision time by following a holistic problem solving approach. Thus, from the result of the analysis and disscussion, it can be concluded that results in the previous studies have a holistic nature of improving the service quality in the sector. But, study on explicit healthcare quality issues such as, demand management, supply chain management, integrated demand management, referral system management in healthcare, pharmaceutical distribution and others, which are more influencial in service quality improvement for the sector are not given due attention in the reviewed literature. Hence, further investigation is needed to improve quality in healthcare by focusing on the mensioned issues especially on the demand management which is not previously given thorough attention.

2.11 Summary

In the literature survey discussed from section 2.1 to section 2.10, the concept of quality in manufacturing, in service and specially in healthcare sector have been studied. The concept of supply chain is also assessed. Demanad management in healthcare and the system representation tools in healthcare are also dealt. In the system representation tools, the fuzzy-ahp and system dynamics with the aid of flow charts are seen. The approaches for quality improvement in healthcare were also assessed by focusing on the tools and models used for the improvement. As it is summarized in section 2.10, the reviewed articles are categorized based on their context, the purpose of the study, the model used for improvement and the result of the study. In the summarized study, general quality improvement and the use of PDCA for quality improvement in healthcare are focused. But, the concept of improving demand management in health care in a better way by using system indicative tools for an ease of understanding the overall prons and cons in healthcare are not given due attention.

This research focused on how to improve the demand management and the supply chain management issues in healthcare by focusing on the chain of service activities in a single sysem using system dynamics. Such representations are not common for service system indications rather than representing production flow and material flow in organizations. This is a new way of showing the flow of service activities similar to that of manufacturing process steps.

Chapter Three

Research Design and Methodology

This chapter explains about the overall design of the research and the methods used to collect relevant data for the accomplishment of the research. It consists of three parts. The first part introduces the design of the research, the second part discusses the methodology followed for data collection (qualitative and quantitative) and the third part illustrates the general framework of the research.

3.1 Research Design

Research designs are core issues for studies to be realized. According to Kothari (2004), research design is important to facilitate the smooth- sailing of the various research operations, thereby making research as efficient as possible yielding maximal information with minimal expenditure of effort, time and money. The design helps the researcher to organize ideas in a form whereby it makes possible for the researcher to look for flaws and inadequacies. Such a design can even be given to others for their comments and critical evaluation. In the absence of such a course of action, it will be difficult for the critic to provide a comprehensive review of the proposed study.

In this dissertation, assessment of service provision in healthcare is done by taking the case of Addis Ababa Highest Referral Hospitals (Tikur Anbessa Specialized Hospital and St. Paul's Hospital Millennium Medical College) and Addis Ababa Dispatch Center for Emergency Cases. The reason for selecting the case study areas was by preliminary assessment on the existing problems in healthcare sector. Results of the preliminary assessment showed the existences of the problems in the areas are becoming aggravated from time to time. Thus, to know on which specific area to focus first on the mentioned wider areas, integrated Fuzzy-AHP method was used in order to identify the priority of improvement needs in the selected areas. Inpatient cases are also studied as the further treatment of both cases needs inpatient service delivery in hospitals. The pharmaceutical distribution in the sector is also dealt. The focus of the

assessment in the sector is on the responsiveness of the activities and flow of activities which are influential for the responsiveness. As a result, core problems are identified. To understand the condition of the existing system and propose means of improvement, system dynamics is used and relevant improvement model is proposed. As a result, integrated demand management model is developed by using system dynamics after assessing previous models to help in determining parameters for the new model. There is no previous model that shows the overall system and flow in healthcare in a single tide with a proposal of new integrative model.

3.2 Research Methodology

To meet the key objectives of the research, qualitative and quantitative methods and combination of primary and secondary sources of data have been used. The data gathering methods used are discussed in following sections.

3.2.1 Literature Review

To achieve the dissertation's objectives, the researcher conducted a broad literature review with regard to service quality improvement in healthcare, the existing improvement approaches and models developed for quality improvement in the sector to help in designing the direction of the research through identifying the existing gap. Theories in demand management, supply chain management and system analysis tools in healthcare were also studied. The major sources of literatures were, reviewed articles, periodicals, proceedings, books, magazines, reports and newsletters. The review helped the researcher to devise a direction for the study by analyzing the contents of the literature survey. As a result, study direction is set and system analysis tool is selected for the research. System dynamics with a stock- flow analysis is used to examine the existing service responsiveness status and to develop a new model together with the concept of integrated demand management. Integration of demand by the use of system dynamics is a new model for increasing responsiveness in healthcare sector.

3.2.2 Data Collection

The data collection is done through: observation, interview, questionnaire and review of recorded secondary data. Benchmarking was also used to help in understanding the existing working situation in healthcare and provide possible solutions through discussion with workers in different departments of the sector in addition to the numerical comparison with other countries performance in the sector. After considering representative Hospitals and Healthcare Sectors in Ethiopia specifically in Addis Ababa and by using systematic sampling approach, the highest referral hospitals and emergency cases are selected for further study.

The data are collected from: Ministry of Health, Referral Hospitals in Addis Ababa (Tikur Anbessa Specialized Hospital and St.Paul's Hospital Millennium Medical College), Addis Ababa Dispatch Center, Pharmaceutical Funds and Supply Agency in Addis Ababa. The data is gathered mainly by communicating with the Liaison offices of the mentioned places and from quality management departments and main laboratories in the hospitals. The core areas of the data collection are; emergency demand management starting from the dispatch center to the service given at hospitals, referral cases demand management as complicated cases are referred to these higher hospitals, inpatient cases demand management as series cases are treated by staying in the hospitals bed and finally pharmaceutical issues outside of the hospitals are also studied. The detail activities accomplished to gather data are explained in following sections.

a) Observation

Observation is a scientific tool and method of data collection for the researcher, when it serves a formulated research purpose, is systematically planned and recorded and is subjected to checks and controls on validity and reliability (Yin, 2003). Under the observation method, the information is sought by way of investigator's own direct observation without asking from the respondent. The main advantage of this method is that subjective bias is eliminated, if observation is done accurately. Secondly, the information obtained under this method relates to what is currently happening; it is not complicated by either the past behavior or future intentions or attitudes. Thirdly, this method is independent of respondents' willingness to respond and as

such is relatively less demanding of active cooperation on the part of respondents as happens to be the case in the interview or the questionnaire method. This method is particularly suitable in studies which deal with subjects (i.e., respondents) who are not capable of giving verbal reports of their feelings for one reason or the other (Kothari, 2004). Observational research findings are considered strong in validity because the researcher is able to collect a deep information about a particular behavior. In this dissertation the researcher used observation method as one tool for collecting basic information and data about the core services provided in healthcare sector by directly visiting all the places selected for the study. In this research, the working activities in the referral cases of the two highest referral hospitals and the working activities in Addis Ababa Dispatch Center is deeply observed. The core points assessed using observations are shown in Apendix A.

b) Interview

In this study, key informants are selected from Governmental hospitals and organizations namely, Tikur Anbessa Specialized Hospital, St.Paul's Hospital Millennium Medical College, Addis Ababa Dispatch Center, Pharmaceutical Funds and Supply Agency in Addis Ababa and from non-governmental referral hospitals in Addis Ababa. Interview with the key informants from the studied and mentioned areas in Addis Ababa have been made. The interview process mostly took 25-30 minutes to complete. In this study, the interview is conducted to collect general information regarding the Ethiopian Healthcare sector with the selected focus areas aiming to; understand the existing situation in the service provision mechanism of healthcare sector in Ethiopia especially in areas of emergency, referral, inpatient cases and pharmaceutical issues, identify the core problems and their causes and devise a means of mitigating the identified problems in the sector. Detailed information about the interview questions and key informants are given in Appendix B.

c) Secondary data

Collection of secondary data can be done through gathering data from the website, related organizational data sources, journals, magazine or other published sources. Secondary data

entails the proactive seeking of existing data in both qualitative and quantitative research. It can also help to interpret the primary data. All secondary data in this dissertation are compared and cross checked for inclusion. In this dissertation secondary data from governmental and non-governmental hospitals in Addis Ababa, Referral Hospitals, Addis Ababa dispatch Center, Ministry of Health and highest referral private hospitals are used. The detail record of service provision process in the core areas; emergency, referral, inpatient and pharmaceutical cases were gathered.

d) Questionnaire

In this research, questionnaires are used to assess the prioritization of improvement needs in the sector. The referral hospitals were assessed through questionnaire for the identification of major improvement areas that should be investigated further in the research work. In addition, information on the pharmaceutical issues is also gathered through questionnaire. Appendix C and D show the details of the questionnaire.

e) Focus group discussion

At the simplest level, a focus group is an informal discussion among a group of selected individuals about a particular topic (Wilkinson, 2004). Focus groups are 'collective conversations', which can be small or large (Kamberelis and Dimitriadis 2008). Focus groups are group discussions which are arranged to examine a specific set of topics. The group is focused because 'it involves some kind of collective activity' (Kitzinger, 2005), for example debating a specific set of social or health issues, reflecting on common perspectives or experiences, or discussing a health or welfare campaign. The primary aim of a focus group is to describe and understand meanings and interpretations of a selected group of people to gain an understanding of a specific issue from the perspective of the participants of the group (Liamputtong, 2010).

In this research, focus group discussion is used to help in clearly identifying existing responsiveness problems and proposing possible improvement ideas in healthcare service. The discussion included professionals from St.Paul's Millennium Medical College, Tikur Anbessa

Specialized Hospital, Addis Ababa Dispatch Centre for emergency cases and from highest private hospitals in Addis Ababa. The core idea of the discussion was on how to improve the responsiveness of service in the Ethiopian Healthcare Sector. Appendix E shows the details on the participants, discussion points, date and place of the focus group discussion.

3.2.3 Data Analysis and Model Development

After the collection of primary and secondary data, the data analysis is followed. First, Fuzzy-AHP for prioritization of core improvement areas was used. Secondly, charts were used to analyze the waiting time to get service in emergency cases and then compare with the standards by using Minitab, finally system dynamics was used to represent the existing situation of the service system in healthcare as well as to develop an integrated demand management model for the enhancement of responsiveness in the healthcare sector.

3.3 Research Framework

The overall research methodology and the steps followed in this research is depicted in Figure 3.1. It starts with building the theoretical framework and wind up with conclusions and recommendations.

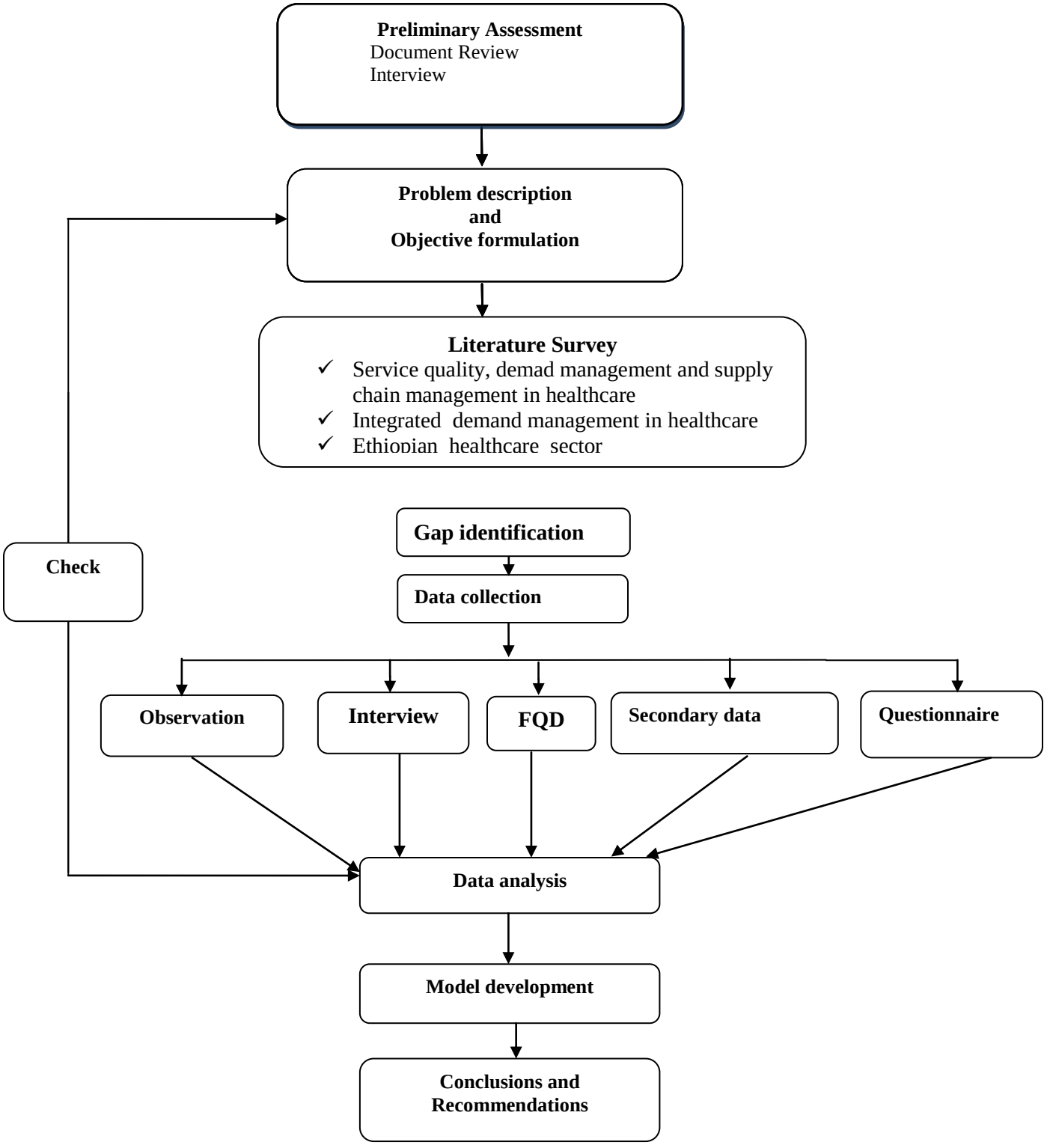


Figure 3.1 The research methodology framework

Chapter Four

The Healthcare Sector

This chapter provides overall information about healthcare. The first part gives information about healthcare sector in general by focusing on healthcare status in the world and the healthcare status in Africa is discussed in the second part. Discussion on the benchmarking of healthcare activities is also made. Finally, the healthcare status specifically in Ethiopia with improvement approaches and identification of existing problems have been dealt with.

4.1 World's Health Sector

Health system consists of all the people and actions whose primary purpose is to improve health. These activities may be integrated and centrally directed, but often they are not. After centuries, as small-scale, largely private or charitable, mostly ineffectual entities, they have grown explosively in this century as knowledge has been gained and applied. They have contributed enormously to better health, but their contribution could be greater still, especially for the poor. Failure in achieving that potential is due more to systemic failings than to technical limitations. It is therefore urgent to assess current performance and to judge how health systems can reach at a better potential. Health status indicators have been included on the basis of their relevance to global public health: the availability and quality of the data and the reliability and comparability of the resulting estimates. Taken together, there are indicators that provide a comprehensive summary of the status of national health and overall global health systems. These key indicators consist of nine key indicative points (WHO, 2012). In the first place, the percentage of access and use of improved sanitation is observed before measurement of the listed indicators as represented in Figure 4.1.

a) Life expectancy and mortality
b) Cause-specific mortality and morbidity
c) Selected infectious diseases
d) Health service coverage

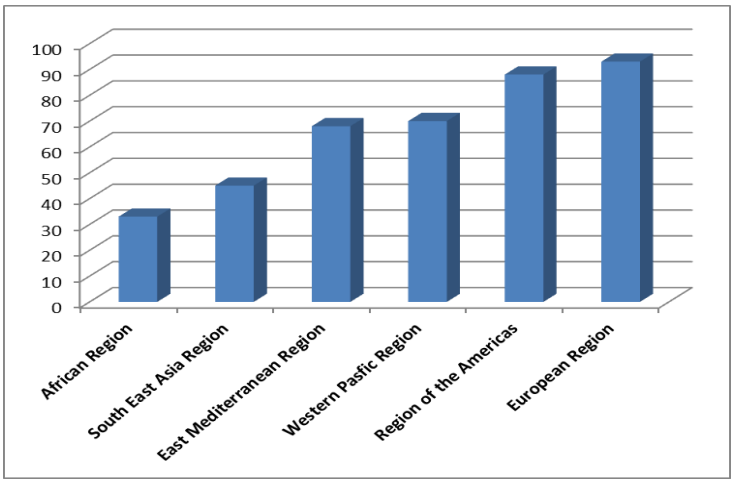
e) Risk factors

f) Health systems

g) Health expenditure

h) Health inequities

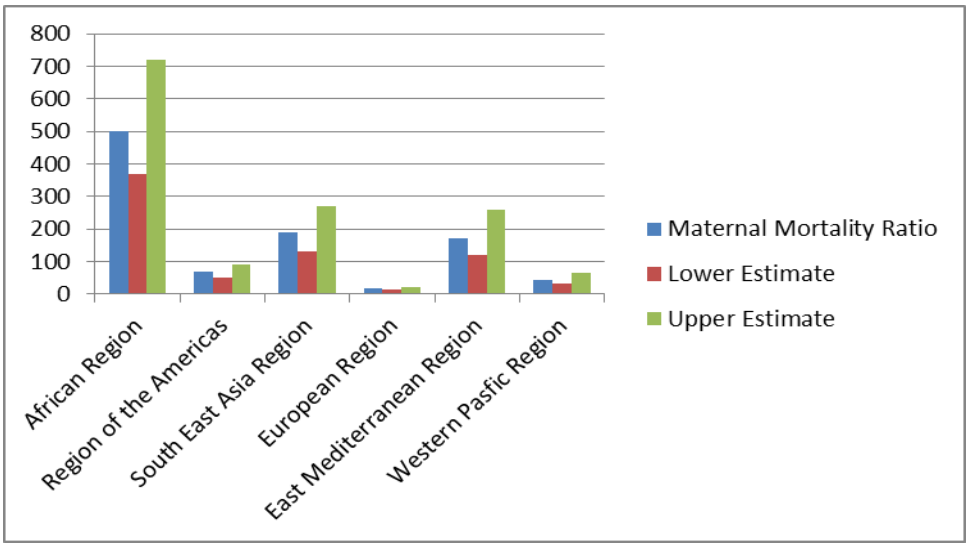
i) Demographic and socio-economic statistics



Source: WHO, 2012

Figure 4.1 Proportion of population with access to improved sanitation in 2012

As showed on Figure 4.1, the percentage in improvement for access and use of improved sanitation varies for different continents and Africa constitutes the least value in the improvement. The next key indicator among the nine indicators is life expectancy and mortality rate. Much has been done to decrease the number on the occurrence of these cases. The sample report for maternal mortality ratio dictates the maternal mortality ratio (MMR) globally. Figure 4.2 shows estimated maternal mortality ratio (maternal deaths per 100 000 live births), number of maternal deaths and lifetime risk (WHO, 2013).

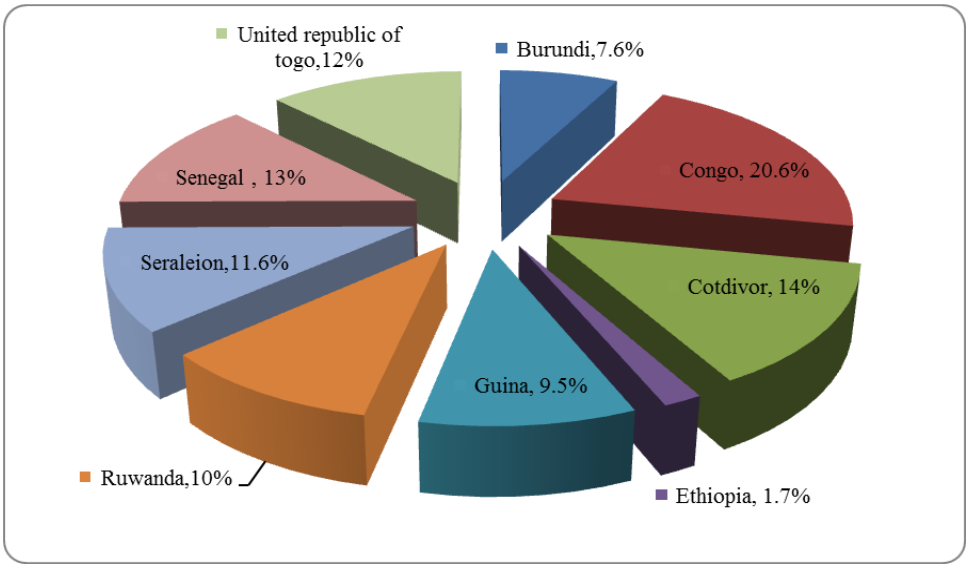


Source: WHO, 2013
Figure 4.2 Maternal mortality ratio in the world

4.2 Health Status in Africa

Whilst healthcare development in Africa has been long overdue, fast-paced economic growth is the driving force behind the huge increase in investment. It is estimated that Sub-Saharan Africa's health market will rocket to $35 billion by 2016. This figure is set to increase even further in the years ahead fuelled by both domestic and international investment and an ever-increasing demand for healthcare (AHS, 2014).

During the next few years as hospital development across Africa increases, so will opportunities for international healthcare investors and solution providers involved in hospital equipment, pharmaceuticals, medical technologies and other healthcare services and products. The Africa Healthcare Summit 2014 is the only event of its kind to bring large delegations of government ministers, senior hospital directors and healthcare professionals to Europe to network with international healthcare experts, investors and solution providers. The Africa Healthcare Summit is a completely unique opportunity for any company involved in or looking to enter the African health sector. Reports on the summit indicate the percentage of quality healthcare coverage as shown in Figure 4.3.



Source: GHO, 2014
Figure 4.3 Quality health service coverage

4.3 Benchmarking for Healthcare Service

Benchmarking is broadly defined as the comparison of similar systems or organizations based on a recognized set of standard indicators (Wait, *et al.*, 2005). Distinctions are made between performance benchmarking and practice benchmarking: the former focuses on establishing performance standards while the latter is concerned with the underlying practices and search for best practices. In the health sector, performance benchmarking is more prevalent, perhaps because health systems are complex and involve many institutions, sectors, payers and providers. The ongoing challenge has, therefore, been to link benchmarking to organizational change processes (Neely, 2010).

Although international comparisons of health care systems date back to the 1930s, those early examples focused mainly on the structural characteristics of health care systems such as the number of physicians and hospital utilization data or on a few specific outcomes such as average life expectancy at birth and maternal and child mortality. More recently, organizations namely the World Bank (1993), the World Health Organization (WHO 2000), the Organization for Economic Co-operation and Development (OECD 2001) and the Commonwealth Fund (2007)

have developed snapshots on cross-national health systems performance measurement. These reports have put international health system performance comparisons on the political agenda, raised awareness of performance issues, and resulted in initiatives to guide policies for the improvement of health care in individual countries (Veillard, *et al.*, 2010).

4.3.1 Types of Benchmarking

Benchmarking can be internal and external. Internal benchmarking focus on and covers two way communication and sharing opinions between departments within an organization or between organizations operating as part of a chain in different countries. Once any part of an organization has a better performance indicator, others can learn how this was achieved. Findings of internal benchmarking can then be used as a baseline for extending benchmarking to include external organizations. External benchmarking requires a comparison of work with external organizations in order to discover new ideas, methods, products and services, the objective is continuously to improve one's own performance by measuring how it performs, comparing it with that of others and determining how the others achieve their performance levels. This type of benchmarking provides opportunities for learning from the best practices and experiences of others who are at the leading edge. Competitive, functional and generic benchmarking are also common (Kay, 2007).

4.3.2 Benchmarking in Ethiopian Healthcare Sector

Ethiopia is developing with a promising rate to join middle income countries in a decade. The health sector should be the contributor to the economic growth by turning the vision of seeing healthy and prosperous Ethiopians to reality as well as benefit from the economic growth to avail adequate resources to provide quality services. Envisioning the future of Ethiopia's health sector has taken into account the assumption of Ethiopia becoming a lower-middle income country by 2025 and a middle-middle income country by 2035 to come up with indicative targets with benchmarking of other countries and strategic recommendations to meet those targets. The impending health sector strategies are expected to cope with a changing landscape in socio-economic situations as well as addressing existing and anticipated challenges such as quality of care and inequalities. A feasible approach to address such challenges is to rehearse universal

health coverage by improving primary health care with seamless continuation to higher level of care (Kesetebrhan, 2014).

The benchmarking exercise for Ethiopia was made mainly through document reviews. The main purpose of the benchmarking exercise was (i) to study the health status of LMICs and upper-middle income countries (UMIC) and understand how far Ethiopia's health profile needs to improve to have a health profile of middle income countries (MIC); (ii) to understand the health system resources of MICs; and (iii) to understand the health care system performance of MIC. The 2013 WHO World Health Statistics report (WHO, 2013) and reports of the World Bank (WB, 2013) were the main documents reviewed for this exercise to make comparison from the same sources of information. Through document review, 48 LMICs and 55 UMICs were identified. Averages of health impact indicators, health performance outcomes, risk factors and health system resources were considered to benchmark targets for Ethiopia for 2025 as a LMIC and for 2035 as a MMIC. In some of the indicators, the average of LMICs was found to be minimal to set as a benchmark target for Ethiopia. Hence, further analysis was made to identify best performing countries to benchmark targets as best case scenario for Ethiopia.

a) Benchmarking for High impact Health Indicators

The average of health status and health care performance achievements of best countries selected by the above criteria are considered as a benchmark target for Ethiopia as a best case scenario (average achievements of best LMICs for Ethiopia's 2025 target as a best case scenario and average of achievements of best UMICs for Ethiopia's 2035 targets as a best case scenario). The average of health status and health care performance achievements of all LMICs and UMICs countries are considered as a benchmark target for Ethiopia as a base case scenario (average achievements of all LMICs for Ethiopia's 2025 target as a base case scenario and average achievements of all UMICs for Ethiopia's 2035 targets as a base case scenario). Table 4.1 shows the impact indicators for 2025.

Table 4.1 Benchmarking of high impact indicators for 2025

Lower-middle income countries	MMR	NMR	IMR	U5MR	Age-standardized mortality rate by cause per 100,000 population			Cause-specific mortality rate per 100,000 population			ALE
					CD	NCD	Injuries	Malaria	TB	HIV	
Egypt	66	7	18	21	76	749	34	No data	0.6	0.9	73
Guatemala	120	15	24	30	225	471	130	0	2.4	17	69
Indonesia	220	15	25	32	244	647	70	3.6	27	6	69
Morocco	100	19	28	33	104	597	37	No data	8.7	5	72
Philippines	99	12	20	25	231	599	55	0.2	29	0.5	69
Sri Lanka	35	8	11	12	79	623	233	No data	5.4	1.2	75
Syrian Arab Republic	70	9	13	15	56	619	45	0	1.8	No data	75
Average of selected LMICs (best case scenario for Ethiopia in 2025)	101	12	20	24	145	615	86.3*	0.5	11	4.4	72
Average of all LMICs (base case scenario for Ethiopia in 2025)	260	28	46	42	223	658	82	14**	22**	25	66
Ethiopia-2011 status	350	31	52	77	721	903	139	4	18	No data	60

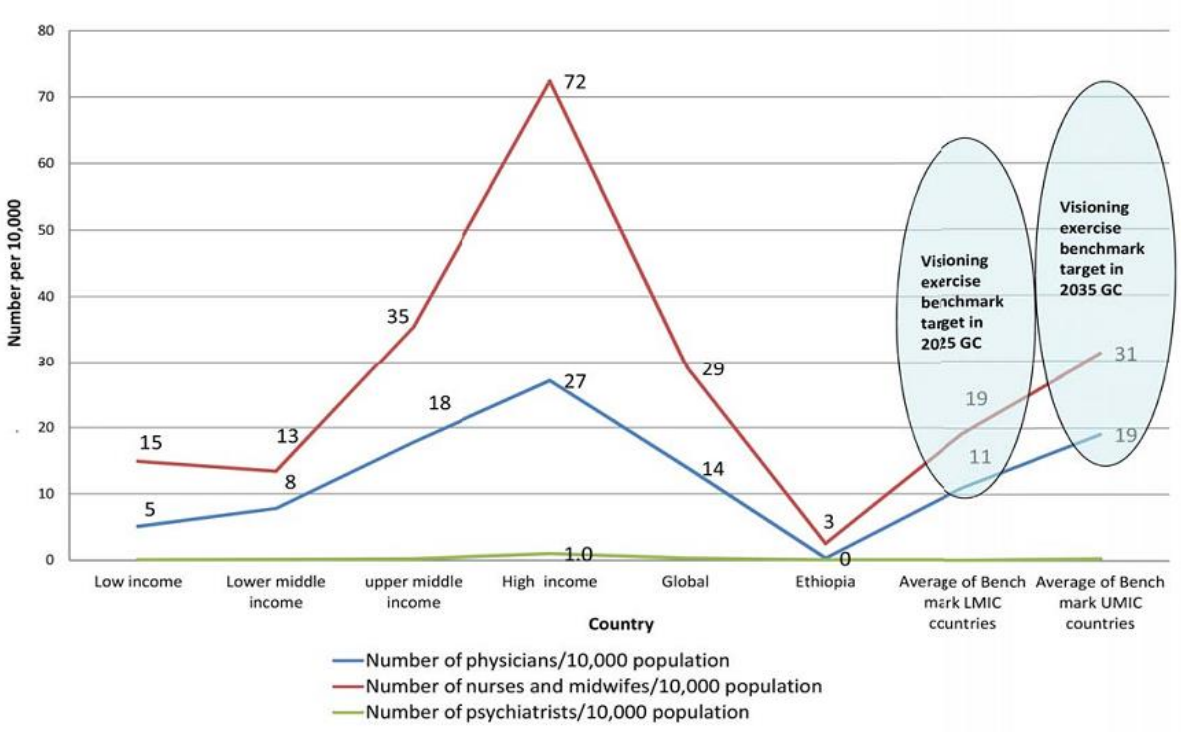
Source: Kesetebrhan, 2014

b) Benchmarking of Health Service Coverage and Comparisons of Risk Factors

One of the determinants of the epidemiologic features of countries is their profile of risk factors. The benchmarking has tried to identify some indicative risk factors for both communicable and non-communicable diseases. Use of improved drinking water, sanitation facilities, housing conditions and nutritional status are among the risk factors for communicable diseases.

c) Benchmarking Targets for Health System Resources

Health system resources are among the limiting factors in the health sector to avail quality health service and reach all segments of the population. Human Resource for Health (HRH) is a key factor among the health system resources. Any health system needs to have an adequate number of health professionals with adequate degree of skill mix to render health care in an efficient and effective manner. The World Health Organization (WHO) recommends 1 physician to serve 10,000 people in low-income countries. Ethiopia is accelerating its pace to meet this recommendation. A decade later, Ethiopia needs to have more human resources in keeping with health needs of a middle-income country.



Source: Kesetebrhan , 2014
Figure 4.4 Human resources for health

Generally, benchmarking is done by different initiatives and involves countries under the initiative body for implementation. The initiatives undergo assessment frameworks by using cross-national comparison of international quality indicators. The major indicators are, patient safety, effectiveness and patient experience (Nolte, 2010).

4.4 Health Status in Ethiopia

According to the recent ranking by the World Health Organization on the world's health systems, Ethiopia ranked 180 among 190 countries (WHO, 2013). The reports worldwide and reports in Africa showed that, the improvement in health systems in Ethiopia is minimum when it is compared with improvement in other countries. In order to improve the country's health status, Ethiopian government is working hard by setting better plans and by working towards the achievement of the plans that are also helpful to meet the Millennium Development Goal (MDG). Among the plans, the GTP (Growth and Transformation Plan) has a medium term strategic framework for five year period and the HSDP (Health Sector Development Plan) are the major indicators for the move (CCS, 2012-15). Before going to the recent improvement plans of GTP and HSDP, the historical development of Hospitals in Ethiopia is discussed.

4.4.1 History on the Establishment of Healthcare Centres in Ethiopia

Literature review showed that the first three hospitals were constructed in 1896 (Russian hospital), 1903(Harar Ras Mekonnen hospital) and 1906 (Menelik II hospital). In 2005, 139 hospitals (87 public and 52 others) were reported. Remarkable hospital construction was done between 1935 and 1948, and between 1995 and 2005. The three prestigious medical schools (Addis Ababa, Gondar, Jimma) were established in 1964, 1978 and 1984, respectively (Berhan, 2008). Following these three hospitals, others were also constructed. Summary of the pioneering hospitals established between the battle of Adwa and the second Italian invasion attempt, 1896–1935 is listed in Table 4.2.

Table 4.2 Summary of the pioneering hospitals in Ethiopia

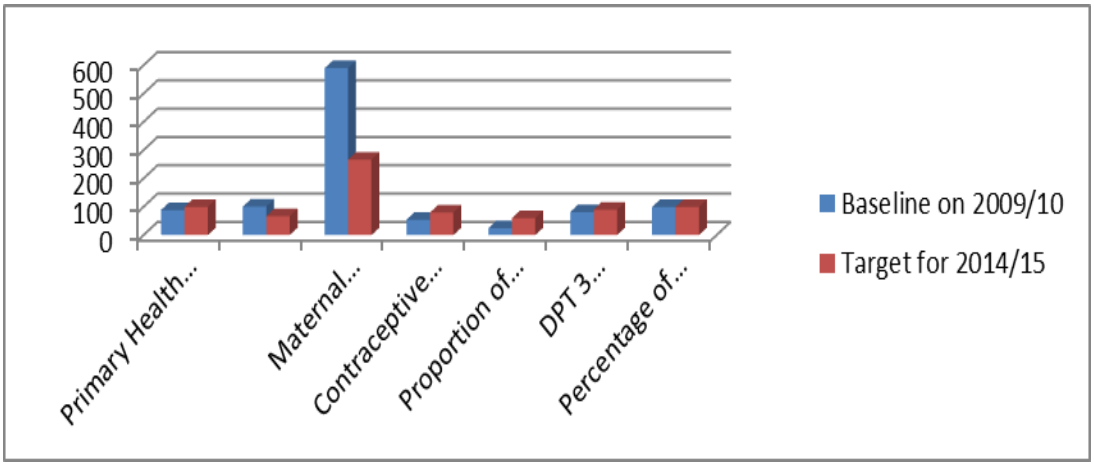
Name of Hospital	Year	Remark
Russian hospital	1896	Closed in 1906 when physicians left.
Harar Ras Mekonnen hospital	1903	Shortly sold to France and named French institution.
Menelik II hospital	1906	Still the same name
Dire Dawa Railway hospital	1911	No data after establishment
Gulele hospital	1922	Later, Pasteur Institute, now Ethiopian health & nutrition research institute
Bete Saida hospital	1923	Current name (Yekatit12 hospital)
Zenebework hospital	1930	Current name(Alert hospital)
Ras Desta Damtew	1932	Still the same name
Zewditu hospital	1933	Still the same name

Source: Berhan, 2008

The establishment of hospitals was diversified through time and reached the existing state. But, the population of Ethiopia is increasing in a fast rate as shown in Appendix D. In the contrary, the number of hospitals is not increasing in line with the population rise. Hence, the number of hospitals is not balanced with the number of population.

4.4.2 Ethiopian Growth and Transformation Plan (GTP) for Healthcare Sector

Ethiopian GTP has eight pillar strategies to foster development of the country. Among the pillars, enhancing expansion and quality of social development through education, and training and through expansion and improvement of health services is the dominant one. With regard to expansion and improvement of health services, the focus under the GTP is towards primary healthcare and preventive services as well as improving the effectiveness of services in relation to availability of drugs. Furthermore, the government is strengthening its measures to improve the number, skills, distribution and management of health workers, through accelerated training of physicians (specialists and general practitioners). New systems of health care financing, including drug revolving funds are in exploration and in implementation to overcome the bottlenecks in the sector. Incentive package is also planned to be further developed in order to domestically produce pharmaceutical products (GTP, 2010).



Source: GTP, 2010/11-2014/15 by MoFED
Figure 4.5 Planned GTP Targets for the period 2014/15 for Health Sector

As discussed in section 4.4.2, GTP one has illustrated the overall goal in health sector for five years. After revising the results and achievements of the first GTP, GTP II is launched for the coming five years plan for development in the country. In GTP II, it is planned to focus on quality issues in healthcare service as the diversification of healthcare centres is achieved in the first GTP.

Thus, in the past years, remarkable achievements have been recorded in the expansion and construction of Health facilities, and improve the quality of health service provision. The Health Extension Program (HEP) is an innovative health service delivery program that aims at universal coverage of primary healthcare. The program is based on expanding physical health infrastructure and developing Health Extension Workers (HEWs) who provide basic preventive and curative health services in the rural community. Health Sector Development Program IV is designed in line with the overall directions of the government for five years. The most priority areas of the health sector development program are maternal and newborn care, child health, halt and reverse the spread of major communicable disease such as HIV/AIDS, TB and Malaria.

The major objectives of the GTP with regards to service in the health sector is to improve the health of the population through provision of promotive, preventive, curative and rehabilitative health services by improving access to health service and improving quality of health services.

The major health problems of the country remain largely preventable communicable diseases and nutritional disorders. Despite major progresses have been made to improve the health status of the population in the last one and half decades, Ethiopia's population still face a high rate of morbidity and mortality and the health status remains relatively poor. Figures on vital health indicators from DHS 2005 show a life expectancy of 54 years (53.4 years for male and 55.4 for female), and an IMR of 77/1000. Under-five mortality rate has been reduced to 101/1000 in 2010 and more than 90% of child deaths are due to pneumonia, diarrhea, malaria, neonatal problems, malnutrition and HIV/AIDS, and often a combination of these conditions. These are very high levels, though there has been a gradual decline in these rates during the past 15 years. In terms of women health, MMR has declined to 590/100,000 though it still remains to be among the highest. The major causes of maternal death are obstructed/prolonged labor (13%), ruptured uterus (12%), severe pre-eclampsia/ eclampsia (11%) and malaria (9%). Moreover, 6% of all maternal deaths were attributable to complications from abortion. Shortage of skilled midwives, weak referral system at health centre levels, lack of inadequate availability of Basic Emergency Obstetric and Newborn Care (BEmONC) and Comprehensive Emergency Obstetric and Newborn Care (CEmONC) equipment, and under financing of the service were identified as major supply side constraints that hindered progress. On the demand side, cultural norms and societal emotional support bestowed to mothers, distance to functioning health centres and financial barrier were found to be the major causes.

4.4.3 Ethiopian Health Sector Development Plan (HSDP- IV)

Following changes of Government in 1991, Ethiopian government produced the health policy which was the first of its kind in the country and was among a number of political and socio-economic transformation measures that were put in place. The translation of the health policy was followed by the formulation of four consecutive phases of comprehensive Health

Sector Development Plans (HSDPs), the first -phase of which was implemented starting in 1996/97. Both of the policy formulation as well as the development of the first HSDP have been the result of critical reviews and scrutiny of the nature, magnitude and root causes of the prevailing health problems of the country and the broader awareness of the newly emerging health problems in the country. The core elements of the health policy are democratization and decentralization of the health care system, development of the preventive, promotive and curative components of health care, assurance of accessibility of health care for all segments of the population and the promotion of private sector and NGOs participation in the health sector. Since the development of HSDP I which also paved the way for the subsequent HSDP II and HSDP III, the Federal Ministry of Health has formulated and implemented a number of policies and strategies that afforded an effective framework for improving health in the country including the recent addition of maternal and neonatal health, including strategies on free service for key maternal and child health services (Health Care Financing Strategy), the training and deployment of new health workforce called all female HEWs for the institutionalization of the community health care services with clean and safe delivery at Health Post(HP) level, and deployment of Health officers(Hos) with Medical Science training in skills of Integrated Emergency Obstetric and Surgery (IEOS). In addition, the establishment of the Millennium Development Goal (MDG) Performance Package Fund and the priority given to maternal health therein is expected to mobilize the much required additional funding opportunities (HSDPIV, 2010).

The health sector development plan is a plan with detail of activities to help in the accomplishment of the plans on GTP. It aims at ensuring community ownership and empowerment through effective social mobilization, enhanced and sustained awareness creation, and creating conducive environment as well as supporting community organizations. Results from the implementation of consecutive HSDP I, II and III has increased the construction of health posts, health centres and hospitals as shown in Figure 4.6.

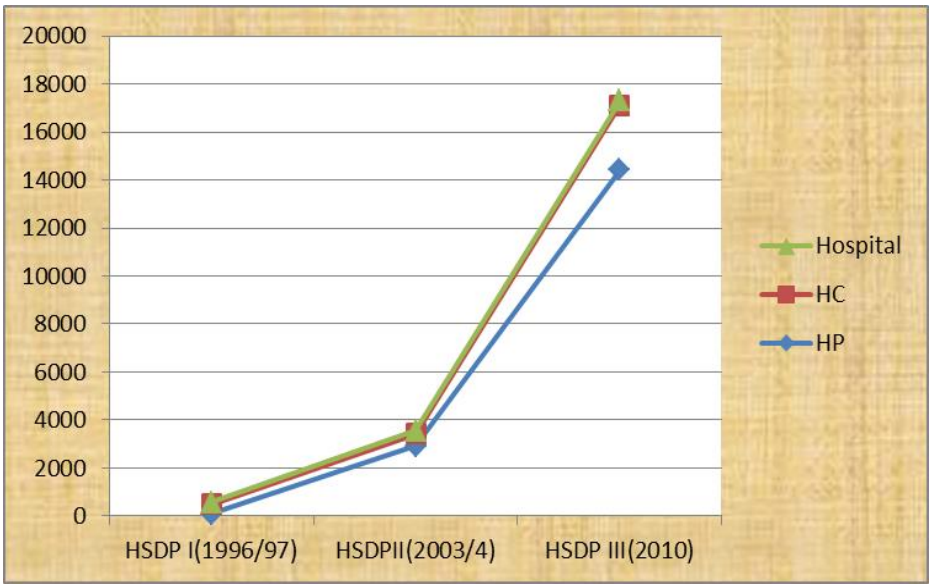


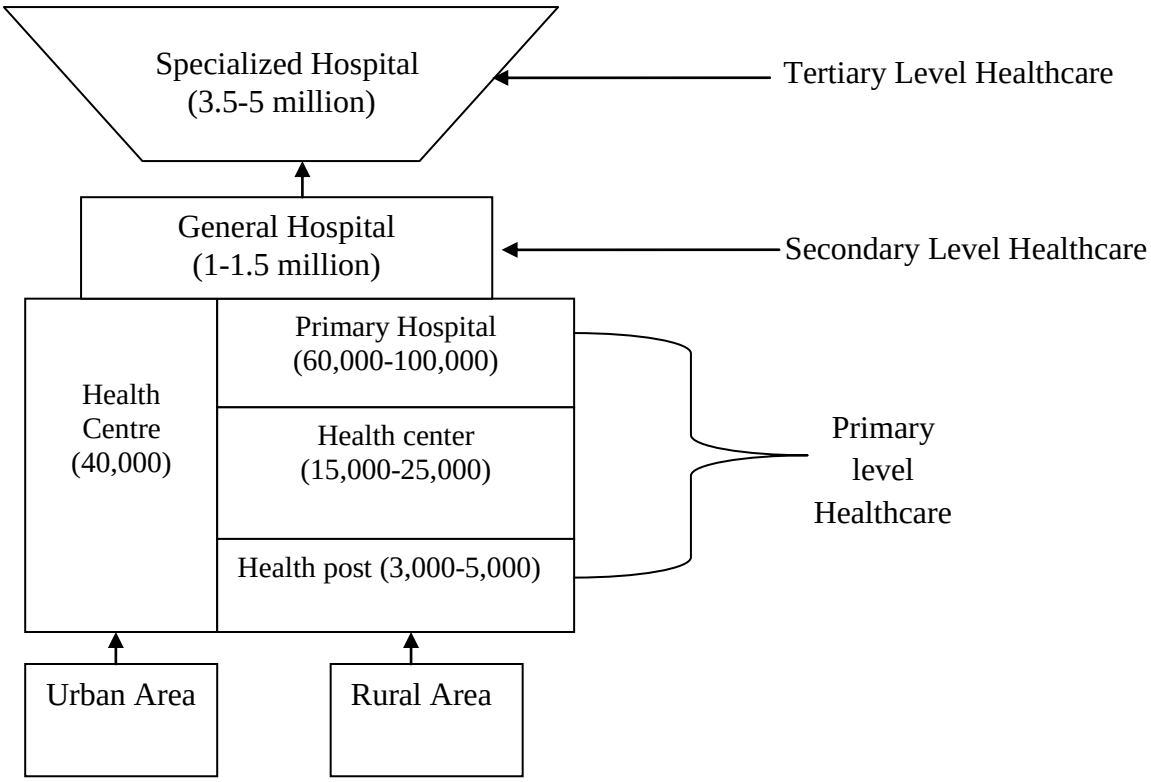
Figure 4.6. Trends of Health Facility Construction(Source: HSDP IV,2010)

4.4.4 Structure of Healthcare Sector in Ethiopia

The recently implemented Business Process Re-engineering (BPR) of the health sector has introduced a three-tier health care delivery system which is characterized by a first level of a Woreda (District) health system comprising a primary hospital with population coverage of 60,000-100,000 people, one health center covering 15,000-25,000 population and one satellite Health Posts serving for 3,000-5,000 population that are connected to each other by a referral system. A Primary Hospital, Health center and health posts form a Primary health care unit (PHCU) with each health center having five satellite health posts. The second level in the tier is a General Hospital with population coverage of 1-1.5 million people: and the third a Specialized Hospital that covers population of 3.5-5 million. The Ethiopian Health care System is augmented by the rapid expansion of the private for profit and NGOs sector playing significant role in boosting the health service coverage and utilization thus enhancing the public (private) NGOs partnership in the delivery of health care services in the country. Offices at different levels of the health sector from the Federal Ministry of Health to Regional Health Bureaus and Woreda Health Offices share decision making processes, decision powers, duties and responsibilities. The Federal Ministry of Health (FMOH) and the Regional Health Bureaus

(RHBs) focus more on policy matters and technical support while Woreda Health Offices have basic roles of managing and coordinating the operation of a district health system under their jurisdiction.

Regions and districts have Regional Health Bureaus (RHB) and district health offices, respectively for the management of public health services at their levels. The devolution of power to regional governments has resulted in the shifting of decision making for public service deliveries from the center to largely under the authority of the regions and down to the district level.



Source: HSDP IV,2010
Figure 4.7 Ethiopian health tire system

4.5 Service Delivery Status in Ethiopian Highest Referral Hospitals

Currently, there are 3, 245 health stations, 16,048 health posts and 229 referral hospitals across the country. In order to attain the target, the construction of 175 hospitals is underway in SNNP, Oromia, Amhara, Benishangul Gumuz and Afar regional states as well as Dire Dawa administration. The level of the service type increases hierarchically from lower level to higher level. Health centres give moderate level of service; hospitals give higher treatment in their area of specialty and referral hospitals give services to complicated cases. There are two highest referral hospitals in Ethiopia namely, Tikur Anbessa Specialized Hospital and St.Paul's Hospital Millennium Medical College. Both the hospitals give service to highly complicated cases for patients coming from different regions and from Addis Ababa. As a result of this, there is always imbalance between the need and the delivery of service in the hospitals.

According to the government's plan and the quest of the time for better quality in every aspect of production and service, especially in healthcare is needed for a safe community. Thus, there are different moves towards realizing the need. In Ethiopia, different activities of service quality improvement are implemented. BPR (business Process Re-engineering) is one of the implemented tools in service sectors and in health sector too. Though significant improvements are gained as a result of the implementation, customer complain is still common in healthcare. Kaisen is also implemented in healthcare and has brought significant improvement related to the material management in healthcare sector. But the customer complain is still aggravating in the sector. The cores complain areas are in all cases such as in the emergency cases, in the inpatient as well as outpatient service cases. The level of complain varies. Towards the focus of improvement areas in the sector, preliminary assessment of the dominant complaint areas is needed. As a result, chapter six has focused on assessment on the need of priority improvement area by the customer by assessing the case of the highest referral hospital in Addis Ababa (Tikur Anbessa Referral Hospital).

4.5.1 Blue Print of Addis Ababa Public and Referral Hospitals

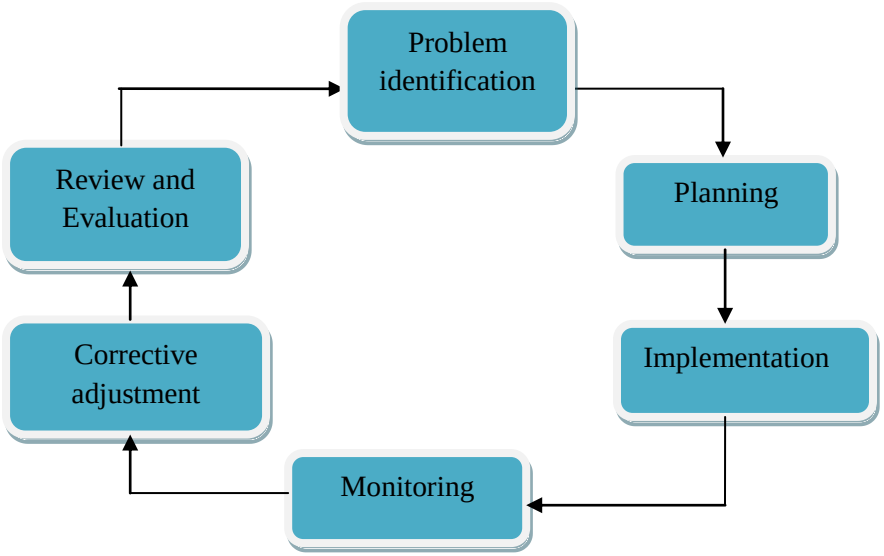
Hospitals in Addis Ababa were following a reform initiative (blueprint) which was financed by the Federal Ministry of Health and technically supported by Clinton Foundation and Yale university of USA. The reform was a result of a personal request in 2005 by Dr. Tewodros Adhanom to President Bill Clinton to give due attention to public hospitals. It was initiated in 2006 and continued onwards as a permanent process till other plans such as BPR and kaizen were implemented in hospitals by the Government to improve service quality.

The reform stakeholders were:

a) Federal Ministry of Health
b) Public hospitals in Ethiopia
c) Other Regulatory Agencies (DACA, Civil Service, MoFED, etc)

The Blueprint was a guide book composed of management systems under which there are standards for each system. It was designed based on the Ethiopian Context. There were eight primary management systems designed, human resources, patient flow, medical records, nursing standards and practice, infection-prevention policies, pharmacy, inventory and warehouse management, global budgeting and financial management and governing board.

According to the blueprint, there was a reform cycle for controlling quality in the hospital having similarity with the Deming's PDCA as shown in the figure 4.8. What makes it different from the PDCA was it focus on dealing with the existing flow and try to take some corrective action if the flow is not followed without taking measurement.



Source: Blueprint of TASH
Figure 4.8 Reform cycle of blueprint

In the implementation process of the blueprint, there are seven steps, formation of a quality management committee, formation of technical tracer teams for the blueprint system, conduct baseline assessment, conduct gap analysis, draft action plans per system, implementation phase and Monitor and evaluate implementation.

4.5.2 Standard for Medical Service in Hospitals

Medical service consists of international standard. The major services given in hospitals are emergency, inpatient and outpatient services including surgical and medical service at all levels for the need of the curing activity. In all cases, there is a referral system according to the hierarchical service provision in different levels of hospitals. The major standards in healthcare service are, accreditation participation requirements, patient centered standards, healthcare organization management standards and academic medical center hospital standards (JCI, 2014).

Emergency Medical Service (EMS) is a service provided outside a hospital with acute care and transport to definitive care, to patients with illnesses and injuries which the patient believes constitutes a medical emergency. It is a complete system capable of responding to the

medical and surgical emergencies of a community with prompt and adequate emergency care. The most common and recognized EMS type is an ambulance pre-hospital care. The aim of EMS is to provide treatment to those in need of urgent medical care, with the goal of either satisfactorily treating the malady, or arranging for timely removal of the patient to the next point of definitive care which is an emergency department at a hospital. In some areas, EMS units may handle technical rescue operations such as extrication, water rescue, and search and rescue. The five components of EMS systems are pre-hospital care, personnel/human resource, equipment and communications, transportation and health facilities. The five components of EMS system are pre-hospital care, personnel/human resource, equipment and communications, transportation and health facilities.

Standards on emergency service focus on, access, triage, transfer, staffing qualifications, site performance, district health authority performance, clinical personnel practice, quality review, patient satisfaction and equipment (Ross, 2010). Standards for referrals and other medical cases are determined based on the service giving capacity of the healthcare center. Private clinics are also guided by this rule and give service to patients up to their capacity. Referral system from private to private or to public is common.

4.5.3 Private Clinics and Private Referral Hospitals in Ethiopia

Investment in education and health infrastructure has been a consistent policy of all successive governments in Ethiopia. The tradition of government support for health development has been a catalyst for the advancement of health care delivery in the country. Financing as well as delivery of health services has historically involved in public and private sector actors (Bhat, 1996). Expanding private sector reduces the burden on the government, of ever increasing demand for health care, offers consumers choice and competition. It will help health sector to improve efficiency and quality and can contribute to health equity. Those able to pay use private services while public resources are aimed at reaching for those who cannot afford to pay (Baru, *et al.*, 2000).

In Sub-Saharan Africa, the private health sector ranges from traditional healers, pharmacies and shop keepers selling health care products, to non-profit and for profit clinics and hospitals. There are varieties of reasons people use private health sector, including convenience, perceived quality, and confidentiality or due to lack of access to public hospitals in their surroundings. Moreover private health care in Sub-Saharan Africa is not just for the rich. Africans of all socio-economic background turn to use private sector for their health care needs (Osewe, 2006). Private hospital sector is expanding significantly in recent years in Ethiopia. The active role of government is a catalyst for the growth of private facilities in the country. Factors outside the health issue are growing disposable income, improvements in literacy, road networks, population growth and long-standing diseases all contribute to the trend (Nair, *et al.*, 2010).

In Ethiopia, especially in the capital city Addis Ababa, there are many private owned clinics and hospitals giving service to the public. These health service providing organizations vary from small clinic to higher referral hospital level. Among them, there are private clinics giving special service for specific case as shown in Table 4.3. It shows the contribution of private hospitals in different specialty areas. This is a good indication that the private health sector is also sharing the load of the public health sectors. But, in the occurrence for the need of complicated cases for critical treatment, even these mentioned private hospitals send their patients to the highest public referral hospitals in Addis Ababa, namely TASH and SPHMMC. These highest referral hospitals possess the knowledge of providing services for complicated cases, but as the demand and service provision capacity are misbalanced most of the time due to problems in the service provision system, there is always complaint from the users.

Table 4.3 List of private owned hospitals with specialty areas in their service

Case	Private Hospitals
Internal Medicine	
Cardiology	Addis cardiac, International cardiac and Landmark hospital
Renal	Bethel, St.Yared, St.Gebriel, Shebelle and Sante Hospitals
Neurology	Yehualashet higher clinic
Hematology	Betezata and Girum Hospital
Gastro intestinal	Landmark hospital, Adera, Mexico and united vision higher clinics
Endocrinology	Landmark hospital, Senay and Yehualashet higher clinic
Infectious disease including HIV	Bethel hospital
Surgical case	
Pediatric surgery	Addis Hiwot Hospital
Chest surgery	Tezena Hospital
Vascular surgery	Teklehaymanot Hospital
Orthopedics	Danu Orthopedic center, Yordanos Orthopedic Hospital, Saron Orthopedic hospital and cure hospital
Gynecology and Orthopedics and Pediatrics	Bras,Betsegah,BGM,Ethio Tebib ,Dinberua Hospital etc.
Opthalmology	Biruh vision clinic, Dr.Seyoum and Waga vision clinic
Neuro surgery	Korea Hospital
Dermatology	Kadisco Hospital and Rank Clinic
Psychiatry	Addisu Michael Psychiatry clinic
Oncology	United vision clinic

4.6 Ethiopian Health Reform Implementation Guidelines (EHRIG)

The Federal Ministry of Heath has been leading a sector-wide reform effort aimed at significantly improving the quality and accessibility of services at all levels of the health system. Through the medical service directorate and as part of this reform, public hospitals in all regions have been implementing the Ethiopian Reform Implementation Guidelines since May 2010. Significant achievements have been registered in terms of effectiveness, efficiency of the hospital processes as well as patient satisfaction as measured by the hospital key performance indicators (http://www.moh.gov.et/hospital-reform accessed on June 2015). The EHRIG includes 124 hospital management standards that assess 13 functions, namely, leadership and governance, patient flow, medical records management, pharmacy services, laboratory services,

nursing care, infection-prevention, facilities management, medical equipment management, financial and asset management, human resource management, quality management and monitoring and reporting. The percentages of EHRIG standards met by hospitals are collected and reported quarterly by government hospitals in Ethiopia since September 2010, with a subset being audited by RHBs (McNatt, *et al.*, 2014). Hospitals in Addis Ababa are grouped in two namely; federal hospitals and health bureau hospitals, and their performance is assessed independently. Figure 4.9 and 4.10 show performance of the hospitals based on the EHRIG standard. It is evaluated based on the 13 functions for the past five years.

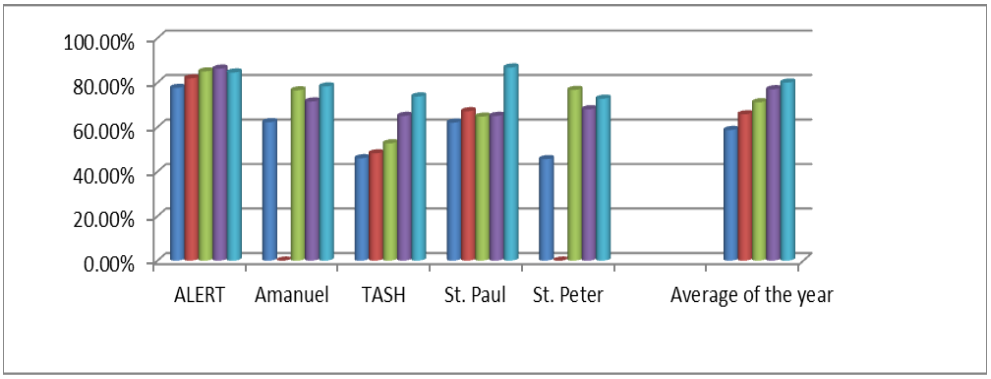


Figure 4.9 EHRIG adherence of Addis Ababa federal hospitals for the past five years

Through years since 2011(2003 EFY) all federal hospitals have cumulative improvement from 58.6% in 2003 to 80% in the year 2015. In 2011, there was problem of data completeness and similar problems were observed in 2012 too. Since 2013 all data reported are complete and it is observed that chapter-owners and key performance indicators (KPI) data owners have developed awareness of their own data. There is still inconsistency between each quarter, which still shows lack of focus on data owners. Three hospitals out of 5 federal hospitals have met above 75% and two hospitals are very close to 75% of EHRIG adherence.

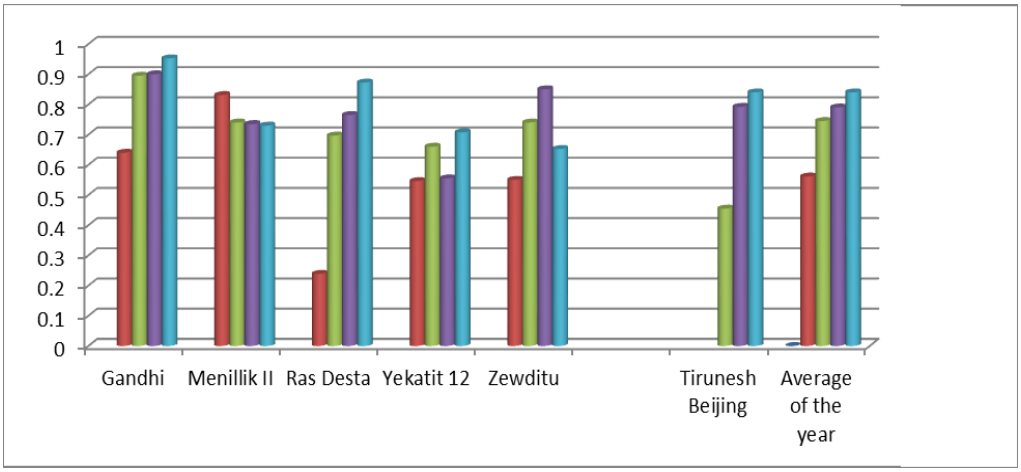


Figure 4.10 EHRIG adherences of Addis Ababa Health Bureau Hospitals for the Past five years

In 2011there was no report of EHRIG, AAHB hospitals have reported since 2012. Similar with federal hospitals, it has been seen an incremental change from year to year. Tirunesh Beijing hospital officially opened in 2012 and report started since 2013. Three hospitals out of six have above 75% and three hospitals are below 75% in 2015 average of the year. The measurements are made based on KPI. These indicators have eleven categories focusing on, hospital management,emergency, referral, outpatient, inpatient maternity ,pharmacy, productivity, human resources and fininace services. There are thirty six key performance indicative points for the eight categories which are measured quarerly by the Health Management Information System (HMIS). Though the result of the performance is appreciable, there are still major compalints in the reponsiveness of the sector. Though the result of the performance is appreciable, there are still major compalints in the reponsiveness of the sector. The performance of the hospitals is thus traced by the report. In the plan for 2016 by EHRIG, it is aimed to meet 100% of the improvement needs in the sector. Generally, hospitals in Ethiopia are trying to enhance their service quality through continuous trial and assessement of existing service quality level. The strengthes, weaknesses, opportuniyies and treats (SWOT) in the sector is studied.

4.7 SWOT Analysis of the Ethiopian Healthcare Improvement Approaches

In the Ethiopian Healthcare sector, different activities aimed at improving quality and enhancing service delivery have been done. The approaches have their own strengths, weaknesses, opportunities and threats and are the core elements of the discussion in this section as shown in Table 4.4.

Table 4.4 SWOT Analysis

Helpful	**Harmful**
Strengths	**Weaknesses**
✓ Continuous assessment on the performance of hospitals by implementing reform guideline(Ethiopian Health Reform Implementation Guideline) ✓ Diversification of Health Posts, Health Centres, Higher Hospitals and Referral Hospitals in Ethiopia ✓ Improved accesses to healthcare service in the country ✓ Increased number of professionals in the healthcare sector ✓ Use of Health Management Information system to track the performance of activities by using key performance indicators	✓ More attention is given on increasing the number of health centres, the concept of focusing on quality lags behind. ✓ Quality problem in the service delivered by healthcare centres. ✓ Weak integration in managing the need of patients to get access in the area ✓ Delay in the access of pharmaceutical in the sector ✓ High Attrition rate of professionals ✓ Lack of medical equipment for special treatment like for cases of cancer and kidney transplant. ✓ Lack of full record of patient information
Opportunities	**Threats**
✓ Especial attention is given to the sector by the government. ✓ Significant trial on how to improve quality of service sectors is going on. ✓ Benchmarking based on developed countries experience in healthcare	✓ Escalating medical equipment and pharmaceutical cost. ✓ High rate of population rise.

4.8 Summary

In representing the existing healthcare sector's status, worldwide, in Africa as well as in Ethiopia, it can be said that there is an upright improvement in healthcare coverage. There are also efforts trying to bring the healthcare quality to a better level in Ethiopia. Among the efforts, the detail plan in HSDP IV to help in fulfilling the plans in GTP I is the major one. To meet the planned activities, different service quality improvement approaches are undertaken in Ethiopian Public Hospitals. Implementations of BPR and Kaizen have also been core elements though their benefit is not as expected. Having the mentioned efforts of improvement, there is still customer complain on the less responsiveness of the service given in the sector as it is wide and implementation of few tools cannot be enough to mitigate the deep rooted problems.

The complaints are on the less responsiveness of the overall activities in the services given in different departments of healthcare centres namely: emergency, referral, inpatient and outpatient cases in hospitals. To work on how to mitigate the mentioned problems, the core areas with aggravated customer complaints should be selected first as it is done in chapter Five.

Chapter Five

Prioritization of Improvement Areas Using Fuzzy-AHP Approach

This chapter discusses the Fuzzy- AHP approach to prioritize service improvements in the study area. Its first part introduces the concept of Fuzzy-AHP and the second part examines tools used previously to assess improvement issues while the third deals with methods of prioritization prior to Fuzzy-AHP. The fourth and fifth parts of the chapter concentrate on the service quality dimensions in relation to Fuzzy-AHP. Sensitivity analysis of the result achieved is discussed in the final part of the chapter.

5.1 Introduction

Service activities are multifaceted and have distinctive behaviors of being delivery and consumption simultaneously. This makes them intricate and problematic. It is also common for customers to express complaints in service areas. In healthcare centres, the complaints are numerous and need immediate solution as the activities in healthcare consist of saving lives as fast as possible. Thus, improving the service quality of healthcare centres is a crucial issue.

In addition, customer needs are different in character and difficult to understand. For example, two customers may have opposite feelings on the same service. Even if their feelings are not diametrically opposed, their opinions on the same service may vary in their degree of satisfaction. Because of this, prioritizing improvements of service quality in healthcare is a difficult exercise due to variations in ranking with different scales. The previous tools such as the likert scale have limited options of quantifying the needs of customers. On the other hand, the Fuzzy-AHP scale gives a range value from equal importance to extremely more importance with value breakdown of (1,1, 2) for the least and (8,9,10) for the highest value. This implies that the Fuzzy-AHP is a better measurement of alternative values than the previous tools.

In order to prioritize improvements, their should be a means of measuring service quality more or less precisely by using quality dimensions, namely Tangibles (physical facilities, equipment, and appearance of contact personnel), Reliability (ability to perform the promised service reliably and accurately), Responsiveness (willingness to help customers and provide prompt service), Assurance (knowledge and courtesy of employees and their ability to inspire trust) and Empathy (provision of caring, individualized attention to consumers). Hence, linguistic values are used to assess the ratings and weights of the quality dimensions. Then, AHP model based on fuzzy sets theory is used in dealing with prioritizing service quality improvements.

In the existing methods, there is no single method which fully handles the difficulties and uncertainties in understanding the human needs. In this chapter, a fuzzy logic integrated with analytical hierarchy process (fuzzy -AHP) is used in order to consider the uncertainties to prioritize service quality improvement in and solve the drawbacks of the exiting methods. As a result, service quality dimensions: Tangibles, Reliability, Responsiveness, Assurance and Empathy are found to be critical factors to prioritize the existing service quality level. In addition, linguistic values are used to assess the ratings and weights of the factors. Then, AHP model based on fuzzy-sets theory has been used to deal with prioritizing service quality improvement in healthcare problems. Tikur Anbessa Specialized Hospital in Ethiopia is taken as a case area to deal with the prioritization of improvement needs and a sensitivity analysis is finally performed to justify the results.

In most of the developed countries, service sector has a considerable share in employment and it is increasing day by day. In addition, service sectors are the main drivers of the economy. As a result without service sectors, developments of other sectors are not possible. This means, the quality of services should be continually improved. Thus, it is found to be that service quality is the key role for success in differentiating the products (services). Therefore, enhancing the service quality became vital issue in recent times. Service quality of healthcare sector is fairly variable and healthcare quality is important because human health is in subject and it is crucial to provide healthcare service that meets or exceeds patients' expectations. It also gives us the reason to choose this sector for implementation in such an increasing population and developing country (WU, *et al.*, 2004).

5.2 Service Quality Improvement Prioritization Approaches

Providing quality healthcare is an important issue because its twin consequences are relief from suffering and improved health status in humans (Bowers, 2002). But without measuring the level of priority given for each service dimension by different customers in healthcare departments, improvement cannot be achieved easily. Thus, prioritization of improvement needs should be the first step for service quality improvement. Measurement based improvements have been applied in healthcare having their own contributions as well as drawbacks in bringing the intended improvement.

The improvement approaches have tried to address the improvement areas by following a general attitude of quality improvement. Different research works were reviewed on how to measure service quality and work for improvement (Büyüközkan, *et al.*, 2011, Li, 2013, Dhote, *et al.*, 2012, Parasuraman, *et al.*, 1985 and WU, *et al.* , 2004). In the reviewed research works, service and the accompanying service quality are chosen for research and analysis. Ways to measure the service quality were also proposed as statistical methods, benchmarking, SERVQUAL (service quality methodology), etc. One of the approaches used for analysis in most of previous studies was the use of Likert Scale which was originally introduced by Rensis Likert in 1932 (Li, 2013). In addition to the commonly used Likert scale, other advanced approaches have been studied to improve quality. By the use of SERVQUAL as a methodology in an effort to measure service quality and by the use of fuzzy extended AHP to evaluate proposed service quality framework was done to assess hospital performance in Turkey (Büyüközkan, *et al.,* 2011). The study prioritized the dimensions after developing a model to measure the relative healthcare performance. A study aimed at integrating the five dimensions of SERVQUAL and fuzzy theory was done by using the five dimensions of SERVQUAL and adopted a fuzzy set theory based research design (WU, *et al.*, 2004). According to the research undertaken by Dhote (2012), identification of the patients' perceived values toward hospitals has been done and the fuzzy logic, a method that had been developed to reflect the fuzzy nature of the human mind was adopted.

The studies discussed above and other studies referred to for this research have contributed a lot to improve service quality in healthcare, but have also some drawbacks. For the case of using Likert Scale in gathering data, it does not give value for the in-between values. As a result, a significant amount of information is lost and/or distorted due to the built-in limitations of the Likert method. The other studies have a drawback of following a general improvement approach without prioritizing the need of the customers in major healthcare departments. This is creating a difficulty in how to prioritize the improvement needs in the sector.

From the existing methods, there is no single method which fully handles the uncertainty through the integrated use of tools to handle the vagueness in understanding human needs. This chapter used a fuzzy-AHP to prioritize the need of customers in the major services of healthcare sector and solve the pitfalls with the exiting methods. However, up to now, no research has been conducted by using fuzzy-AHP to prioritize the need of customers in the major services of healthcare sector.

5.3 Steps for Prioritization of Improvement Needs

Prioritizing the need of customers in the major services of healthcare consists of five main steps:

1. Identifying the major service quality dimensions
2. Prioritizing the service quality dimensions based on fuzzy-AHP
3. Selection of case study and development of alternatives
4. Prioritize and Rank the alternatives
5. Sensitivity Analysis

5.4 Service quality improvement Prioritization using Fuzzy-AHP

5.4.1 Fuzzy - AHP

In this section, the Fuzzy-AHP is found to be a better approach to work on the identified gap of prioritizing the need of customers in major cases of healthcare departments. Because, fuzzy logic is primarily concerned with quantifying and reasoning using linguistic expression in which words can have ambiguous meaning. Supporting and extending it with AHP helps to give a

reasonable weightage in the study to prioritize customer needs in different healthcare departments. In many practical cases, the linguistic assessment of human feelings and perceptions are vague and it is not reasonable to represent it in terms of precise numbers. It feels more confident to give interval judgments than fixed value judgments (Dag, 2013). Also as the service quality concept is an intangible phenomenon because of criteria, it makes people more difficult to evaluate it. Thus, the case of fuzzy- AHP approach adequately handles the difficulty and uncertainty in understanding the human preferences, this approach is more desirable and helpful for evaluation. The fuzzy- AHP methodology extends Saaty's AHP by combining it with the fuzzy set theory pioneered by in 1965 by Zadeh (Büyüközkan, *et al.*, 2011). As the focus of this section is on using this approach for prioritizing customer needs in major cases of healthcare departments, some terminologies and operations of fuzzy logic are defined and explained in the following sections.

5.4.2 Fuzzy Sets

A membership function in fuzzy sets assigns to each object a grade of membership in [0, 1]. A tilde is placed above a symbol if the symbol represents a fuzzy set. A triangular fuzzy number (TFN), M is shown in the figure 5.1. A TFN is denoted simply as (l, m, u). The parameters l, m, and u denote the smallest possible value, the most promising value and the largest possible value that describe a fuzzy event (Kahraman, *et al*., 2003). When l=m=u, it is a non-fuzzy number by convention (Dag, 2013). As shown in equation (1), and each TFN has linear representations on its left and right side such that its membership function can be defined as:

$$\mu_{\widetilde{M}} = \begin{cases} 0, & x < 1 \\ (x - 1)/(m-l), & l \le x \le m, \\ (u- x)/(u- m), & m \le x \le u, \\ 0, & x > u \end{cases} \qquad (1)$$

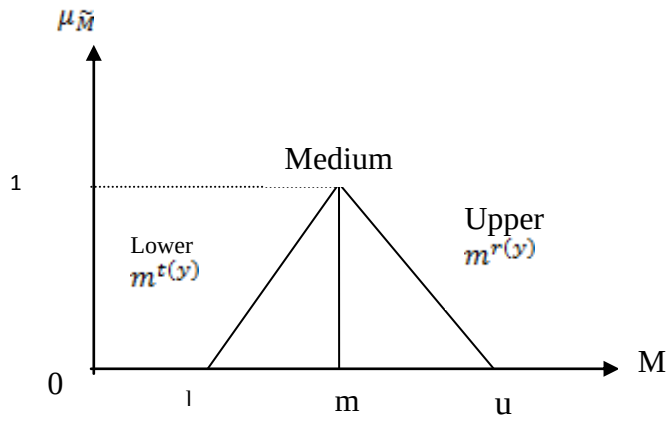


Figure 5.1 A triangular membership function of fuzzy number

A fuzzy number can always be given by its corresponding left and right representation of each degree of membership [8]:

$$\tilde{M} = M^{l(y)}, M^{r(y)} = (l + (m - l)y, u + (m - u)y, y \in [0,1) \qquad (2)$$

Where $M^{l(y)}$ and $M^{r(y)}$denote the left side representation and the right side representation of a fuzzy number respectively.

According to the method of Chang (1992), the extent analysis is used to consider the extent of an object to be satisfied for the goal, that is, a satisfied extent. In the method, the ‘‘extent’’ is quantified by using a fuzzy number. On the basis of the fuzzy values for the extent analysis of each object, a fuzzy synthetic degree value can be obtained. As an example, in a supplier selection problem, let X= $\{x_1, ., x_n\}$ represent the elements of the alternatives as an object set and let U= $\{u_1, ., ., u_m\}$ represent the elements of the supplier selection criteria as a goal set. Each object is taken and extent analysis for each goal g_i is performed respectively. Therefore, m extent analysis values for each object can be obtained with the following signs:

$M_{gi}^1, M_{gi}^2, ., ., ., M_{gi}^m$, i=1, 2, 3,.,., n (3)

Where all the M_{gi}^j (j=2,.,.,n) are TFNs.

5.4.3 Computational Procedure of Fuzzy-AHP

Step 1. The value of fuzzy synthetic extent with respect to i^{th} object is defined as:

$$S_i = \sum_{j=1}^{m} M_{jgi} \; *1/\sum_{i=1}^{n}\sum_{j=1}^{m} M_{jgi} \qquad (4)$$

To obtain $\sum_{j=1}^{m} M_{jgi}$, the fuzzy addition operation of m extent analysis values for a particular matrix is done such that:

$$\sum_{j=1}^{m} M_{gi}^{j} = \left(\sum_{j=1}^{m} l_j \, , \sum_{j=1}^{m} m_j , \sum_{j=1}^{m} u_j\right), \;\; i = 1,2, \ldots, n \qquad (5)$$

To obtain $\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-i}$, the fuzzy addition operation is done

$M_{gi}^{j} (j = 1,2, \ldots, n)$ values such that:

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i}\right) \qquad (6)$$

Step 2. The degree of possibility of $M_2 = (l_2, m_2, u_2) \geq M_1 = (l_1, m_1, u_1)$ is defined as:

$$V(M_2 \geq M_1) = \sup_{y \geq x}[\min(\mu_{M1}(x), \mu_{M2}(y))] \qquad (7)$$

And can be equivalently expressed as:

$$V(M_2 \geq M_1) = hgt(M_1 \cap M_2) = \mu_{M2}(d) \qquad (8)$$

Where the value is expected to be:

$$\begin{cases} 1, & \text{if } m_2 \geq m_1, \\ 0, & \text{if } l_1 \geq u_2, \\ l_1\text{-}u_2/(m_2 - u_2) - (m_1 - l_1) & \text{otherwise} \end{cases} \qquad (9)$$

Where d is the ordinate of the highest intersection point D between μm_1 and μm_2. Fig.3 below shows the intersection point between M_1 and M_2. To compare M_1 and M_2, the values of $V(M_1 \geq M_2)$ and $V(M_2 \geq M_1)$ are needed.

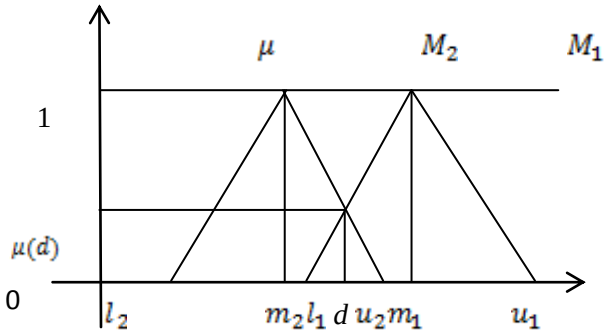


Figure 5.2 The intersection between M_1 and M_2 (Chang, 1992).

Step 3. The degree of possibility for convex fuzzy number to be greater than k convex fuzzy numbers M; (i = 1 , 2 ,. . ., k) can be defined by:

$$V\ (M \geq M_1 M_2, \ldots, M_k) = V[\ (M \geq M_1 \text{and}\ (M \geq M_2) \text{and} \ \ldots \ \text{and}\ (M \geq M_k)] = \min V(M \geq M_i),\ i = 1,2,3,\ldots,k) \quad (10)$$

Assume that

$$d'\ (A_1 = \min V\ (S_i \geq S_k) \quad (11)$$

For K=1,2…n; K≠i, then the weight vector is given by

$$W'\ ((d'(A_1),\ (d'(A_2)\ldots\ (d'(A_n)\ )^T \quad (12)$$

Where $A_i\ (i = 1,2, \ldots, n)$ are n elements.

Through normalization, the normalized weight vectors are

$$W=(d(A_1), d(A_2),\ldots,d(A_n))^T \quad (13)$$

5.5 Service Quality Dimensions

Before focusing on prioritization of immediate improvement needs, there should be a measuring means for the need of the customer and the existing service quality level. Service quality is essential to obtain and retain customers, through the function of customer satisfaction and repurchase (Caruana , 2002). It is the primary contributor to the competitive strength of firms (Dubrovski, 2001 and Kaye, 1999). Literatures have identified that the major and common service quality dimensions are, Tangibles, Reliability, Responsiveness, Assurance and Empathy

which is provision of caring and individualized attention to consumers (Parasuraman, *et al.*, 1985). These five dimensions are identified as per their expressive content of service quality.

5.5.1 Pair-wise Comparison

After identifying the service quality dimensions, different priority weights of each service quality dimensions are calculated using the fuzzy-AHP approach. The comparison on the importance of one service quality dimension over another is done by using the questionnaire as explained in detail in Appendix B. The questionnaire facilitated the answers of pair-wise comparison questions. The preference of one measure over another was decided by the experience of experts in the area.

Experts used the linguistic variables to compare the criteria with respect to the main goal. Then the linguistic variables were converted to fuzzy numbers. Table5.1 shows the linguistic variables and their corresponding fuzzy numbers.

After the pair-wise comparison matrices were formed, the consistency of the pair-wise judgment of each comparison matrix was checked, using the calculation method of consistency index and consistency ratios in crisp AHP.

Each fuzzy number, $M = (l, m, u)$ in the pair-wise comparison matrix was converted to a crisp number using M-crisp= $(4* m + l + u)/6$. After the fuzzy comparison matrices were converted into crisp matrices; the consistency of each matrix was checked by the method in crisp AHP.

After calculating the consistency ratios of the entire matrix and making it below 0.1, the next step is to calculate the weight vector for each factor lying at different levels of the hierarchy by the use of fuzzy-AHP approach.

Table 5.1. Definition and Membership Function of Fuzzy Scale (Satty, 1989).

Intensity of Importance	Fuzzy Number	Definition	Membership Function
9	$\tilde{9}$	Extremely more importance(EMI)	(8,9,10)
7	$\tilde{7}$	Very strong importance(VSI)	(6,7,8)
5	$\tilde{5}$	Strong importance(SI)	(4,5,6)
3	$\tilde{3}$	Moderate importance(MI)	(2,3,4)
1	$\tilde{1}$	Equal importance(EI)	1,1,2)

Step 1. Comparison of the relative strength of each dimension in the same hierarchy

Before going further, there should be the relative weightage of each service quality dimension: Tangibles (T), Reliability (Rel), Responsiveness (Res), Assurance (A) and Empathy (E) with respect to the other as shown in Table 2 by using the Saaty's fuzzy scale. A linguistic evaluation with respect to each dimension is taken. The base for giving this weightage is a discussion with experts having more than ten year work experience in the hospital.

- Reliability is strongly important than tangibles.
- Responsiveness is very strongly important than tangibles.
- Assurance is moderately important than tangibles.
- Empathy is equality important as tangibles, responsiveness, and assurance, etc.

Table 5.2. Fuzzy Evaluation Matrix With Respect to Service Quality Dimensions

	T	**Rel**	**Res**	**A**	**E**
T	(1,1,1)	(0.17,0.2,0.25)	(0.13,0.14,0.17)	(0.25,0.33,0.5)	(0.5,1,1)
Rel	(4,5,6)	(1,1,1)	(2,3,4)	(0.5,1,1)	(0.25,0.33,0.5)
Res	(6,7,8)	(0.25,0.33,0.5)	(1,1,1)	(1,1,2)	(0.5,1,1)
A	(2,3,4)	(1,1,2)	(0.5,1,1)	(1,1,1)	(0.5,1,1)
E	(1,1,2)	(2,3,4)	(1,1,2)	(1,1,2)	(1,1,1)

For the detail computation, the row sum and the column sum of each dimensions is needed to know weights for each dimensions and to further proceed in calculating the degree of possibility in step 2. The total column sum should is also computed and result of these summations is represented in Table 5.3. Then further calculations of the weights for each dimension can be easily done.

Table 5.3. Row and Column Sum of Service Quality Dimension

	Row Sums	**Column sums**
Tangibles	(2.05,2.67,2.92)	(14,17,21)
Reliability	(7.75,10.33,12.5)	(4.42,5.53,7.75)
Responsiveness	(8.75,10.33,12.5)	(4.63,6.14,8.17)
Assurance	(5,7,9)	(3.75,4.33,6.5)
Empathy	(6,7,11)	(2.75,4.33,4.5)
Column Sum		**(29.55,37.33,47.92)**

s_1= (2.05,2.67,2.92) *(1/47.9,1/37.33,1/29.55)= (0.04,0.07,0.10)

s_2 = (7.75,10.33,12.5) *(1/47.9,1/37.33,1/29.55)= (0.16,0.28,0.42)

s_3 = (8.75,10.33,12.5) *(1/47.9,1/37.33,1/29.55)= (0.18,0.28,0.42)

s_4= (5,7,9)*(1/47.9,1/37.33,1/29.55)=(0.10,0.19,0.30)

s_5 = (6,7,11)* (1/47.9,1/37.33,1/29.55)= (0.13,0.19,0.37).

Step 2: To calculate the degree of possibility of Si over Si (i – j) , equation (7) and (8) are used.

$V(S_1 \geq S_2) = l_1 \geq u_2$=0

$V(S_1 \geq S_3) = l_1 \geq u_2$=0

$V(S_1 \geq S_4) = l_1 \geq u_2$=0

$V(S_1 \geq S_5) = l_1 \geq u_2$=0

$V(S_2 \geq S_1) = m_2 \geq m_1$=1

$V(S_2 \geq S_3) = m_2 \geq m_1$=1

$V(S_2 \geq S_4) = m_2 \geq m_1$=1

$V(S_2 \geq S_5) = m_2 \geq m_1$=1

$V(S_3 \geq S_1) = m_2 \geq m_1$=1

$V(S_3 \geq S_2) = m_2 \geq m_1$=1

$V(S_3 \geq S_4) = m_2 \geq m_1$=1

$V(S_3 \geq S_5) = m_2 \geq m_1$=1

$V(S_4 \geq S_1) = m_2 \geq m_1$=1

$V(S_4 \geq S_2) = \frac{0.16-0.30}{(0.19-0.30)-(0.28-0.16)}$=0.61 $V(S_4 \geq S_3) = \frac{0.18-0.42}{(0.28-0.42)-(0.28-0.18)}$ =1

$V(S_4 \geq S_5) = m_2 \geq m_1$=1 $V(S_5 \geq S_1) = m_2 \geq m_1$=1

$V(S_5 \geq S_2) = \frac{0.16-0.30}{(0.19-0.30)-(0.28-0.16)}$=0.7 $V(S_5 \geq S_3) = \frac{0.16-0.30}{(0.19-0.30)-(0.28-0.16)}$ =0.75

$V(S_5 \geq S_4) = m_2 \geq m_1$=1

Step 3. The degree of possibility for a convex fuzzy number to be greater than k convex fuzzy numbers $M_i (i = 1,2, \ldots, k)$ can be defined by equation(11):

$$d(A_t) = \min V(S_i \geq S_k)$$

$V(M \geq M_1, M_2, \ldots, M_k) = V[(M \geq M_1) and\ (M \geq M_2) and \ldots and\ (M \geq M_k)] = minV(M \geq M_i), i = 1,2,3, \ldots, k\ W' = ((d'(A_1), d'(A_2), \ldots, d'(A_n))^T$

Where A_i $(i = 1,2, \ldots, n)$ are n elements. Via normalization, the normalized weight vectors are:

$$W = (d(A_1), d(A_2), \ldots, d(A_n))^T$$

Where W is a non-fuzzy number. This gives the priority weights of one alternative over another.

d′(C1) = V($S_1 \geq S_2, S_3, S_4, S_5$) = min(0,0,0,0,) = 0

d′(C2) = V($S_2, \geq S_1, S_3, S_4, S_5$) = min(1,1,1,1) = 1

d′(C3) = V($S_3 \geq S_1, S_2, S_4, S_5$) = min(1,1,1,1) = 1

d′(C4) = V($S_4, \geq S_1, S_2, S_3, S_5$) = min(1,0.61,1,1) = 0.61

d′ (C5) = V ($S_5 \geq S_1\ S_2, S_3, S_4,$) = min (1, 0.7, 0.75,1) = 0.7

W′ = (0, 1, 1, 0.61, 0.7)

Through normalization, the weight vectors are obtained with respect to the decision criteria C_1, C_2, C_3, C_4 and C_5 :W = (0,0.30,0.30,0.18,0.21).

The final weights for Tangibles (T), Reliability (Rel), Responsiveness (Res), Assurance (A) and Empathy (E) were found to be 0, 0.3, 0.3, 0.18, and 0.21 respectively. It is concluded that the most important quality dimensions per the need of the customer to be prioritized in the major services of healthcare sector are Reliability (Rel) and Responsiveness (Res) as they have the highest and equal priority weight. Empathy (E) is the next preferred dimension.

5.5.2. Prioritizing service quality improvement needs in Ethiopian Healthcare

The healthcare sector in Ethiopia is with aggravated customer complaints. To minimize this complain different activities that focus on improving the existing service delivery mechanism in the sector have been done. Among them, the use of a reform cycle for controlling quality in the hospital having similarity with the Deming's PDCA (Plan, Do, Check, Act) was used as a blueprint to improve the overall service quality in hospitals. BPR (Business Process Re-engineering) was also implemented in 2010 to improve the service quality in the highest referral hospital in Addis Ababa (Tikur Anbessa Specialized Hospital). But the results achieved were not as expected. These improvement activities were not successful because they lack a focus of prioritizing customer needs in the major cases of healthcare departments of the sector. Though the need of customers in healthcare sector can be generalized as to get fast and good service of life of saving lives, the major priority of the service dimensions in major cases of healthcare departments is not clearly stated in the hospital rather it follows a general approach of service quality improvement. This section dealt with how to prioritize customer needs in different cases of healthcare departments by measuring the dominant service quality dimensions using the fuzzy extended AHP concept and by taking the case of Tikur Anbessa Specialized Hospital.

Tikur Anbessa Specialized Hospital is the highest referral hospital in Ethiopia. The major departments are: Emergency, Outpatient, Referral, Gynecology and Obstetrics, Surgical, Pediatric and Inpatient department for different medical cases. But in all departments, there are Emergency cases, referral cases and outpatient cases. Thus, this study focused on these three representative cases throughout the hospital and on measuring the major service dimensions (tangibles, reliability, responsiveness, assurance and empathy) in each case as the level of complaints are different in all cases. This indicates the priority of different quality needs is

different in all the departments. For an ease of identifying the improvement needs, the level of the priorities needed in each department should be studied. To assess this, the SERVQUAL approach is used supported with the Fuzzy extended AHP concept. By this approach, the major dimensions of service quality are prioritized in the three representative cases of the services in the hospital. Figure 5.3 represents the overall objective, the basic criteria to consider for selection (service quality dimensions) and the major case in healthcare departments that is selected as a result of the measurement and analysis by fuzzy extended AHP.

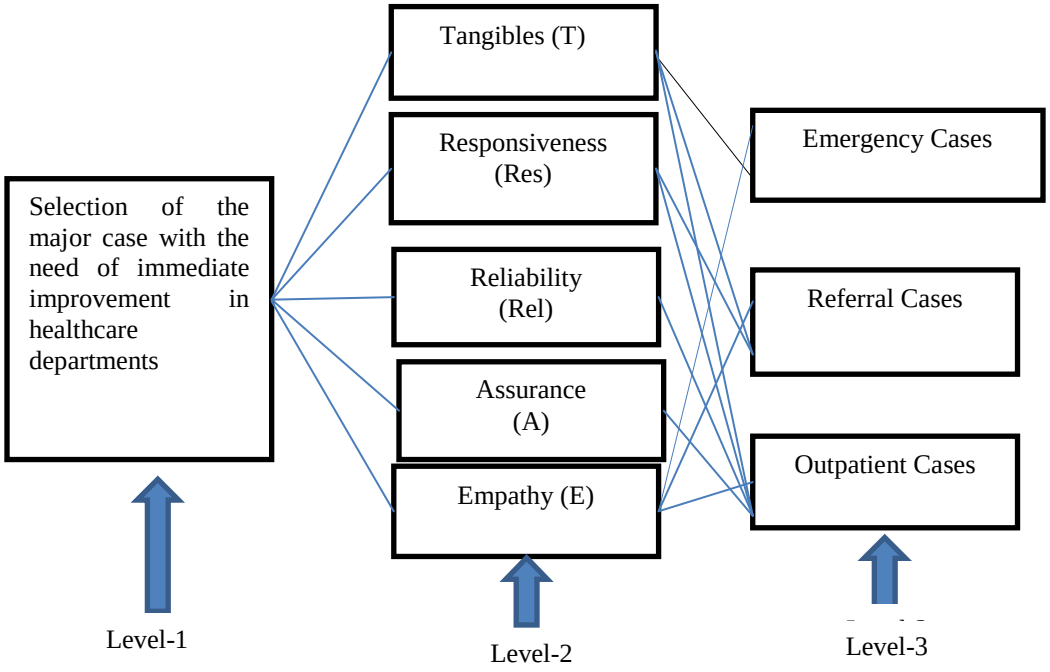


Figure 5. 3 Evaluation Framework to select specific healthcare departments

By applying the fuzzy-AHP concept with fuzzy numbers and hierarchical analysis to find preference weights through a step by step pair- wise comparison in a reasonable way, the major case in need of immediate quality improvement is selected as explained in the next topic.

Similarly, relative weights are given for the five dimensions with respect to each case as represented in Table 5.4, 5.5, 5.6, 5.7 and 5.8. By using the weights given in the tables, raw sum

and column sum calculations and finding the total column sum, the priority weights of the five dimensions in the three major cases in the hospital are computed and represented.

Table 5.4 Pririty of each case in major departments with respect to Tangibles

T	Emergency case	Referral case	Outpatient case	Priorityweight
Emergency case	(1,1,1)	(0.13,0.14,0.17)	(0.25,0.33,0.5)	0
Referral case	(6,7,8)	(1,1,1)	(2,3,4)	1
Outpatient case	(2,3,4)	(0.25,0.33,0.5)	(1,1,1)	0

Table 5.5 Pririty of each case in major departments with respect to Reliability

Rel	Emergency case	Referral case	Outpatient case	Priority weight
Emergency case	(1,1,1)	(6,7,8)	(0.5,1,1)	0.42
Referral case	(0.13,0.14,0.17)	(1,1,1)	(4,5,6)	0.16
Outpatient case	(1,1,2)	(0.17,0.2,0.25)	(1,1,1)	0.42

Table 5.6. Pririty of each case in major departments with respect to Responsiveness

Res	Emergency case	Referral case	Outpatient case	Priorityweight
Emergency case	(1,1,1)	(8,9,10)	(6,7,8)	0.66
Referral case	(0.1,0.11,0.13)	(1,1,1)	(0.5,1,1)	0.17
Outpatient case	(0.13,0.14,0.17)	(1,1,2)	(1,1,1)	0.17

Table 5.7. Pririty of each case in major departments with respect to Empathy

Empathy	Emergency case	Referral case	Outpatient case	Priority weight
Emergency case	(1,1,1)	(0.5,1,1)	(2,3,4)	0.52
Referral case	(1,1,2)	(1,1,1)	(0.5,1,1)	0.28
Outpatient case	(1,1,2)	(1,1,2)	(0.5,1,1)	0.30

Table 5.8. Pririty of each case in major departments with respect to Assurance

Assurance	Emergency case	Referral case	Outpatient case	Priority weight
Emergency case	(1,1,1)	(1,1,2)	(2,3,4)	0.52
Referral case	(0.5,1,1)	(1,1,1)	(0.25,0.33,0.5)	0.04
Outpatient case	(0.25,0.33,0.5)	(2,3,4)	(1,1,1)	0.44

After having the priority weights of the five dimensions in the three cases, all the weights are collected in one table as shown in Table 5.9.

5.5.3 Prioritization and ranking of the alternatives

The same calculations were applied to the other pair-wise comparison matrices and the priority weights in the three cases with respect to the five dimensions, Tangibles (T), Reliability (Rel), Responsiveness (Res), Assurance (A) and Empathy (E). Results of these pair-wise comparison matrices are shown in Table 5.9.

By taking the average of each of the priority weights, the final weight that should be given in the major cases of all departments is determined. From the result found and represented in the last column of this table, the case that needs immediate quality improvement is known. The priority weights for the alternatives were found to be (0.42, 0.33, 0.25). According to the result, healthcare service in emergency cases should be first improved to minimize customer complaints and then the referral cases and Outpatient cases should be assessed accordingly.

Table 5. 9. Pririty of each Department with respect to the overall service quality dimensions

Cases	T	Rel	Res	E	A	Weight
Emergency case	0	0.42	0.66	0.52	0.52	0.42
Referral case	1	0.16	0.17	0.28	0.04	0.33
Outpatient case	0	0.42	0.17	0.20	0.44	0.25

5.6 Sensitivity analysis

A sensitivity analysis is conducted in order to monitor the robustness of the preference ranking among the alternative cases by changing the priority weights of the quality dimensions. Five trials have been done to justify the results. As shown in figure 5.4 in most trial cases, the ranking among the alternatives stayed the same. In case 1 when Tangibles (T) quality dimension significantly higher than the others and in Case 4 Tangibles (T) and Empathy (E) quality dimensions higher than the others, the ranking between emergency cases and referral cases are exchanged. In case 2 when Empathy (E) quality dimension increases, and in case 5 when all quality dimensions have equal weight, the rank of emergency cases referral cases and outpatient case stayed the same. Generally, sensitivity analysis shows that the ranking among the cases is not sensitive to the changes in the weights of the quality dimensions.

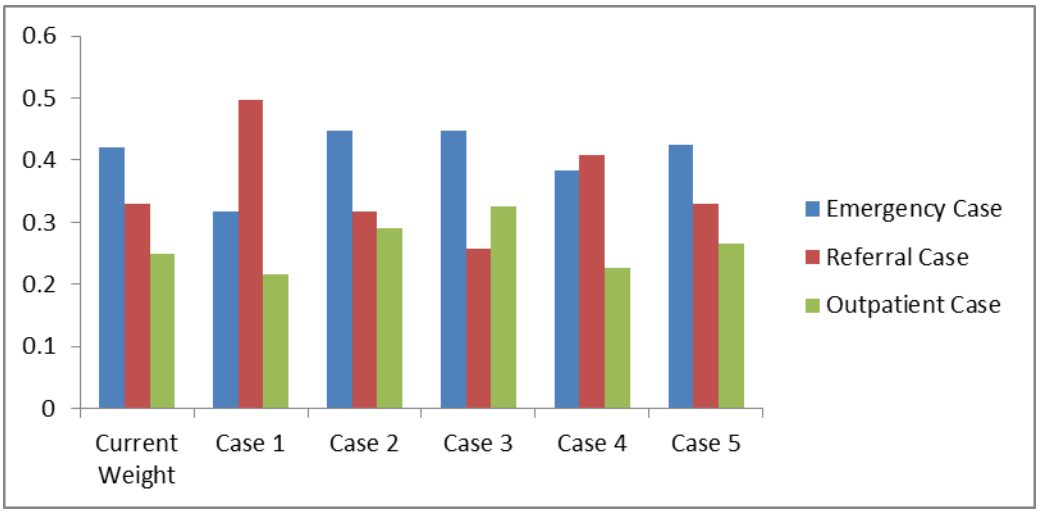


Figure 5. 4 Sensitivity analysis

5.7 Summary

In this study, fuzzy-AHP has been used as a methodology to prioritize the need of immediate quality improvement solutions in core cases of healthcare departments. Using fuzzy-AHP helps in clarifying the ambiguous human needs which is difficult to measure especially in service sectors. Tikur Anbessa Specialized Hospital was selected as a case to illustrate the existing situation and to take an improvement action. Results from this case area are extended to prioritizing improvement needs in other referral hospitals. Finally, sensitivity analysis has been done to discuss and explain the results. Next chapters have investigated the problems in the prioritized areas. The emergency case is in the first rank which needs improvement. But, as emergency service starts outside the hospital, Addis Ababa Dispatch Center is assessed to get full information on the service chain of emergency cases starting from the place where an emergency occurred to emergency service in hospitals. Next to the emergency, the referral case is investigated. As both services may further go to a long stay in hospital, the inpatient service is also highlighted. The basic input to all services in hospitals, which is the pharmaceutical case is also studied in chapter eight.

Chapter Six

Emergency Cases Demand Management in Addis Ababa

This chapter discusses about emergency cases and how they are tackled when they occur due to various reasons. The response to such emergencies either before or after receiving the attention of healthcare personnel is categorized within the sphere of demand management. The chapter explains how emergency cases are treated in Addis Ababa by analyzing existing services and the major problems facing the people deployed in the field on the one hand and those seeking the service on the other, who, more often than not, complain about the existence of delays.

6.1. Introduction

An emergency is a situation that poses an immediate danger to health, life, property, and environment either individually or collectively. Most emergencies require urgent interventions to prevent a worsening of the situation. Urgent cases in need of fast treatment in healthcare can occur at home, at working areas or everywhere in our surrounding. The reasons for the occurrence of the need of fast treatment can be due to car accidents, poor working conditions, occupational injuries or mistakes in operating machines, natural disasters or accidents created by persons knowingly or unknowingly. Such cases should be treated immediately. In Ethiopia, emergency cases were previously managed by ambulances belonging to the Ethiopian Red Cross Society and by ambulances attached to hospitals in Addis Ababa. With increasing population, the demand could not be fulfilled in a proper manner by hospitals and the Red Cross Society. In addition, ambulances from hospitals and the Red Cross Society mostly aim at helping the patient to reach health centres. But during this stage, the condition of the patient might deteriorate before the desired place is reached. Thus, ambulance services with nurses especially assigned for treating emergency cases and the necessary equipment can minimize the adverse condition that can occur to a patient. This is the reason for the establishment of an organization that controls, manages, dispatches ambulances and gives pre-hospital service to a patient till the patient reaches an area for better healthcare - hierarchically a health centre or a hospital. Thus,

the Addis Ababa Dispatch Center (AADC) was established under the Addis Ababa Accident and Fire Emergency Control Authority in order to fill the existing service gap.

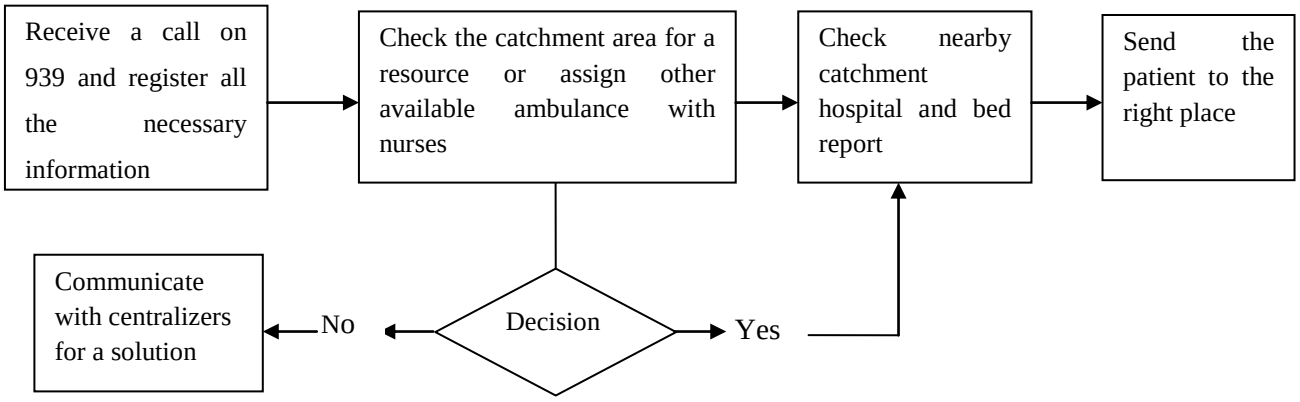
6.2 Addis Ababa Dispatch Center for Emergency cases

AADC was established in 2009 (2001 E.C.). One of the reasons was to manage the ambulance service properly. This means, the centre rebulates the dispatch of ambulances in such a way that all service calls are answered;ambulances are dispatched within the shortest time possible; pre-hospital treatment are given with high degree of care and medical attention; the necessary equipment are used efficiently and effectively and the appropriate manpower are assigned to use their knowledge and skills appropriately.

Ambulacnces in different hospitals did not provide pre-hospital treatment to the patient inside the umbulance to decrase the aggravation of the problem and mortality until the patient reaches hospital. In addition,the red cross association which gives service to emergency cases is not reachable to all service seekers. Thus, dispatch center office works to fill the gap in the existing emergency cases service in the Addis Ababa.

The centre consists of seven branches. The branches are found in different sub-cities namely:Arada, Kirkos, Addis Ketema, Nefas Silk, Akaki/Kaliti ,Bole and Kolfie. At the beginning, two ambulances were assigned to each branch with two nurses. At present, the number of ambulances was doubled with four ambulances operating at each branch together with additional nurses.

All communication contacts between the public and the dispatch centre are done through the telephone. The centre receives a call on 939 and service starts by accepting a call from the callers in different areas in Addis Ababa. The free emergency call number is 939. After registering the name, the age, the area of the caller and the type of accident occurred and gathering all the necessary information , available resources at the catchement area are checked to send ambulance to the place where accident occured and to reach to a near by hospital.



Source: AADC, 2014
Figure 6.1 Core Activities in AADC for emergency cases

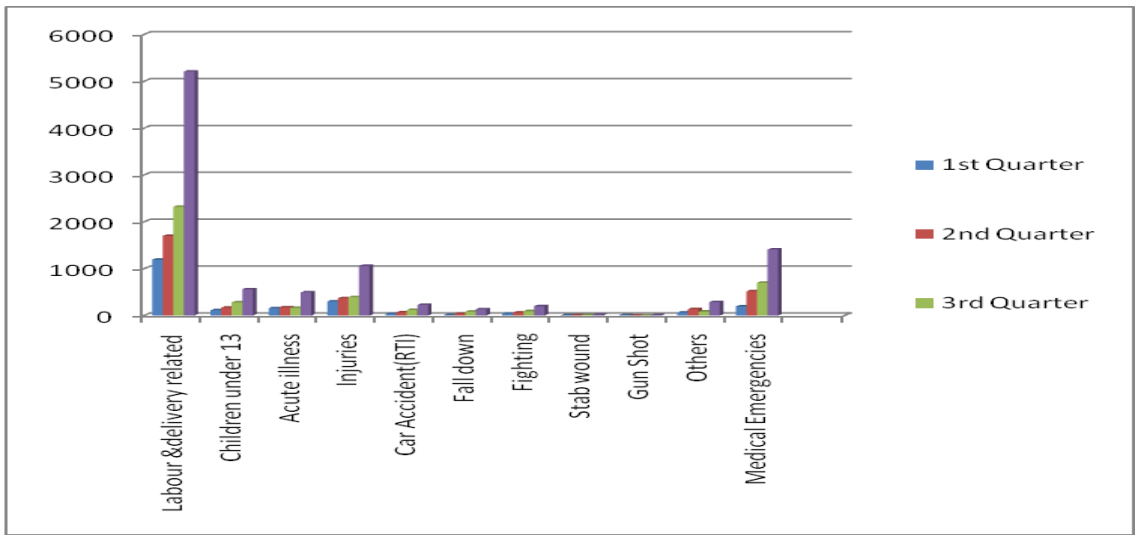
The demand in cases of emergency is increasing in the country. This is assured by the number of calls collected from the call report at Addis Ababa dispatch center main office. Table 6.1 shows the increment in the number of calls from time to time as represented in the nine month call report to the dispatch center.

Table 6.1 Call Report to Dispatch Center

S.No.	Calls to Command post office	Calls to command post to get pre-hospital service			9 month call report
		1st Quarter	2nd quarter	3rd Quarter	Total
1	Call to get ambulance service	2002	2980	3971	8953
2	Direct call from society	250	605	1134	1989
3	Call from health center and hospital to command post	708	2372	2813	6893
4	Service delivered out of the total call	1945	2921	3854	8726
5	Unanswered service due to different cases	51	59	125	230

Source: AADC, 2014

Currently, there is a great attempt towards decreasing maternal death related to medical access for birth at hospital. The dispatch center focuses on giving fast service for delivery cases. In addition, it tries to give services for other emergency cases caused by accidents. The service types delivered to patients called by the emergency call number 939 is shown in Figure 6.2 and the service detail of each case is shown in Table 6.2.



Source: AADC, 2014
Figure 6.2 Pre - Hospital medical and ambulance service

The services given by the Dispatch Center are increasing in number. Similarly, the number of unanswered calls is also rising as shown in Table 6.2. This is an indication for the diversification of the service by the centre as well as the need for better means of managing the service in the centre.

Table 6.2 Call report of Dispatch Center in the past three years

S.No.	Calls to Command post office	Calls to command post to get pre-hospital service			9 month call report
		2012	**2013**	**2014**	**Total**
1	Call to get ambulance service	8953	13326	18000	40279
2	Direct call from community	1989	4813	8013	14815
3	Call from health centre and hospital to command post	6893	18560	24640	50093
4	Service delivered out of the total call	8726	13100	17374	39200
5	Unanswered services	230	500	950	1680

Source: AADC, 2014

Before sending a patient to a nearby hospital, free bed report is checked which is collected twice a day by calling to the liaison offices (check the availability of free bed in hospital) from government hospitals in Addis Ababa. The number of available beds is categorized in different cases of specialty to show the availability of free bed report in each case.

In addition to the problems facing in the working activities of the Dispatch Center, there is a major problem in the availability of free bed. The daily free bed report shows full occupancy (a zero) free bed report in almost every day report and this is becoming a major problem.

The free bed report shown in Table 6.3 is a sample of one day report. The record found in the report is the major obstacle for the proper service delivery by the dispatch centre, because due to this kind of report, time is spent to check by calling to all hospitals for the availability of free bed and to emergency medical service centralizers to look for a solution. The duty and responsibility of emergency medical service centralizers is explained in section 6.6.

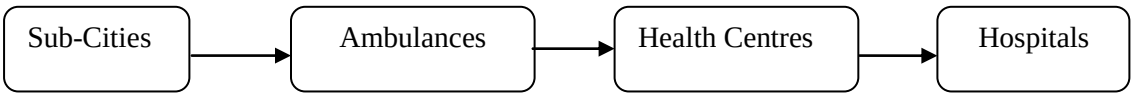
Table 6.3. Sample daily Free Bed Report of Addis Ababa Governmental Hospitals

	Medical		**Surgical**		**Orthopedics**		**Emergency**	
	Morning	**Afternoon**	**Morning**	**Afternoon**	**Morning**	**Afternoon**	**Morning**	**Afternoon**
Black Lion	0	0	0	0	0	0	0	0
Zewditu	0	0	0	0	0	0	0	0
Minilik	0	0	1	0	0	0	0	0
Yekatit 12	0	0	0	0	0	0	0	0
Ras Desta	0	0	0	0	0	1	0	0
Paulos	0	0	0	0	0	0	0	0
Petros	0	0	0	1	0	0	0	0
Gandi	0	0	0	0	0	0	0	1

Source: AADC, 2014

6.3 The Demand Management Process in Dispatch Center

In delvering service to patients by the command post, there is a chain of activities starting from sub cities, health posts, health centres and hospitals. The chain of actvities is based on the proximity of the health centres in different sub cities to hospitals. The demand chain (Figure 6.3) is used in the dispatch centre for delivery cases and other emergency cases. In order to assign hospital for medical cases, there is a chain representing related case treatment in the nearby area of hositals to the health centres for different sub cities as shown in Table 6.4. For the ten sub cities in Addis Ababa, twenty eight ambulances are assigned. These ambulances serve the thirty one health centres and eight higher hospitals including the referral hospitals.



Source: AADC, 2014
Figure 6.3 Demand flow in service delivered by dispatch center

Table 6.4. Sample catchment area for different medical cases

Sub City	Health centres	Opthalmic and Dental	INT/Med, Surgery & E.N.T	Neonotology&Pediatric	Psychatry	Dermatology
Addis Ketema	Addis Ketema,	St.Paulos	Ras Desta	Yekatit 12	Amanuel	Alert
	Woreda 07 &03					
	Woreda 03					

Source: AADC, 2014

From the observation, the office works as much as it can to help patients especially for emergency cases. It works for 24 hours in three shifts (8 hour each shift). Workers in the office are too busy answering calls on the number assigned for the service. There are seven telephone lines and 8 workers (6 workers for answering a call and 2 nurses for understanding the situation in the emergency area) over 24 hours. A worker answering a call registers all the necessary information about the emergency call and tries to assign ambulance for the catchment area after checking the right catchment area for the called case and after checking free bed report of hospitals from the daily recorded document. The first thing for calls from the community is to help them reach health centres in their catchment area. After patients are treated in the health centres, they may be referred to hospitals for further treatment or complete their treatment in the health centre. If further investigation is needed, the health centres may call back for ambulances in the dispatch center after checking the availability of free bed.

In the recorded document review, the way activities are planned, the way free bed report is managed in the office is deeply studied. As a result, there was a result which is hard to believe that the recorded daily free bed report of hospitals is mostly zero. It is hard to imagine how patients are managed in hospitals with such high occupancy of bed for complicated and emergency cases.

6.4 Problems Identifed in the Service Delivery of Dispatch Centre

AADC is providing a good service to the community and to health centres. But there are many problems in the service. In additon to the mensioned major problem (zero free bed report), there are also lots of problems by referral hospitals and health centres that create delay in the service delivery of the Dispatch Center. Some of the existing problems are: refusing to accept a patient sent to the referral hospitals, sending patients back to the referees , refusing to take the assigned case to the hospitals, unnecessary call for ambulance service by the users, unproper referral to hospitals, refuse to accept patients out of their cathment areas, writing improper referral letter(refer to all), refer without giving all the needed service, poor communication from liason to liason and from hospital to hospital and a host of many others. There are also other major barriers like lack of awareness of the society on the proper duty of the dispatch center. This is creating unnecessary calls to come to the office and block the resource to give the right service to the service seekers. Lack of awareness of polices is also creating a delay in reaching to the emergency area. There is also a resource problem in the number of communication radios used in the office. There is only one codded radio is used for communication for the three teams (emergency team,fire team and rescue team). This is creating a delay in the overall service. To provide a determinant solution in the free bed report of hospitals, Addis Ababa Health Office has established a centralizer team that helps to solve the problems in the emergency services. The duties and responsibilities of the centralizers is explained in the next section.

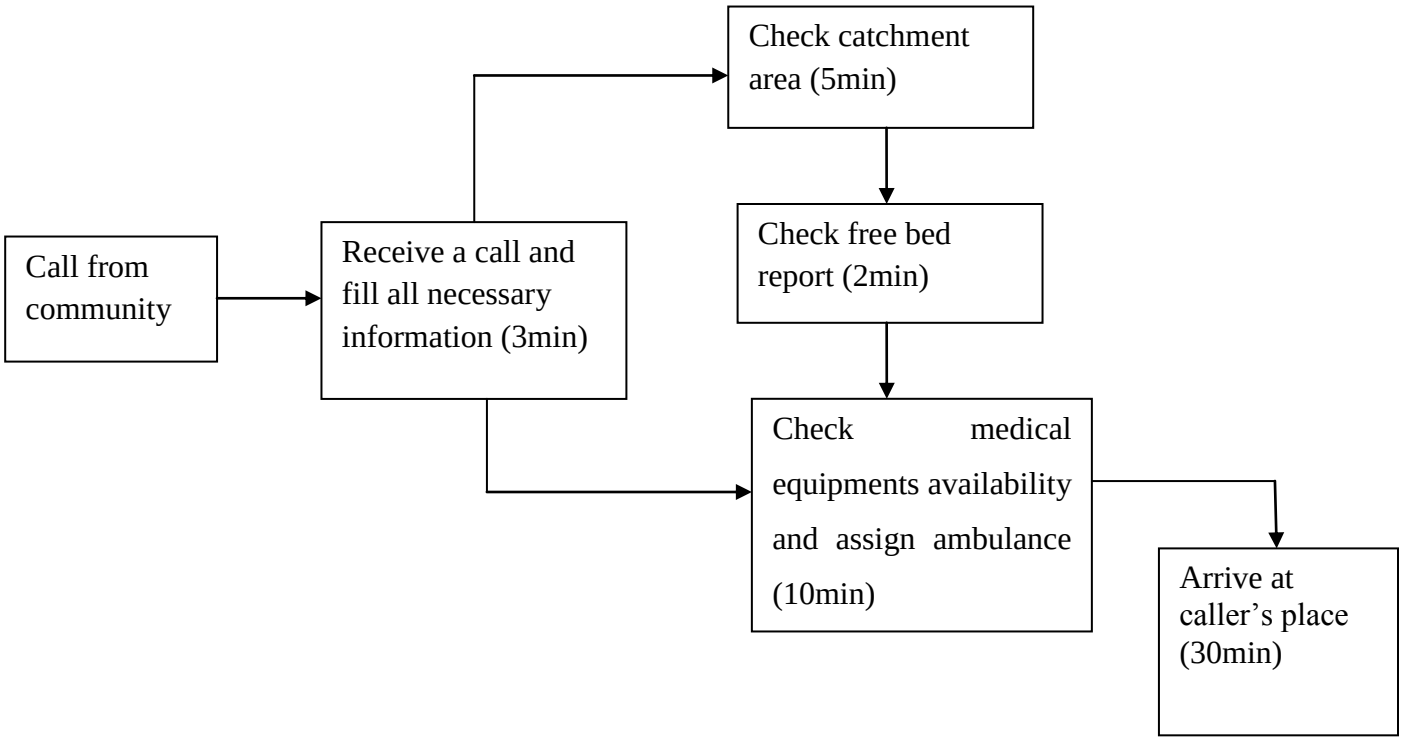
6.5 Emergency Medical Service Centralizers

Emergency medical service centralizers office was established in April 2014. Its aim is to support the emergency medical service by facilitating the working activities in hospitals after assessement of existing problems in emergency sercvices. The emergency medical service centralizers help hospitals in using their resource efficiently. They closely work with liaison officers in hospitals and observe the activities by visiting hospitals once a day. The occupacy of bed in the hospitals is highly variable and needs close tracing. Therefore, the centralizers closely collect reports and communicate with others to facilitate the overall service of emergency cases. Their office has three planned phases. The first phase is Support and Assessement of emergency

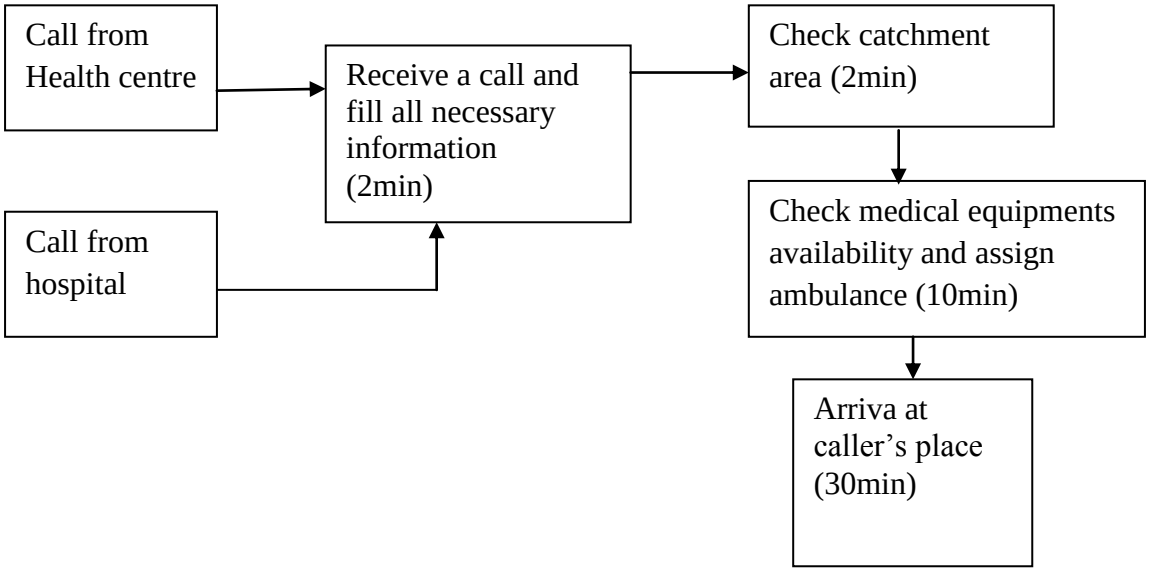
services in Addis Ababa hospitals and itis already accomplished. The second phase on which the office is currently working focuses on minimizing inappropriate referrals to hospitals. The third phase focused on implementation of improvement plans that are helpful in facilitating the referral system by using modern applications such as e- reporting. There is significant improvement after the work of centralizers.The availabilityof free bed in hospitals is also improved.

6.6 Flow of Activities in Addis Ababa Dispatch Centre

The flow of activities in the service delivery by AADC is grouped in two. The calls coming to the centre are from the community and from the helath centres as well as hospitals for ambulance services. Both services follow their own procedure. The time taken for each service in the two cases is shown in Figure 6.4 and 6.5.



Source: AADC, 2014
Figure 6.4 Flow of activities in AADC for calls from community



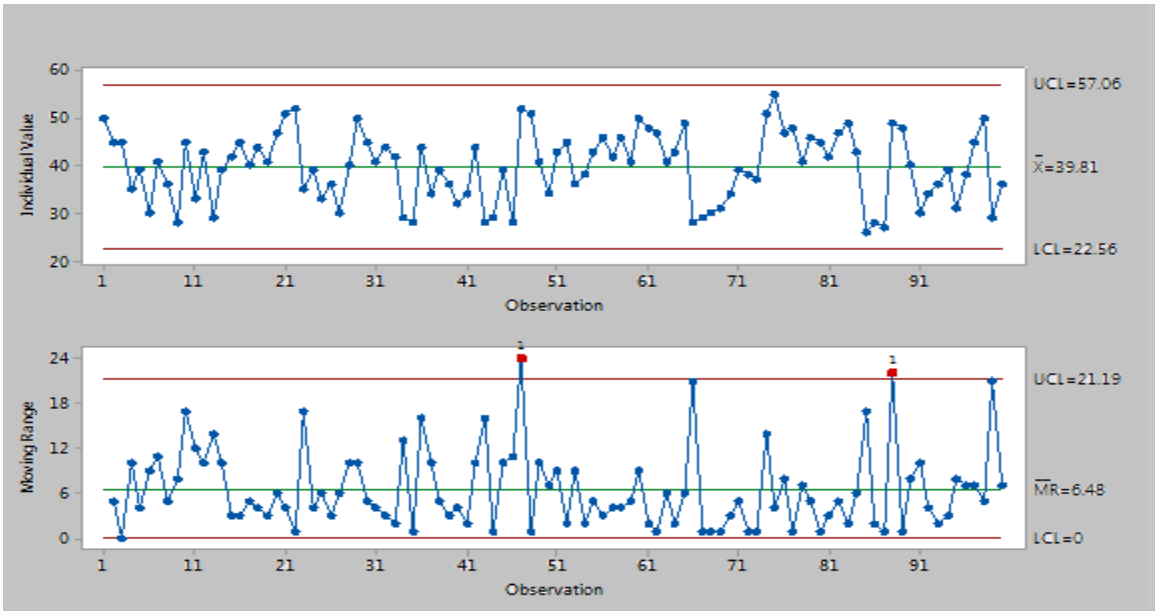
Source: AADC, 2014
Figure 6.5 Flow of activities in AADC for calls from health centres and hospitals

6.7 Summary on the Process Flow of Dispatch Center

The activities in the dispatch center follow the process mentioned in Figure 6.4 and 6.5. The average time for processing a call varies. In average, the time spent to process a single call and to reach to the needed area is 39.10 minute, which is far beyond the standard time in case of emergency which is 15 minute as shown in Figure 6.6. The major reasons for the delay are:

- ✓ Delay in receiving a call as the callers are not fully aware of the information they should deliver to the person receiving the call.
- ✓ Delay in communicating with the catchment area due to many calls to the area.
- ✓ Delay in checking free bed report as the reports show most of the time a zero report and a second call to look for free bed is needed, or call to the centralizers for better information is needed.
- ✓ Delay in fulfilling materials for a pre-hospital treatment due to the delay in the delivery of necessary pharmaceutical equipment and medicines by PFSA.
- ✓ Delay to arrive at the needed area due to the road condition and a host of many other reasons.

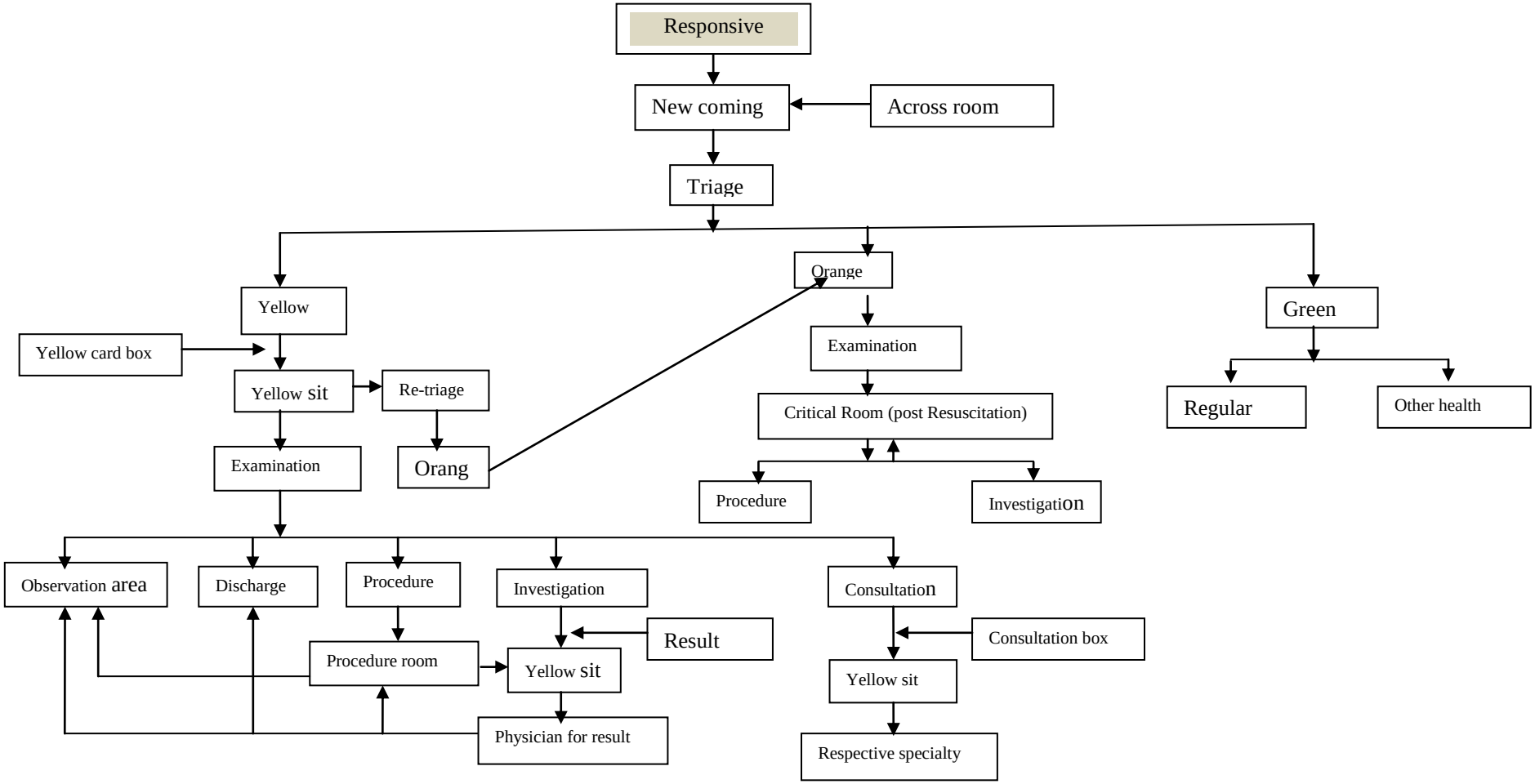
The chart shown in Figure 6.6 clarifies the behavior of the waiting time to get service in the dispatch center. The international standard for emergency service is 15 minutes. In the case of service delivered by Addis Ababa dispatch center, the average time is 39.81 minutes which is far beyond the standard. The chart is developed by using Minitab. In the service for emergency cases, there is also a high waiting time after a patient reaches health center or hospital as discussed in section 6.9.



Source: Author's computaion base on AADC data
Figure 6.6 Waiting time to get emergency service in AADC

6.8 Emergency Case Management at Addis Ababa Referral Hospitals (Case of TASH and SPHMMC)

Emergency department crowding and delays have become major issues for many hospitals. Reducing delays and making sure that patients receive the right care at the right time will have a significant beneficial effect on the quality of care patients receive. In turn, this can improve patient outcomes and reduce the cost of care. The flow of patients arriving at the emergency department of referral hospitals is represented in Figure 6.7.



Source: Author's computaion based on referral hospital's data
Figure 6.7 patient flows in emergency departments of referral hospitals

From the discussion in the previous sections, it can be concluded that emergency cases service is with high waiting time though it should have been a service where immediate response is given. The patient flow until reaching the hospitals and the service at emergency departments in the hospitals is not responsive. The overall service delivery system of emergency cases demand management is represented by using system dynamics stock-flow diagram in section 6.9 for a better analysis, understanding and visualization of the overall system.

6.9 Modeling Patient Flow in Addis Ababa Emergency Cases Demand Management by Using System Dynamics

Healthcare centres are complex systems that can be represented as networks of interacting units called "services". For example, model of hospital emergency room patients is used to analyze utilization and the backlog in emergencies using a system dynamics tool. It shows how the organizational boundary creates a lack of coordination among services. In their simplest form all systems consist of inputs, processes and outputs. These are fundamental to operate a productive, goal achieving organization. To comprehend an organization's system it is necessary to examine the interactions, relationships, and transactions that comprise the substance of the organization's day-to-day business. These dependent variables are influenced by the behavior of internal and external environmental as well as cultural factors. The structure of the relationships affects the feedback loops and direction of each variable's interaction. This transforms the composition of other variables and ultimately influences decision-making and policy directions. The feedback loops and their direction are capable of producing factors that determine growth, stagnation, or decline in an organization's development. How the feedback is balanced and driven determines the productivity of the organization. The system dynamics approach focuses on helping decision makers understand how structure drives behavior; it does so using the rigor of simulation and the power of visualization.

6.9.1 Parameters to Model Emergency Cases Demand Management by System Dynamics

In considering parameters which are influential to the flow in the healthcare service delivery system, the waiting time changes and the resource availability and the transition of state at each

phase is considered as a changing and influencing factor for the overall performance of the system. The rates for transition between states are also with great impact to the state of the system and should be carefully selected. As a major parameter, the waiting time is studied in the emergency and referral cases demand management in healthcare. Assumptions are taken by using systematic evaluation of the real data. Accident rates, service rates and service delays are represented by using the collected data from the sector.

6.9.2 Representation of Existing Emergency Cases Demand Management in Addis Ababa using System Dynamics Stock -Flow Diagram

To model the stock-flow diagram of the emergency cases in Addis Ababa, the data from the dispatch center and from emergency departments of Addis Ababa Hospitals is used. The values used in the formulation are a combination of the real data and result of careful decision that is representative of the real data.

(1) Accident rate= Number of accidents and health problems, Units: People/Day
(2) Availability of resource= 1/5, Units: Dmnl
(3) Availability of resources= 1/8, Units: Dmnl
(4) Average service time at dispatch center =Population at Health centres*Availability of (resources, Units: People/Day
(5) Average service time at hospitals= 1/8, Units: Day
(6) FINAL TIME = 14, Units: Day (The final time for the simulation).
(7) Frequency of contact with cause of accident=0.035, Units: Dmnl
(8) INITIAL TIME = 0, Units: Day, The initial time for the simulation.
(9) Number of accidents and health problems=Probability of accidents causing health problems*Situations leading to accidents, Units: People/Day
(10) Population = INTEG (-Risk rate, 10000), Units: People
(11) Population at Health centres=INTEG (Service rate of dispatch center-Service rate of hospitals,1), Units: People
(12) Population in need of emergency service=INTEG (MIN (0, Accident rate- Service rate of dispatch center), 1), Units: People

(13) Population in risk of emergency= INTEG (Risk rate-Accident rate, 1),Units: People

(14) Population who got service on time= INTEG (Service rate of hospitals, 0), Units: People

(15) Probability of accidents causing health problems=0.125, Units: Dmnl

(16) Risk factor=0.08, Units: 1/Day

(17) Risk rate=Population*Risk factor, Units: People/Day

(18) SAVEPER = TIME STEP, Units: Day (The frequency with which output is stored).

(19) Service rate of dispatch center=RANDOM UNIFORM (1/Average service time at dispatch center, Population in need of emergency service, 0.75), Units: People/Day

(20) Service rate of hospitals= DELAY1 (Population at Health centres, Average service time at hospitals/Availability of resource), Units: People/Day

(21) Situations leading to accidents= Frequency of contact with cause of accident*Population in risk of emergency, Units: People/Day

(22) TIME STEP = 1, Units: Day ,the time step for the simulation.

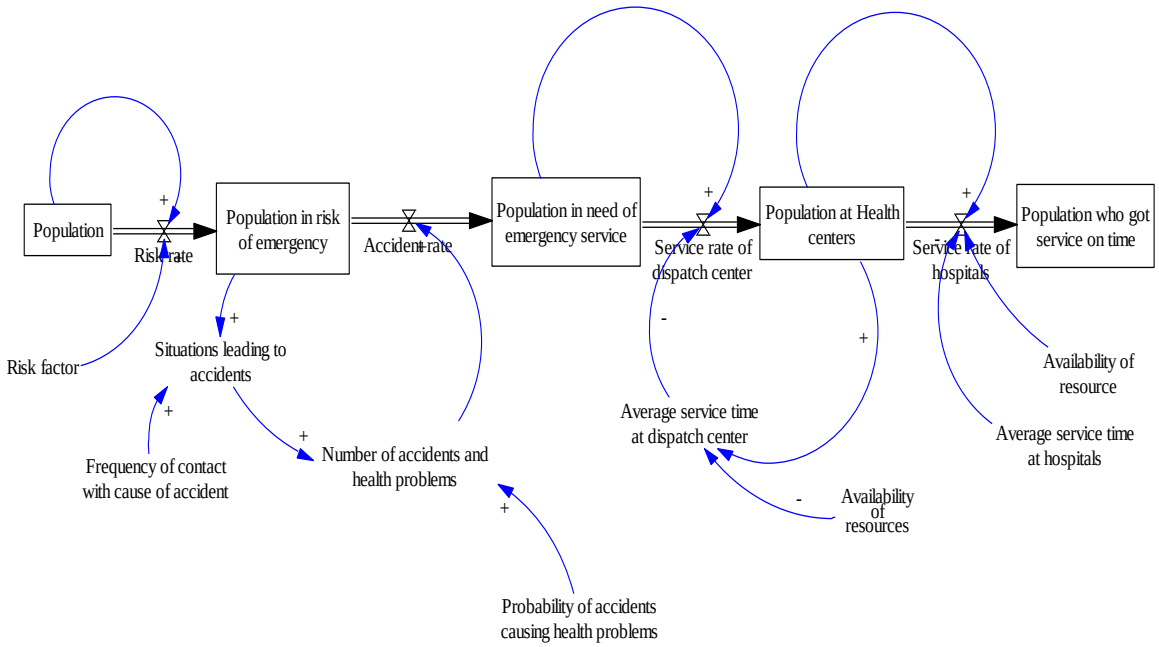


Figure 6.8 Existing situations in emergency service in Addis Ababa Healthcare Service

6.9.3 Graphical results of the existing system model for emergency cases

After simulation, the graphical results are summarized. As shown in Figure 6.9 the property of patient flow is not stable. There is a dynamic change in the patient flow and number of patients waiting at each stage. The same unstable result is obtained from the property of the rates also as shown in Figure 6.10.

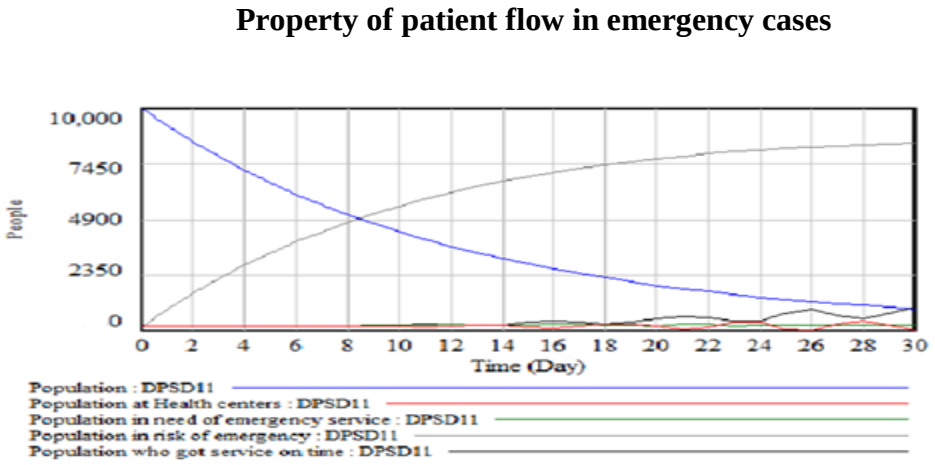


Figure 6.9 Graphs of patient flow of the existing in emergency service

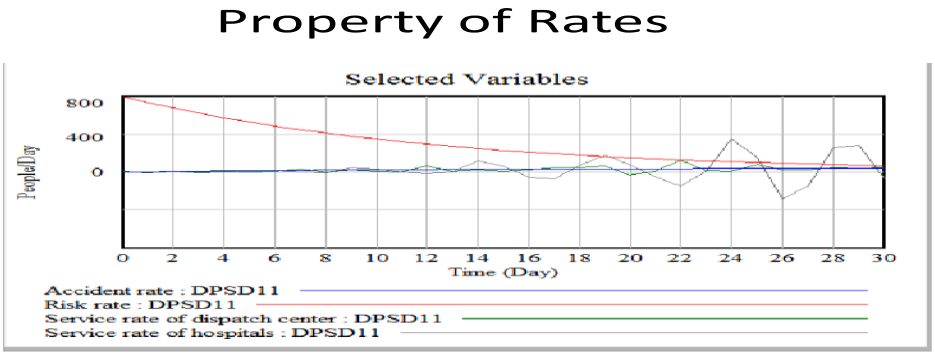


Figure 6.10 Graphs of rates of existing emergency service

6.10 Summary

The data from the Addis Ababa Dispatch Center and results of assessment in the emergency services of Addis Ababa Hospitals show the existence of delays in providing service for emergency cases. The presence of the delays is analyzed from the data collected from the center and as a result of patient flow as well as flow rate analysis by using system dynamics. The graph in Figure 6.9 (patient flow) shows the number of patients waiting at each stage in the healthcare centres and the graph named by property of rates in Figure 6.10 shows the speed of service delivery at each level in the system. Such kinds of graphs are representatives of unstable system. Thus, this is an indication for the need of a better service in the area.

Chapter Seven

Demand Management in Addis Ababa's Highest Referral Hospitals

This chapter deals with the management of referral cases in two of Addis Ababa's Referral Hospitals, namely 'Tikur Anbessa' and St. Paul's Millenium Medical College. It discusses the activities of the two major hospitals to cope with existing public demands and the problems faced by health workers and supporting staff in the adminisrative department. It gives an overall picture of the challenges, opportunities and technical possibilities to be considered to improve the service delivery system for the benefit of both the public and the institutions themselves.

7.1 Introduction

A referral arrangement of health delivery service is a process by which a health worker transfers responsibilities of medicare temporarily or permanently to another health professional due to limitations of manpower or equipment to provide the necessary services. It is a two-way process involving the community and health institutions on the one hand or from one hospital to another on the other. Referral activities can be managed hierarchically as between a health centre and a hospital or on the basis of specialization where one hospital is given prominence in handling specific cases compared with another hospital.

As to where a patient is referred is dependent on many factors including the patient's status in terms of severity or seriousness of sickness, the kind of disease the patient is suffering from, either emergency or long duration of treatment, and the availability of specialists such as pediatrics, gynaecology, ENT(ear, nose ,teeth) or other organs.

In Ethiopia, the highest hospitals for referral cases working at a tertiary level, the 'Tikur Anbessa Specialized Hospital and St. Paul's Millenium Medical College. They have their own specialization areas. For example, cases of cancer are treated only in Tikur Anbessa, while cases

of Maxilo facial and Dialysis are treated in St. Paul's. The details of the services in the two hospitals are discussed in following sections.

7.2 Tikur Anbessa Specialized Hospital (TASH)

Tikur Anbessa Specialized Hoapital, located in the nation's capital Addis Ababa, is Ethiopia's largest general public hospital and one of only two University Hospitals in the country. In 1998 it was transferred to Addis Ababa University by the Ministry of Health to be administered as the Medical Faculty and to serve as the main teaching centre for new doctors. The Medical Faculty is the oldest and largest training institution in the country being staffed with senior medical specialists. The hospital is open 24 hours for emergency services. It provides teaching for about 300 medical students and 350 Residents every year. The hospital offers diagnosis and treatment, complex curative care and emergency medical service for the severely injured or the critically ill. It is a centre for the transfer of medical knowledge and skills and constitutes an essential source of information and power.

Moreover, it is generally considered to be managed by a good portion of the country's annual health budget offering services that include Medical, Surgical, Gynacology and Obstetrics, Pediatrics, etc. catering to in-patients and out-patients who are served both in its emergency and regular units. Approximately 370,000- 400,000 patients are treated every year. The hospital has 625 beds. The number of specialists is shown in Appendix E.

7.3 Major Medical and Support Services in TASH

In the major departments of medical service in TASH, there are core service activities and support services for the accomplishment the medical or surgical cases. The hospital's major services are listed below.

a) It serves as referral hospital for patients throughout the country.

b) It provides training for undergraduate and postgraduate medical students.

c) It provides outpatient and inpatient care in the fields of Medicine (with sub-specialties), surgery (with sub-specialties), orthopedics, Gynecology and obstetrics, Pediatrics (with sub-

specialties). These services are provided for paying and for non-paying patients (patients who can bring a certificate from their residential area about their financial incapability for the service given in the hospital). The care covers various forms of examination, diagnostics, treatment and therapy.

d) It provides emergency services and intensive care for medical, surgical and trauma patients. The forms of diagnostics include radio-diagnostics (X-ray), ultrasound, pathology and laboratory tests (biochemistry, bacteriology, hematology, etc).

e) It provides general services such as food, laundry, pharmacy, sterile supplies, consumables, technical operation and maintenance, etc.

7. 4. Referral System Management in TASH

The referral system in TASH is managed by the Liaison office. It is concerned with managing admission and discharge of emergency and elective referral cases in the hospital from all over the country. In the process of managing the referral case, there is a screening process of all referred patients to the hospital every morning. Then according to the case, referred patient is sent to outpatient department for simple cases and to a specialist for further consultation. Simple cases are sent to moderate surgery after all the necessary checking is done. Surgery for complicated cases are sent to the liaison and registered to wait for the required service accordingly. Nurses at the liaison office register according to the case of the patient by taking full contact address of the patient to call when his/her turn reaches. For an ease of the follow up, the availability of free bed is checked three times a day and reported to the liaison office. Patients with their turn are sent to pre anesthesia to be checked for being fit or unfit to take surgery and checked for the availability of the right amount of blood at the Red Cross. Then bed assignment is done according to the rank of the bed and the financial capacity of the patient. Patients who are treated for free are also assigned by comparing the seriousness of their case. Wards are assigned for different cases at different floors of the hospital's building.

For emergency referral cases, it is managed by the call from different hospitals and from AADC. The overall process of patient treatment activities is represented in the Figure 7.1.

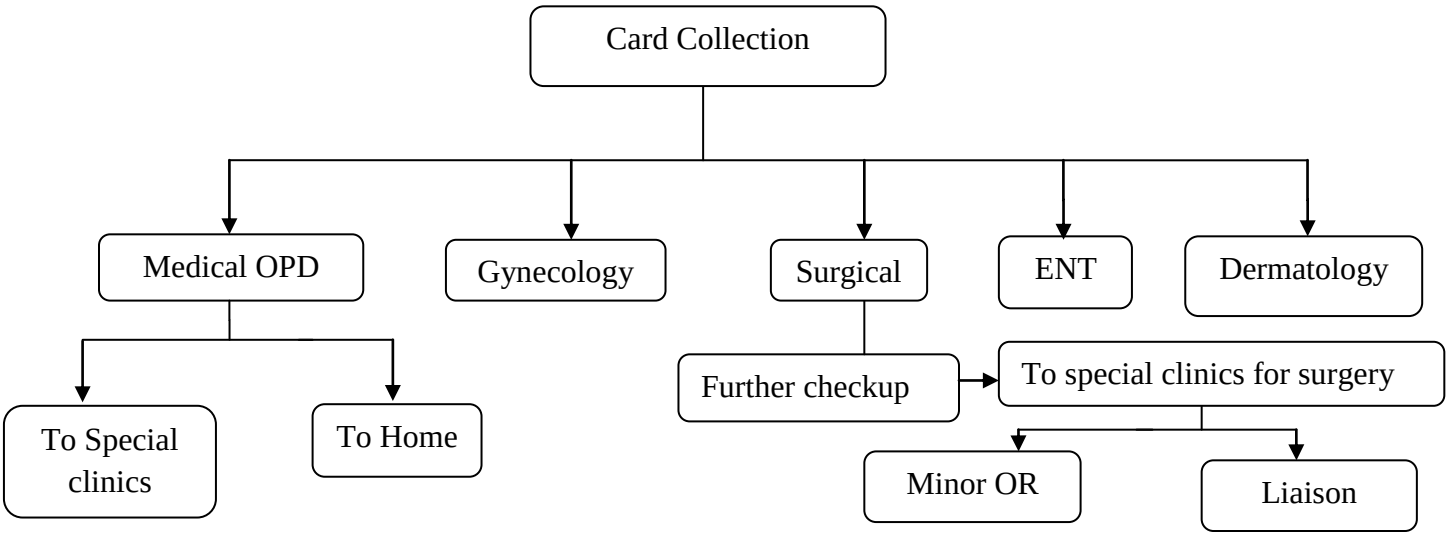


Figure 7.1 Referral system patient flows in TASH

7.5 TASH Liaison Office working procedures

TASH Liaison office was established in 2012 by Clinton Foundation. The purpose of its establishment was to manage admission and discharge cases of patients. According to the working procedure of the hospital, patients' cases are divided into two, namely, emergency cases and elective cases. The first cases are un-planned which result from trauma or acute illness which cannot be treated as outpatient, need rapid clinical assessment and diagnostic documentation and early medical discussion. These are urgent cases coming to the hospital in need of fast treatment. Such cases are assigned to get medical treatment at the date of their arrival at the hospital. And the second cases are elective/planned admission cases and are selected for planned admission by giving priority for selected cases trough measurement of criteria for hospital admission. These cases are relatively able to wait until conditions in the hospital for giving service are fulfilled. But, for an ease of prioritization, urgency of the case is indicated by the referee. Elective referral cases are registered to wait until their turn reaches and upon called by the hospital, they come to get treatment. The duties of liaison office are: supporting and improving individual well-being; Ensuring clients' well-being before admission during admission and being discharged to meet social and physiological need plan; update the elective admission waiting list; assigned

admission date based of urgency; facilitate rapid access for emergency cases; secure bed for patient; communicate in patient case team before admission; give proper direction to the ward; Plan discharge timing; works on ward round early morning and on the afternoon; support a leading rule in coordination of discharge; develop care path way and ensure regular bed census are carried out.

7.5.1 Patient information recording system in the Liaison Office of TASH

In TASH, patient information is recorded in a structured way. Medical and surgical cases are categorized accordingly and recorded on different sheets. The record includes all the necessary information about the patient being registered and expected to wait for elective treatment based on his/her turn. Information on the record should basically include: card number, sex, age, diagnosis, decision for admission, call for admission, arrival after call, admission date, discharge date and duration of stay at the hospital.

In the data recording system, there is no complete information most of the time. This is because of the urgency in activities in the office and the value given to the needed information for basic improvement in the service given by the Liaison Office. The information's fully registered include card number, sex, age, diagnosis and decision for admission and details are filled occasionally. Thus, the absence of information on the exact admission date, length of stay and discharge date of patients is not easily traced by the liaison office. Summarized information on the number of emergency cases served in a day for thirty days selected randomly is shown in Table 7.1.

Table7.1. Emergency referral Services

S.N.	Date	Number	Date	S.N.	Number
1	2/08/2012	**6**	18/08/2012	**17**	**16**
2	3/08/2012	**10**	19/08/2012	**18**	**16**
3	4/08/2012	**10**	20/08/2012	**19**	**11**
4	5/08/2012	**8**	21/08/2012	**20**	**6**
5	6/08/2012	**16**	22/08/2012	**21**	**8**
6	7/08/2012	**6**	23/08/2012	**22**	**11**
7	8/08/2012	**8**	24/08/2012	**23**	**22**
8	9/08/2012	**21**	25/08/2012	**24**	**14**
9	10/08/2012	**12**	26/08/2012	**25**	**15**
10	11/08/2012	**17**	27/08/2012	**26**	**23**
11	12/08/2012	**17**	28/08/2012	**27**	**7**
12	13/08/2012	**17**	29/08/2012	**28**	**6**
13	14/08/2012	**11**	30/08/2012	**29**	**9**
14	15/08/20012	**2**	1/08/2012	**30**	**18**
15	16/08/2012	**13**	2/08/2012		
16	17/08/2012	**26**			

The average number of emergency cases per day which were managed by the Liaison office is 13. But the daily demand shows high variability. Other surgery cases also show great variability. The elective referral cases for surgery in TASH include: elective general surgery; gynecology and obstetrics, uro-surgery, orthopedic case, general surgery from private wing, pediatric neurosurgery, chest case and neurosurgery. For the elective cases, the waiting time to get surgery service is high and variable according to the free bed availability in the hospital's ward.

Table 7.2 Waiting time for elective medical surgery

Date of Decision for Admission	Date of call for Admission	Waiting for Admission (number of days)
27/2/2012	2/11/2012	245
23/9/2012	2/11/2012	39
22/2/2012	2/11/2012	250
13/9/2012	2/11/2012	49
9/1/2012	2/11/2012	293
25/7/2012	2/11/2012	97
15/10/2012	2/11/2012	17
20/10/2012	2/11/2012	12
12/10/2012	2/11/2012	20
18/10/2012	2/11/2012	14
18/10/2012	2/11/2012	14
4/10/2012	2/11/2012	28
25/10/2012	2/11/2012	7
21/10/2012	2/11/2012	11
10/7/2012	2/11/2012	112
28/6/2012	2/11/2012	124
20/2/2012	2/11/2012	252
27/9/2012	2/11/2012	35
4/10/2012	2/11/2012	28
26/10/2012	12/11/2012	16
9/10/2012	12/11/2012	33
20/10/2012	11/11/2012	21
29/10/2012	11/11/2012	12
29/10/2012	11/11/2012	12
29/10/2012	11/11/2012	12
2/11/2012	12/11/2012	10
4/11/2012	13/11/2012	7
19/10/2012	14/11/2012	25
23/10/2012	14/11/2012	21
5/8/2012	14/11/2012	96
27/5/2012	14/11/2012	167

In addition to the general medical surgery, there are different types of surgeries in TASH. The number of service given in these cases in three consecutive years is represented in Table 7.3.

Table 7.3 Summary of the number of elective surgery cases treated in TASH

Year	Neurosurgery	Urosurgery	Elective general surgery	Chest	Private	Orthopedic	Pediatric neuro- surgery
2012	54	152	187	115	232	221	-
2013	217	864	1020	566	808	167	14
2014	195	512	621	182	-	23	1
Total	464	1528	1828	863	1040	411	15

The available numbers of beds in the hospitals are subdivided into different wards based on the specialty of the service delivered. By now, 572 beds are giving service out of the total 650 beds due to maintenance of selected wards in the hospital. The divisions of the wards in different specialties and their number are given in Table 7.4. The availability of beds with their specialty division of St. Paul's Hospital is shown in Appendix G.

Table 7.4 Total number of Beds in TASH

Divisions of wards	Number of beds
Surgical department ward	121
Gynecology department ward	142
Medical ward	121
Pediatric ward	113
Gynecology emergency ward	4
Adult emergency ward	25
Pediatric emergency ward	46
Total	**572**

7.5.2 Process flow of activities in the liaison office in TASH

Activities in the liaison office follow the same rule in all the elective cases. The registration process, the calling and bed report checking process is the same for all cases. Figure 7.2 shows the steps and flows of activities in TASH Liaison Office.

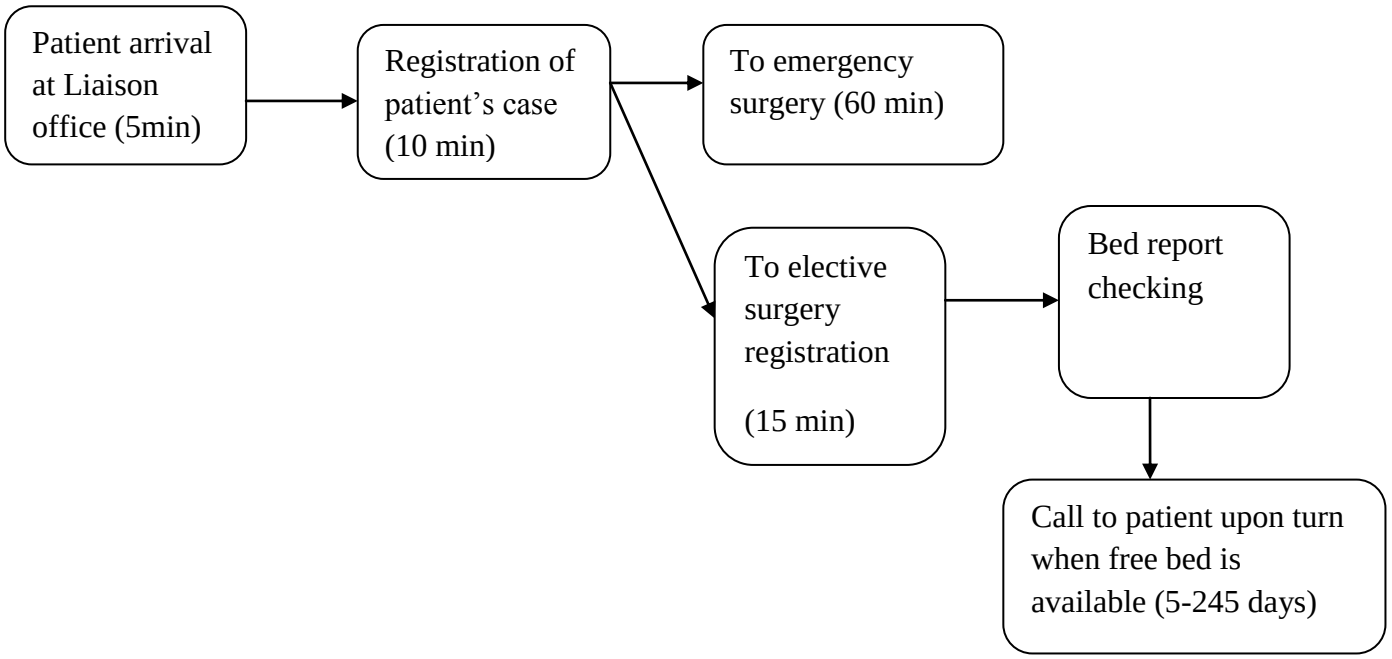


Figure 7.2 Process flow of activities in Liaison office in TASH

7.5.3 Laboratory service in TASH

In TASH, laboratory services are given widely with special laboratories for cancer cases. There are 936 laboratory equipment for the service. Among them, Hematology unit test is found only in TASH. The organizational structure for the laboratory service of the highest referral hospitals is given in Appendix F.

7.5.4 Key performance indicators (KPI) in TASH

The KPI assessment in TASH is taken in quarterly bases. Each KPI consists of its own category, code and reporting element. The major categories include inpatient services, maternity services, referral services, pharmacy, productivity, human resources, finance and patient satisfaction. As a KPI for referral system, number of emergency referrals made and number of non emergency referrals made is recorded monthly and summarized in a quarterly bases. Bed occupancy rate is assessed under the inpatient category. Completeness of inpatient medical records and length of

stay is also studied under the inpatient category. The KPI is implemented in all Addis Ababa hospitals.

7.6 St. Paul's Hospital Millennium Medical College (SPHMMC)

SPHMMC is a referral hospital in Addis Ababa under the Ethiopian Federal Ministry of Health (FMOH). It is the second largest public hospital in the country, built by the Emperor Haile-Selassie in 1961 with the help of the German Evangelical Church. The hospital was established to serve the economically under privileged population, providing services free of charge to about 75% of its patients. In 2007 it became a medical college and its core services include the provision of medical care, teaching and research. The number of medical students attending the college is 275 and its new and integrated curriculum stands out in comparison to the country's other medical schools. Although its transition to a medical college had its own challenges, the staff members at St. Paul are striving to set high academic standards which are helpful to produce competent and compassionate physicians. It has 800 clinical and non-clinical staff members that provide medical specialty services to an estimated 110,000 people annually who are referred from all over the country (MLI, 2011).

7.6.1 Referral System management in St. Paul's Millennium Medical College

STHMMC is also highest referral hospital in Ethiopia. It has a specialty area of dialysis and Maxilla facial cases. Like TASH, referral cases are managed through the liaison office in the hospital. The liaison office works on bed management, patient referral and elective referral by prioritizing urgent cases for immediate service like cases of cancer. But, the way of recording patient information in the hospital is computerized and checking the date of appointment is tiresome as well as time taking. The number of free emergency and ward beds is managed by the liaison office. Records are summarized monthly on the status of service managed by the liaison office as shown in Table 7.5.

The report shows the summarized number of services given at the hospital under the management of the liaison office. There are no consistent and continuous reports. But, in the waiting list, there are many patients waiting for elective treatment.

Table 7.5 Emergency and referral cases report at STHMMC

Name of medical cases	August 2014	September 2014	October 2014
Medical	107	125	160
Surgical: Emergency	92	143	146
elective case	98	125	104
Pediatrics	74	124	112
Ophthalmology	0	0	01
Gynecology: Emergency	41	644	630
elective case	43	34	31
Maxilla facial	23	9	19
Total	478	1204	1203

7.6.2 Laboratory Equipment Management in SPHMMC

The laboratory service in SPMMC gives wide service for varieties of tests. It takes around 10,000 laboratory tests in a week. There are special laboratories testing machines named Cobaentgra 400 for chemistry test and 411 for hormone, cancer and tumor cases testing. These special test types need their own re-agent. The availability of the re-agent in the laboratory equipment supply chain creates delays in the laboratory service. Currently, the way of managing the required re-agents at the laboratory service is through forecasting. The past experience of each laboratory department is summarized and summed up to forecast the annual consumption of re-agents and laboratory equipment. According to the summarized data for forecasting, re-agent orders are made and additional equipment are requested to the supply chain management department head of the laboratory services by setting the necessary equipment specification.

7.7 Summary of Identified Problems in the Referral Hospitals

From the discussion in sections 7.1 to 7.6, it can be summarized that there are delays in the services given in the two highest referral hospitals in Ethiopia. The major causes of the delays are:

- ✓ The long steps to be followed in the referral process
- ✓ The way information about referral patients are managed
- ✓ The delay in getting pharmaceuticals
- ✓ The delay to access laboratory re-agents
- ✓ Availability of limited resources especially limited number of beds in the hospitals and many others.

7.8 Modeling Patient Flow for the Referral Cases in Addis Ababa

Following the same pattern of the modeling in emergency services ,in designing the existing situation of referral cases demand management in Addis Ababa highest referral hospitals, stocks ,rates and parameters were selected from the real data and from reasonable judgments of the data for the given constant values and the rates.

(01) Access to referral=Patients in need of referral service*Proximity and proper referral letter
Units: People

(02) Accident rate=Number of accidents and health problems, Units: People/Day

(03) Average duration of patient in hospital=15, Units: 1/Month

(04) Discharge= INTEG (Service rate 3, 5), Units: People

(05) FINAL TIME = 6, Units: Month (The final time for the simulation).

(06) Free bed availability=0.0002, Units: 1/Month

(07) Frequency of contact with cause of accident= 0.125, Units: People/person/Day

(08) INITIAL TIME = 0, Units: Month (The initial time for the simulation).

(09) Number of accidents and health problems=Probability of accidents causing health problems*Situations leading to accidents, Units: People/Day

(10) Patients admitted for referral service= INTEG (Service rate 2-Service rate 3, 250), Units: People

(11) Patients at referral hospitals= INTEG (Access to referral-Service rate 1, 1000), Units: People

(12) Patients grouped to emergency or elective treatment= INTEG (Service rate 1-Service rate 2,200), Units: People

(13) Patients in need of referral service= INTEG (Referral rate-Access to referral, 10000)
Units: People

(14) Population= INTEG (-Risk rate, 100000), Units: People

(15) Population at Health centres= INTEG (Service rate of dispatch center-Service rate of hospitals, 1), Units: People

(16) Population at hospitals= INTEG (-Referral rate,100000), Units: People

(17) Population in need of emergency service= INTEG (Accident rate-Service rate of dispatch center, 1), Units: People

(18) Population in risk of emergency= INTEG (Risk rate-Accident rate, 10000), Units: People

(19) Population who got service on time= INTEG (Service rate of hospitals, 0), Units: People

(20) Probability of accidents causing health problems= 0.05, Units: Dmnl

(21) Probability of cases with complication= 0.25, Units: 1/Month

(22) Proximity and proper referral letter=0.04, Units: 1/Month

(23) Referral rate=Population at hospitals*Probability of cases with complication
Units: People/Month

(24) Resource availability=0.001, Units: 1/Month

(25) Risk factor=0.05, Units: 1/Day

(26) Risk rate=Population*Risk factor, Units: People/Day

(27) SAVEPER = TIME STEP, Units: Month (The frequency with which output is stored).

(28) Service delay=0.002, Units: 1/Month

(29) Service delay at dispatch center=0.3, Units: Day

(30) Service delay at hospitals=0.02, Units: Day

(31) Service delay1=0.0003, Units: 1/Month

(32) Service rate 1= DELAY1 (Patients at referral hospitals, Service delay/Resource availability)

Units: People/Month

(33) Service rate 2=DELAY1 (Patients grouped to emergency or elective treatment, Service delay1/Free bed availability), Units: People/Month

(34) Service rate 3=Patients admitted for referral service/Average duration of patient in hospital

Units: People/Month

(35) Service rate of dispatch center= DELAY FIXED (Population in need of emergency service, Service delay at dispatch centre, 0), Units: People/Day

(36) Service rate of hospitals=DELAY FIXED (Population at Health centres, Service delay at hospitals, 0), Units: People/Day

(37) Situations leading to accidents= Frequency of contact with cause of accident*Population in risk of emergency, Units: People/Day

(38) TIME STEP = 0.5, Units: Month (The time step for the simulation).

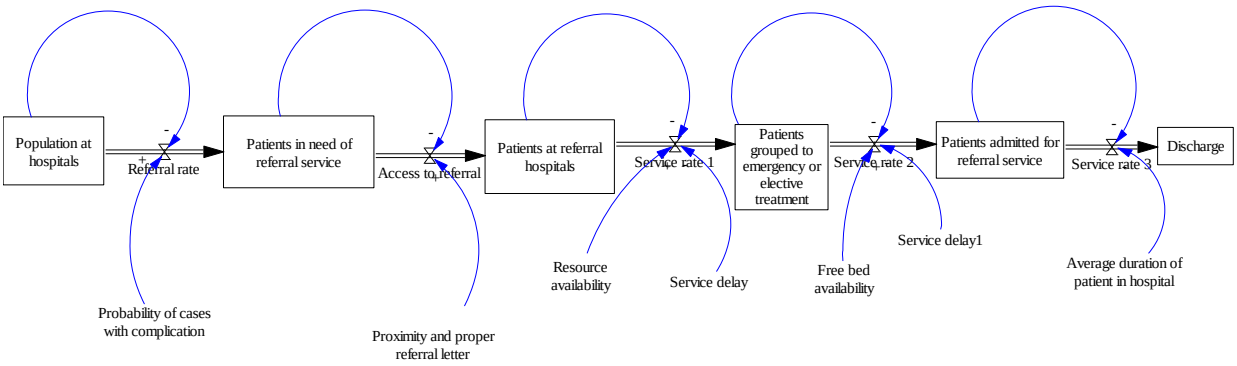


Figure 7. 3 Existing situation of referral cases demand management using system dynamics

Results on the property of the system are represented in Figure 7.4 and 7.5.

Property of patient flow in referral cases

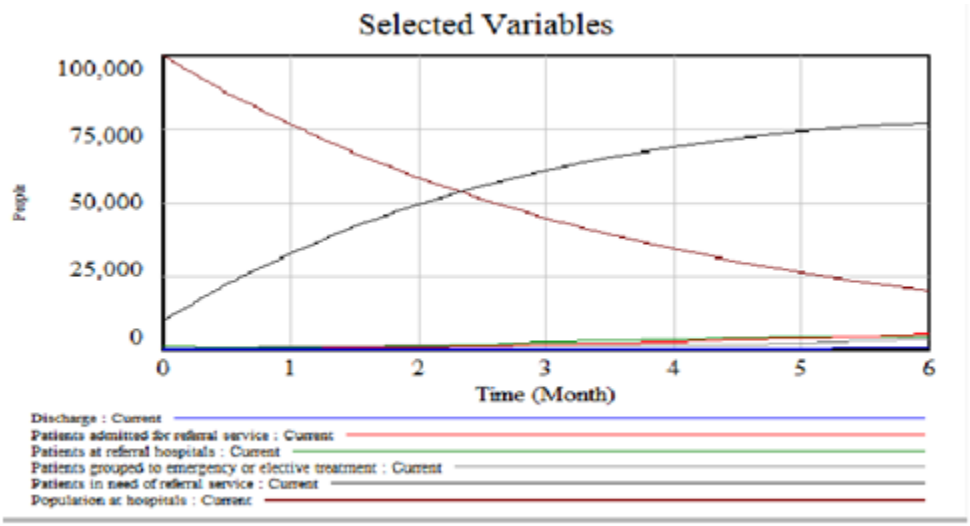


Figure 7.4 Graphs of patient flow of existing situation in referral service in Addis Ababa

Property of Rates

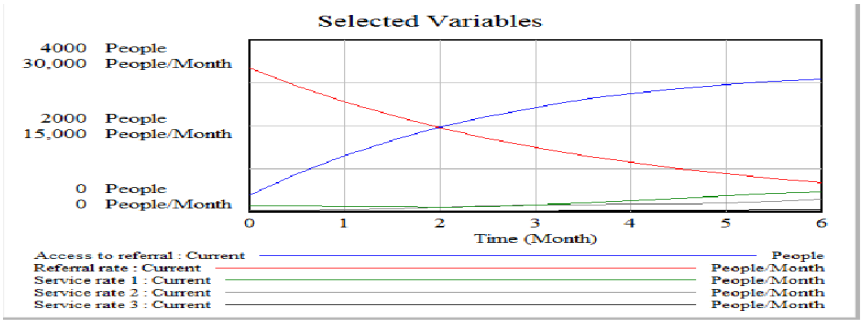


Figure 7.5 Graphs of rates of existing situation

Summary

It can be summarized that from the above two models, the system shows variability. It is unstable Thus the reasons for the systems instability are identified to the way the demand is managed in the sector. The fragmented way of managing patients needs in healthcare sector is creating the disturbance of the service delivery in the sector. By the concept of integrated demand management, new proposed model which is the first of its kind in the sector is developed in chapter nine.

Most of the emergency and elective referral services need to be admitted to hospitals and stay for few days for treatment. But, there is a problem in the service given in the wards due to delays in inputs for the service. The next sections of this chapter dealt with the inpatient services in hospitals and the next chapter deals with the pharmaceutical distribution.

7.9 Inpatient Services in Addis Ababa Referral Hospitals

Inpatient care goes back to 230 BC in India where Ashoka the Great founded 18 hospitals. The Romans also adopted the concept of inpatient care by building a specialized temple for sick patients in 291 AD on the island of Tiber. It is believed the first inpatient care in North America was provided by the Spanish in the Dominican Republic in 1502; the Hospital de Jesús Nazareno in Mexico City was founded in 1524 and is still providing inpatient care. Perhaps the most famous provider of inpatient care was Florence Nightingale who was the leading advocate for improving medical care in the mid-19th century. Ms. Nightingale received notoriety during the Crimean War where she and 38 women volunteer nurses traveled to Crimea to treat wounded soldiers. During her first winter at the hospital 4077 soldiers died in the hospital there. She would use this experience to change the course of inpatient care by focusing on improving sanitary conditions and better living conditions within the hospital. Florence Nightingale became known as" The Lady with the Lamp" and is still considered the founder of modern nursing. The Nightingale School of Nursing continues today and her image is the one depicted each year on nurses' day (https://en.wikipedia.org/wiki/Inpatient_care).

Hospitals in Addis Ababa give inpatient service broadly. There is an admission protocol for a patient to enter to the admission ward and get treatment in a hospital. The duration of patient in a hospital and the availability of bed in the wards determine the access to inpatient service. The inpatient service in the highest referral hospitals is assessed continuously based on the KPI. The assessment is done by HMIS in the hospital. There are 19 case teams and seven departments in the inpatient service of TASH. The average length of stay is computed monthly by the HMIS. Based on the result of the measurement by HMIS, a comparison is made between the current achievement and the target planned for the year and a gap is identified. Thus, there are different problems that must be solved to fill the gap and meet the planned performance. Among the identified problems, the major problems are, delay in support services like the pharmaceutical, autoclave, emergency equipment and support services. The same procedure is followed in SPHMMC to measure the performance of inpatient, outpatient and emergency services in the hospital.

Table 7.6 Performance of the inpatient services in TASH

category	KPI Code	KPI	Result on 2014\15
Inpatients	KPI 10	Inpatient Admissions	18178 patients
	KPI 11	% of inpatients that are admitted to private wing services	0.0%
	KPI 12	Inpatient mortality rate	7.1%
	KPI 13	Delay for elective surgical admission	3.7
	KPI 14	Bed Occupancy Rate (BOR)	82.2%
	KPI 15	Average Length of Stay (ALOS)	4.8
	KPI 16	Pressure Sore Incidence Rate	0.5%
	KPI 17	Surgical Site Infection Rate	1.1%
	KPI 18	% of completeness of inpatient medical records	67.9%

7.10 Summary

In this chapter, the demand management in TASH and SPHMMC is studied. The major services in the hospitals, the way the patient flow is managed in the emergency and in elective referral cases is deeply assessed. The duties, responsibilities and working procedures of liaison office in the referral hospitals are dealt. The inpatient service for cases beyond a short treatment is also highlighted. The role of HMIS in continuously tracking the performance of service activities in the hospital is also overviewed. Model on the existing referral activities in the highest hospitals is developed by using system dynamics. Finally the existing problems in the referral system are pinpointed.

Chapter Eight

Assessment of Distribution of Pharmaceuticals in Addis Ababa

This chapter discusses the flow of the existing pharmaceutical products in Addis Ababa. It has seven sections. The first section introduces supply chain, the central idea of the chapter. The second gives an overview of the Pharmaceutical Fund and Supply Agency (PFSA) in Ethiopia. The third and fourth sections illustrate the supply chain network design and building blocks. The fifth explains the methodology for the research in PFSA as well as the qualitative and quantitative data analysis. The sixth section centres on the newly re-designed model for the existing supply chain (SC) distribution. The last section summarizes the results of the research in the agency and its expected benefits.

8.1 Introduction

SC is the interconnected set of linkages between suppliers of materials and services that spans the transformation of raw materials into products and services and delivers them to a firm's customers. In the pharmaceutical industry, it is essential to ensure that the drugs are protected from adulteration and counterfeiting, removed and destroyed in a safe and environmentally friendly manner, and made available to patients at all times. The pharmaceutical industry is not renowned for its supply chain management capabilities unlike many other highly publicized industries that have profitably exploited their supply chains. This results in weak integration among the agency, customers, suppliers and other stakeholders. It is thus critical to explore the current supply chain distribution trends in the pharmaceutical industry of PFSA in Ethiopia.

A typical pharmaceutical SC is responsible for supplying pharmaceutical products such as drugs and medications to market in an efficient way. It consists of a network of manufacturing and distribution chain and logistics facilities. It includes supplier, manufacturer, warehouses, distribution centres, wholesalers and retailers; hospitals, health centres or health posts and clinics (Shah, 2004). In the outbound end of the pharmaceutical products SC, the warehouse and

distribution operation is responsible to ensure that the drugs, medications and other products are protected from damage, adulteration, and counterfeit and made available to patients at all-time where they can purchase from public and private pharmacies and drug stores.

8.2 Overview of Pharmaceutical Supply Chain in the PFSA

The former PFSA was established by law to regulate prices of pharmaceuticals in Ethiopia by supplying the same product from both local and foreign suppliers at reasonable prices. In fact it was not duty bound to make sure uninterrupted supply of quality pharmaceuticals to neither public nor private health facilities, rather it used to bridge market gap and involve more in business-oriented activities.

The existing pharmaceuticals supply system is a push system, where by pharmaceuticals are supplied in anticipation for customer demand. In practice, the forecasting and procurement activity were performed mainly based on sales data marketability and revenue generation principles. Customers were obliged to buy what is available in stock at the time of arrival at former PFSA hubs. The distribution system was more or less first-come- first-served. Customers were expected to physically collect pharmaceuticals of their interest from the branch warehouses based on list of products available in stock. There is poor or no transport service to deliver products to customers. In few branches where there is transportation service, it is only for bulk purchasers. Even if many customers are interested in getting their pharmaceuticals supply from the agency, for many reasons including competitive prices, stock rupture has turned out a stumbling block. Because of the very nature of the business, the agency was involved in exercising its bargaining power it has possessed through economy of scale and 60 years of experience at the expense of the customers' interest denying them the required attention.

In order to avoid the historical problems in the public pharmaceuticals supply system, establishment of central procurement became mandatory. As it is stated in the standard operating procedure manual for the pharmaceuticals logistics system in health facilities of Ethiopia in 2011, the PFSA operation manual in 2011, PFSA was established to overcome the problems and assure uninterrupted supply of pharmaceuticals to the public at an affordable price. Nevertheless, to effectively carry out the duties and responsibilities bestowed on to PFSA, re-engineering the

existing pharmaceuticals distribution system based on supply chain network redesigning principles is considered worthy. The Pharmaceuticals Fund and Supply Agency was established in September 2007 by Proclamation No. 553/2007 as part of logistics master plan implementation. The processes of pharmaceuticals supply and the inputs and outputs details are represented in Table 8.1.

Table 8.1 Pharmaceuticals supply processes input and output cascade

Description	Input				Out put	Outcome
	Demand	Request	Order	Customer Problem		
Forecasting, procurement, storage and distribution of pharmaceuticals	Projected demand in terms of volume and variety based on generic indicators	Purchase request from public health facilities	Special order from health facility programs, NGOs, etc for products which are not available in stock	Feedback information obtained, from customers about pharmaceuticals supplied through PFSA	▪ Pharmaceuticals delivered to public health facilities ▪ Service	Patient cured from their ailment by the virtue of the pharmaceuticals distributed

Source: Unpublished company BPR document, 2008

8.3 Supply chain Network Design

Supply chain network design focuses on issues that are strongly related to them such as inventory control policies, the choice of transportation modes and capacities, warehouse layout and management, and vehicle-routing. In today's competitive market, a company's distribution network must meet service goals at the lowest possible cost. In some instances, a company may be able to save millions of dollars in logistics costs and simultaneously improve service levels by redesigning its distribution network. To achieve this, an ideal network must have the optimum number, size, and location of warehouses to support the inventory replenishment activities of its retailers (Melo, *et al.*, 2007). The problem of network design has become increasingly important in our highly connected world. A general network design model consists of finding some subset of a given network to support the demand for flow between pairs of locations. Each potential link

in the network might have associated with it a ‘‘fixed’’ cost, which is incurred if the link is utilized, a ‘‘variable’’ cost that depends on the number of units of flow it supports, and a capacity on its total flow. A design objective would be to find a sub network that can feasibly support the demands at minimum total cost. Computationally, these are often hard problems, requiring some form of enumeration in order to guarantee optimality in the solution. In some cases, the decision maker might be willing to settle for some less than optimal design that could be more easily obtained if it is believed to have a relatively low cost and would satisfy additional design criteria regarding; network reliability, demand protection, and insensitivity to fluctuations in level of demand. General models for network design might have multiple source and destination locations for the commodity being shipped, or might involve multiple commodities to be delivered between pairs of locations over a shared infrastructure (Crainic, 2002).

8.4 Supply Chain Distribution Network Building Blocks

For many people, distribution sounds the easiest part of the whole manufacturing and supply process. But a lot of planning and theoretical work to decide which network, transport medium, unit loads and storage and handling systems will result in not only a minimum cost, but also delivery in an acceptable time period are taken into consideration during distribution network design. The elements in distribution which we can deal with are the numbers, locations and sizes of manufacturing points and supply points, the type of transport frequency of delivery and service level. Distribution is an important task in supply chain and optimal distribution network can improve the efficiency of supply chain (Shapiro, 2003). There are two key decisions when designing a distribution network:

1. Will product be delivered to the customer location or picked up from a preordained site?
2. Will product flow through an intermediary (or intermediate location)?

Based on the choices for the above two product flow and delivery decisions, there are six distinct distribution network designs that are classified as follows:

a) Manufacturer storage with direct shipping

b) Manufacturer storage with direct shipping and in-transit merge

c) Distributor storage with package carrier delivery

d) Distributor storage with last mile delivery

e) Manufacturer / distributor storage with customer pickup.

f) Retail storage with customer pickup (Chopra, 2001).

Manufacturing and service industries consider effective SC as one of top priorities in their competitiveness schema as it enables to delivery of products faster, reduce inventory and lower operating costs. Despite this, service SC should be managed differently from manufacturing SC because of their intangibility, heterogeneity, consumption, and perishability features (Y. T. Lin, 2010). A well-designed distribution network is a key driving force of the overall profitability of a firm because it affects both the SC cost and the customer experience directly (Lee, 2004). The warehouse and distribution operation focuses on the need to ensure that the right product is available to the end -user in the right quantity, at the right place and at the right time. There are different types of distribution networks to realize and select for a particular industry. Researchers attempt to describe the requisite for an effective SC distribution network. Among these integration, coordination, SC flexibility, and utilization of technology, value of information, transport systems and location are widely taken into consideration.

An efficient and effective distribution network is critical in today's competitive environment. The major roles and decisions of distribution network design in the SC are facility role, facility location decision and capacity supply allocation. All network design decisions affect each other, i.e. the strategic network design decisions have interrelated spatial and temporal characteristics and must be made taking this fact into consideration. A network designer needs to consider product characteristics as well as network requirements when deciding on the appropriate delivery network as various networks have different strengths and weaknesses (Melo, *et al.*, 2007).

In designing a supply chain network, different models can be used to have a better decision during analysis and making decision on alternatives stated by the management. Among the various alternatives, optimization models, demand allocation models, heuristic models and simulation models are assessed in the model development of this study.

8.5 Research design and methodology for the study of PFSA

Given the complex nature of issues examined in this study and to facilitate in-depth analysis, both qualitative and quantitative research methodologies in the form of case study are employed considering the guidelines for good case study design and conduct provided by Yin (2003). The data for the study was gathered through an on-site visit of the case study agency and hubs by assessing the techniques used in documentation and system of operation as well as the available facilities. Primary data about the existing pharmaceutical SC network and distribution practice in PFSA was collected by using semi-structured interviews conducted with 12 concerned officials and employees in the entire chain including director and operation deputy director of the agency, directors from procurement, forecasting and capacity building, fund management, storage and distribution, planning monitoring, IT, human resource and general services; and from hospitals and suppliers and wholesalers. Open-ended questionnaires were used to expand the depth of data gathering during the interviews. Secondary data was gathered through review of agency documents and external literature search. Given the total number of employees and SC members in the pharmaceutical products distribution network of PFSA participated in the study as about 5000, a sample size of 479 was considered adequate. Participants are selected from the entire distribution chain based on their direct involvement in SC. Hubs, hospitals and health centres were selected based on capacity of warehouse, frequency of delivery and high delivery coverage or higher demand from the hubs. Thus, the data was gathered through direct observation, structured interviews and survey questionnaire. The entire supply chain of pharmaceutical products in Ethiopia is shown in Figure 8.1.

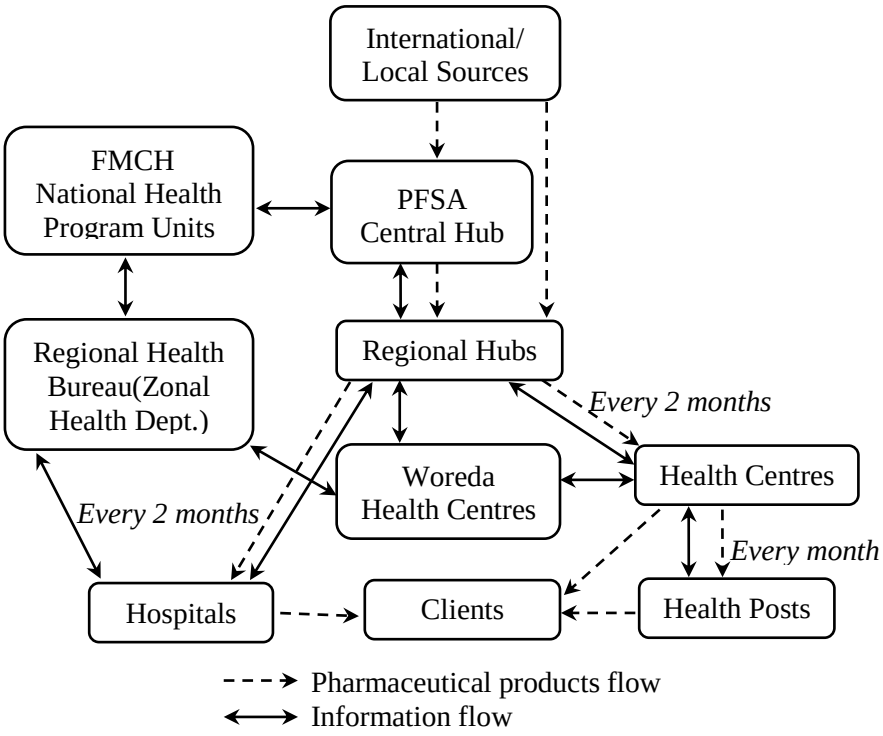


Figure 8.1. Ethiopian pharmaceutical products SC

As illustrated in Figure 8.1, pharmaceutical products acquired from local and international suppliers and donations are directly transported to the central hub (warehouse) at Addis Ababa. All regional hubs of PFSA acquire their demand from the central hub then each hub is responsible to distribute to public hospitals and health centres. The clients (end users) get the pharmaceutical products directly from hospitals, health centres and health posts. This in turn results longer distance travel by trucks and other vehicles to deliver the required amount in different sites from the hubs. Table 1 summarizes the distance from central hub to regional hubs and different sites, total distance in the current distribution routes and the trucks available in each hub with their capacity. In addition, if there are surpluses of items, private health facilities can purchase from PFSA while priority is given to the public health facilities. The existing detail distribution network is shown in Figure 8.2.

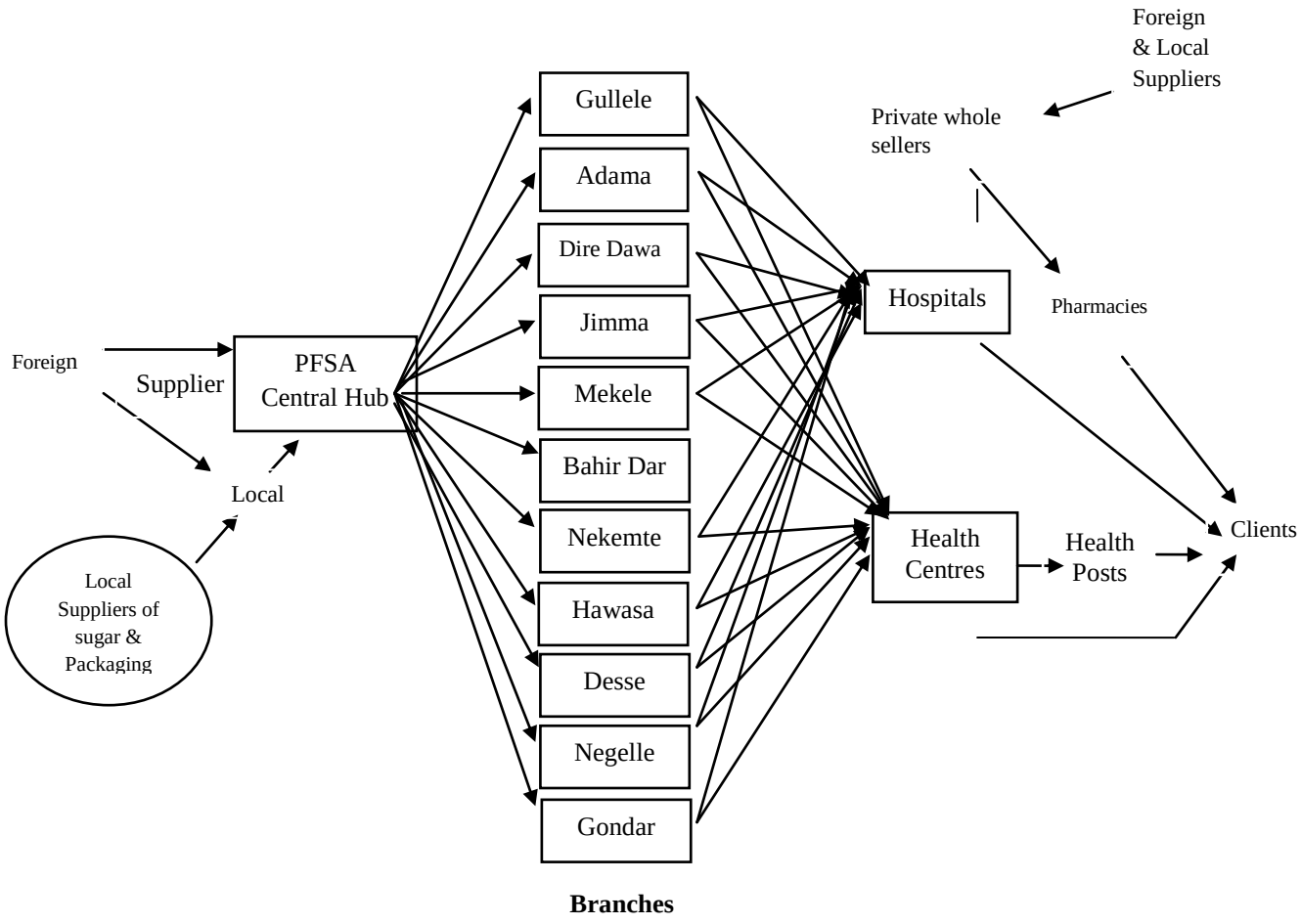


Figure 8.2 The existing distribution network of PFSA

As illustrated in Figure 8.2. private wholesalers are allowed to import from the international suppliers as well as from the local suppliers. Public health facilities can also procure from the private wholesellers getting approval from PFSA hubs justifying shortage of the required product. 62 Trucks with a total carrying capacity of 10,031 Quintals are deployed during distribution and 28 delivery vans are currently operating. Six heavy trucks with trailer are in the process of procurement.

8.5.1 Results of Qualitative Data Analysis in PFSA

The collected data is analyzed using comparative benchmarking for the qualitative data in separate stages. The data collected through on-site observation, interview and from agency documents and reports are summarized by segmenting into three categories based on the stages of the agency's supply chain.

- ✓ Demand Forecasting and capacity building
- ✓ Procurement and cycle time
- ✓ Frequency of delivery and distribution.

All the three parameters were investigated in detail. In the demand management and forecasting, a huge error in forecasting at health centres and health posts due to unavailability of demand data for the previous years and shortage of skilled personnel in forecasting the demand need in a proper way. In general the existing pharmaceutical supply system is a push system, where by pharmaceuticals are supplied in anticipation for clients' demand. In practice the forecasting and procurement activity is performed mainly based on sales data, marketability and revenue generation principles.In the procuremnt and cycle time,there is a 2-3 week delay time for national suppliers and 5 to 6 month delay for international suppliers. The capacity of procurement has increased from 600 million to 3.5 Billion Birr in the last 3 years showing about six times increment as a result of an increase in demand every year. But there is a challenge to meet this requirement due to longer lead time and complicated procedure. Besides, PFSA doesn't have long term collaboration with any of the international suppliers. The procurement process begins from sales report at branch level and continued to project the demand at branch

level. There are approximately 33 processes from sales process report up to handover of supplies to clients. The total cycle time elapsed from sales report up to hand over supplies to customers is around 470 days. In the frequency of distribution, the quantity of pharmaceuitical products distributed has increased year by year implying an increase demand in all regional hubs.

8.5.2 Results of Quantitative Data Analysis in PFSA

In analyzing the quantitative data, respondents were asked different questions related to supply chain distribution and answers by the respondents' opinions through questionnaires were analyzed by sing Microsoft Excel solver and SPSS software. The survey questions were focusing on: customer satisfaction in the service; distribution and fleet management; forecasting and capacity building and storage and warehousing.

Generally, results of qualitative and quantitative data analysis indicated the existence of major problems related to distribution such as; availability of few branches, limitation in space in the warehouse for safe storage, slow delivery, poor forecasting knowledge and techniques, delay due to routing problem, non-automated warehouse and facilities, shortage of transport vehicle and lack of using recent technologies so as to co-ordinate, integrate and collaborate all the stakeholders along the distribution network. Thus, it is found to be relevant to develop a model that can be helpful in mitigating the identified problems. After the data are analyzed by the above method, modeling the facility location problems have been done.

8.6 Newly Re-designed Model for the Supply Chain Distribution of PFSA

Designing a model includes formulating a mathematical model with a set of demand points and facility sites with different input parameters, allocating capacity of warehouses at different regions, locating facilities with a suitable place for customers' requirement, increasing the number and the capacity of transport vehicles and designing additional central warehouses (Melo and Gama, 2007). The capacity allocation, the facility location and study on expansion of existing warehouses through increasing the number and the capacity of transport vehicles and finally designing additional central warehouse are considered.

As a result, the total distance covered from Djibouti port to Addis Ababa port and to each old facility is 25122 km in the existing routing system. But on the newly designed model shown in Figure 8.3; the total distance covered by delivery vehicles to the end facilities is 13997 km. The difference in distance between the existing and the new distribution system is 11125km (reduced by 44% the total distance travelled in the old facilities). This greatly reduces the delivery time of the vehicles to the required facilities, because the distance is shortened by 44% or reduced from 215122 km to 13997 km. Finally this new design routing helps to improve the availability of pharmaceutical item.

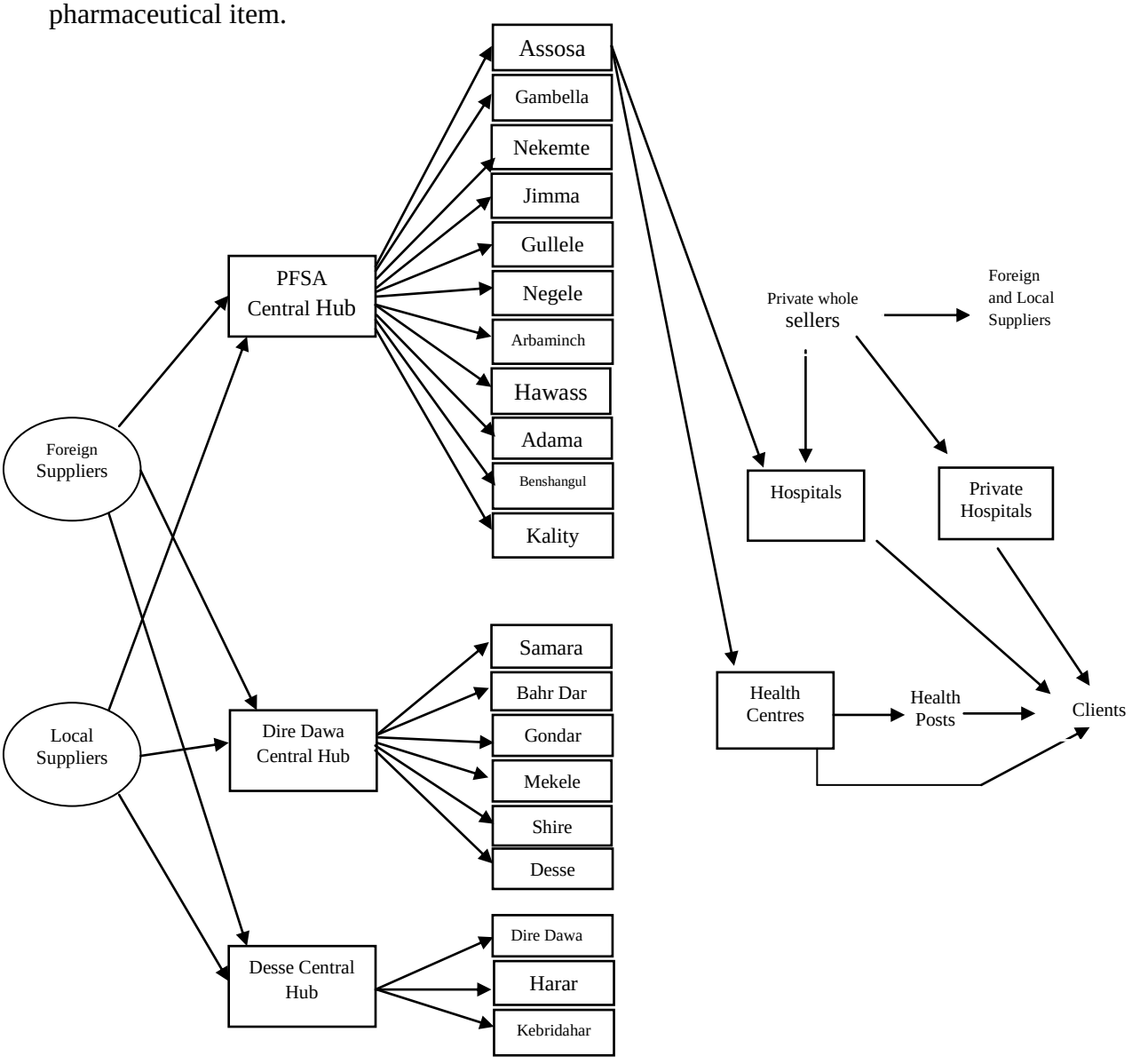


Figure 8.3 The overall distribution map of the newly designed distribution Network

8.7 Summary

Pharmaceuticals are basic inputs for services in healthcare. The supply chain and the distribution network of these pharmaceuticals are core components to enhance the responsiveness of the service in the sector. In this section, the existing distribution of pharmaceuticals by PFSA in Ethiopia is studied. Qualitative and quantitative data have been used to gather data on the existing distribution system. The distance and the lead time in the existing system is computed and a new model is re-designed that optimize the distance travelled and the lead time. The new model included additional central hubs to facilitate delivery to end customers. Having this change, the way demand is managed interactively should be done to fulfill the responsiveness in the sector. The next section focused on the development of integrated demand management model using system dynamics for healthcare services.

Chapter Nine

Developing an Integrated Demand Management Model Using System dynamics

This chapter introduces the concept of integrated demand management in healthcare. It explains how demand can be managed and integrated to minimize the complaints in the sector and to show the planned integrated demand management by using system dynamics. A new model is proposed to improve service quality and the expected results out of the proposed model are represented graphically.

9.1 Integrated Demand Management in Healthcare

Demand management in healthcare focuses on ensuring an appropriate flow of patients to health institutions. From an operational perspective, patient flow can be thought of as the movement of patients through a set of locations in a health care facility. Effective resource allocation and capacity planning are contingent upon patient flow because patient flow in aggregate is equal to the demand for health care services. Given the natural complexity of the health care environment, its setting greatly influences both the perception and analysis of patient flow. Fortunately, however, the health care environment can be easily characterized based on the nature of health care services (Murray, 2000).

Simulation and formal models are both useful and effective tools for capacity planning and efficiency improvement of healthcare systems (Fanti *et al.*, 2013). Healthcare delivery is becoming increasingly complex as it shifts from care delivered by a single provider and setting to collaborative care delivered by multiple providers across multiple settings. The Institute of Medicine's (2001) study "Crossing the Quality Chasm" claims that team-based care delivery is the future of healthcare, and a healthcare system redesigned includes effective use of information technology (IT) and coordination of care across patient conditions, services, and sites of care over time (The Committee on Quality of Healthcare in America of the Institute of Medicine, 2001). Yet, current healthcare systems are not designed to support an integrated team-based care

delivery that spans multiple providers and settings. IT is set to play a significant role in coordinating healthcare teams who are often separated by time and space (Benyoucef, *et al.*, 2011). But, without the integrated design, IT by itself cannot fully solve the demand management problem of complex healthcare services.

It is impossible to address the meaning of Integrated Demand management without first examining the roots and core notions of integration. The word 'integration' stems from the Latin verb *integer*, that means 'to complete.' The adjective 'integrated' means an 'organic part of the whole 'or 're-united parts of a whole.' It is mostly used to express the bringing together or merging of elements or components that were formerly separate. The idea of comprehensiveness overlaps with that of integration. Similar to the original meaning of the Greek verb 'diagnosis', the word 'comprehensive' denotes '(full) understanding of a situation.' In other words, what is connoted is a desire to understand the relationship of elements that constitute the entirety.

'Integration' is at the heart of systems theory and, therefore, is central to organizational design and performance. All organizations (and systems) are, to some extent, hierarchical structures that comprise separate, but interconnected components. These components are supposed to play complementary roles in order to accomplish their joint tasks (Dennis and Cor, 2002).

However, the division, decentralization, and specialization found in the architecture of more complex organizations usually interfere with efficiency and quality goals. Therefore, the fulfillment of system aims necessitates cooperation and collaboration among and between the various parts of the organization or system. In this sense, integration is the ''glue'' that binds the entity together, thus enabling it to achieve common goals and optimal results (Dennis and Cor, 2002).

Health systems and health care institutions are among the most complex and interdependent entities known to society. Historically, many factors have worked to divide various types of health care institutions and services on the one hand, and administrators, physicians, nurses and allied professionals on the other. Besides, there are differing rules, inter sectoral boundaries (as between health care, mental health care, and social care), funding streams, and institutional and

professional cultures, to name the most obvious. Without integration at various levels, all aspects of health care performance suffer. Patients get lost; needed services fail to be delivered or are delayed; quality and patient satisfaction decline; and the potential for cost-effectiveness diminishes.

Integrated demand management is bringing together the demand of the customers , the service delivery, the management aspect and organization of the healthcare services as a means of improving access, quality, user-satisfaction and efficiency.

9.2 System Dynamics for Integrated Demand Management

System dynamics (SD) is the study of how systems change over time. The technique is employed to provide an understanding of a complex system through the construction of qualitative diagrams and quantitative simulation models. Among all the research approaches, SD is an ideal technique to study complex and multivariable non-linear systems (Nuo and Xiao-jie, 2010).

SD was introduced by Jay Forrester in his book *Industrial Dynamics* in the early 1960s. In several areas of management research, computer simulators based on SD models are used as a means to explore the subjects' understanding and behavior in a complex situation. SD is a methodology for studying and managing complex feedback systems such as the ones found in business and other social systems. In fact, it has been used to address practically every sort of feedback systems as well as problem-solving policy designs. The purpose of SD modeling is to improve understanding of the ways in which an organization's performance is related to its internal structure and operating policies and then to use that understanding to design high leverage policies for success (Sterman, 2000). SD is also a rigorous modeling method that enables the building of formal computer simulations of complex systems and use them to design more effective policies and organizations (Lidia *et al.*, 2012).

There are two structural ways to analyze any dynamic system: 'causal loop diagram'(CLD) and 'stock-and-flow diagram'. The causal loop diagram only describes the basic aspects of the feedback structure, and cannot show the difference among variables of different nature (Wang, 2011). SD stock-and-flow diagram solves this problem. It uses stock, flow,

diagram which is used to explain both variables, i.e. the stocks and flows. Stocks refer to the status of variables at a point/moment of time while flows exist during a period of time. Stocks are accumulated over time through inflows and outflows. Apart from stock and flow variables, another kind of variable called an 'auxiliary variable' has been used. Auxiliary variables are used to connect between stocks and flows as well as among themselves. By using all these three kinds of variables, stock-and-flow diagram can explain dynamic systems more appropriately.

Many researchers and authors have used the SD approach to model and describe supply chain performance variables, such as those of Nuo and Xiao-jie, 2010; Lidia *et al.*, 2012; Wang, 2011; Xiao-yan and Jian-hua, 2010; Jianghong, 2010; Mahmodi and Minaee, 2010; Asgari and Hoque, 2013.

System dynamics is an approach that helps in solving problems which are important at top management level. The solutions to small problems yield small rewards. Very often, the most important problems are little more difficult to handle than the less important. Many people predetermine ordinary results by setting initial goals too low. The attitude must be one of enterprise design. The expectation should be for major improvement. The attitude that the goal is to explain behavior, which is fairly common in academic circles, is not sufficient. The goal is to find management policies and organizational structures that lead to greater success Jay W. Forrester (Industrial Dynamics, 1961, p. 449).

9.3 Modeling Services in Healthcare by the use of System Dynamics

Healthcare centres are complex systems that can be represented as networks of interacting units called "services". For example, model of hospital emergency room patients is used to analyze utilization and the backlog in emergencies using a system dynamics tool. It shows how the organizational boundary creates a lack of coordination among services. In their simplest form all systems consist of inputs, processes, and outputs. These are fundamental to operate a productive, goal-achieving organization. To comprehend an organization's system, it is necessary to examine the interactions, relationships, and transactions that comprise the substance of the organization's day-to-day business. These dependent variables are influenced by the behavior of

internal and external environmental as well as cultural factors. The structure of the relationships affects the feedback loops and direction of each variable's interaction. This transforms the composition of other variables and ultimately influences decision-making and policy directions. The feedback loops and their direction are capable of producing factors that determine growth, stagnation, or decline in an organization's development. How the feedback is balanced and driven determines the productivity of the organization. The system dynamics approach focuses on helping decision-makers understand how structure drives behavior; it does so using the rigor of simulation and the power of visualization.

9.4 Parameters to model integrated demand management in healthcare with the Use of System Dynamics

In considering parameters which are influential to the flow in the system, the waiting time changes, the resource availability and the transition of state at each phase are considered as a changing and influencing factor for the overall performance of the system. The rates for transition between states are also with great impact to the state of the system and should be carefully selected. As a major parameter, the waiting time is studied in the emergency and referral cases demand management in healthcare. Assumptions are taken by using systematic evaluation of the real data. Accident rates, service rates and service delays are represented by using the collected data from the sector.

9.5 Proposed Integrated Demand Management Model for Healthcare Using System Dynamics

The core concept of the new model is demand management integration. The components of demand management integration shown in detail in section nine are considered in the new system in order to minimize the instability of the service system in the healthcare and to minimize delays. Assumptions for the value are taken by initially considering the need and the expected improvement as a result of the demand integration concept and through discussion with experts in the area.

(01) Access rate=Population in need of emergency and referral medical service*Accessibility /Integrated demand management, Units: People/Month

(02) Accessibility=0.8, Units: People/Month

(03) FINAL TIME = 12, Units: Month
The final time for the simulation.

(04) Free bed and adequate manpower availability= 0.8, Units: Dmnl

(05) INITIAL TIME = 0, Units: Month
The initial time for the simulation.

(06) Integrated demand management=Resource availability/Linked communication and resource assignment, Units: 1/Month

(07) Integrated service management=Interlinked communication of service status, Units: 1/Month

(08) Interlinked communication of service status= 0.8, Units: 1/Month

(09) Linked communication and resource assignment=0.8, Units: Dmnl

(10) Population at Hospitals= INTEG (Service rate 2-Access rate, 500), Units: People

(11) Population in need of emergency and referral medical service= INTEG (-Access rate, 500000),Units: People

(12) Population who got on time service= INTEG (Service rate 2, 20), Units: People

(13) Resource availability= Free bed and adequate manpower availability*Integrated service management, Units: 1/Month

(14) SAVEPER = TIME STEP
Units: Month
The frequency with which output is stored.

(15) Service rate 2=DELAY FIXED (Population at Hospitals, Integrated service management, Population at Hospitals /4)
Units: People/Month

(16) TIME STEP = 0.5, Units: Month , the time step for the simulation.

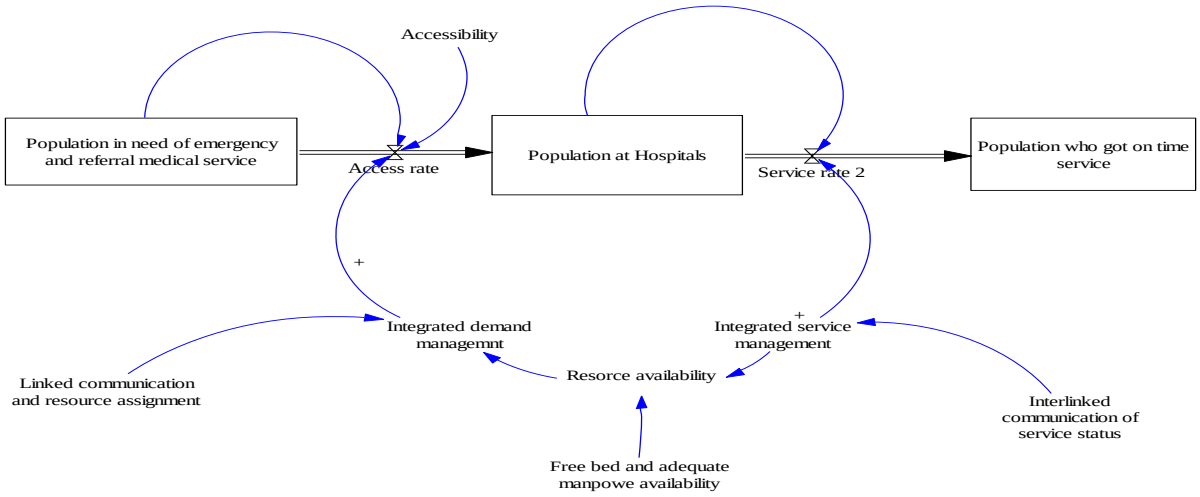


Figure 9.1 Proposed flows of activities for demand management in healthcare

Patient flow in emergency and referral cases

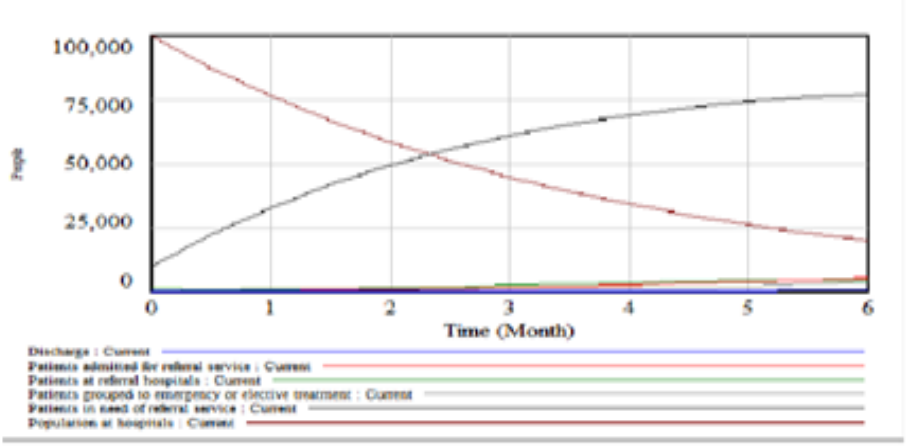


Figure 9.2 Proposed flows of activities for demand management in healthcare

9.6 Model Validation

A model should be checked for its validity and compatibility with the real situation. Models developed with system dynamics should also be checked for and tested for validity. Model testing creates better decision and confidence in the decision makers and increases the acceptability of the model by the users. Validation and model testing includes parameter

evaluation, dimensional consistency, structural and behavioral assessments as well as sensitivity analysis (Sterman, 2010). In this research, all these core points of model validation and testing are done in the study area and as a result, the model is found to be acceptable and appropriate.

9.7 Summary

Managing the demand of customers in healthcare should be given great attention to enhance the health and wellbeing of a society. Integrated demand is proposed to be helpful in improving the responsiveness in healthcare services thus to minimize complaints and increase customer satisfaction.

Chapter Ten
Conclusions and Recommendations

In this chapter, concluding statements on the whole research are given, recommendations based on results of the study are provided and areas in need of further research and investigation have been mentioned.

10.1 Conclusions

Quality is the main differentiator in the manufacturing and service areas. The move towards quality improvement in the service sector lags behind compared with that of manufacturing, though service sectors constitute a considerable part of economic growth. In addition, quality in healthcare sector is a mandatory issue as healthcare service is an integral part of every country and society. There are complaints by patients on the services given in the healthcare centre in the country mainly on responsiveness. Patients claim that there is high waiting time at every step in healthcare service in hospitals, especially in the highest referral hospitals of the country.

In Ethiopia, different approaches of quality improvement in the healthcare sector have been attempted. But the result achieved by implementing the improvement plans is insignificant. This led the sector to be full of complaints. The nature of complexity in the sector and the loose of integration in the planned improvement activities are the core reasons for the sectors' weak results. In addition, the general approach of improving service without giving priority to core problem areas is also the reason for the least improvement in the sector.

As an aid for better improvement to come in the healthcare sector, identification of core problem areas and prioritization for improvement needs is done in this research by using Fuzzy-AHP approach. As a result of the identification: emergency cases were first dealt for further improvement, referral cases, inpatient cases and pharmaceutical distribution were also studied hierarchically. After analyzing the existing situation in the assessed areas, integrated demand

management model with the use of system dynamics was proposed in addition to the re-design of a new model for pharmaceuticals distribution.

As a result, this research came up with core concluding remarks. The first one is, in addition to the appreciable moves towards quality improvement in healthcare services, managing the demand in an integrated way should be given great attention in order to help in using the limited resources effectively. Secondly, new way of understanding the system to ease improvement approaches like system dynamics should be adapted to simplify the visualization of the whole system in a single model.

10.2 Recommendations

Based on the core findings of the research, the following recommendations are provided to the Ethiopian Healthcare Sector aimed at enhancing the sector's service quality.

- ✓ The sector should first identify priority areas for improvement by interpreting the need of patients in a better way.
- ✓ The demand side in the sector should be given great attention in addition to the supply side.
- ✓ The focus on basic inputs distribution like the case of pharmaceuticals should be there.
- ✓ There should be an integrated way of managing demand at different tiers of healthcare centers in order to help in managing the demand at different levels and in the highest referral hospitals hierarchically.
- ✓ The sector should adopt the proposed model for better demand management and responsiveness.

10.3 Direction of Future Research Areas

This study forwarded an integrated demand management model for the healthcare quality improvement. The proposed model is helpful to manage the demand in a better way and to fill the gap of the existing weak integration in different service levels of the system. Considering the output from this research as a good start, further investigation should be carried out in the following areas.

- ✓ Continuous assessment of the performance at each level of the Ethiopian healthcare services should be made focusing on finding the gap as well as investigating a means of improvement for the specifically studied areas.
- ✓ Elaborated study on integrating the demand management of material inputs for the service in healthcare; pharmaceutical, medical equipment, etc. with the patient demand in the sector should be done.

References

1. Admasu, K. (2014). Envisioning the Future of the Health Sector:an update. *Quarterly Health Bulletin Editorial.*
2. Africa Health Summit (AHS) (2015).London :Mondragon Health.
3. Ahmadeva, H. A. (2004). "No more tears!" A local TQM formula for health promotion. *International Journal of Health Care Quality Assurance, 17*(3), 135-145.
4. Ang, D. A. (2008). Supply Chain Management for Higher Education, 11(2), 28-33.
5. Asgari, B., & Hoque, A. (2013). A System Dynamics Approach to Supply Chain. *Ritsumeikan , 32*(1), 51-61.
6. Babu, S. H. (2015). Conceptual Evolution of Service Quality – A Primer,*5*(5).
7. Baru, R., & A, J. (2000). The role of the World Bank in international health renewed commitment and partnership, *50*.
8. Benyoucef, M., Kuziemsky, C., & Elsabbahi, A. A. (2011). Modeling healthcare processes as service orchestrations and choreographies, *17*(4).
9. Berhan, Y. (2008). Medical Doctors Profile in Ethiopia: Production,Attrition snd Retention, *Ethiop Med Journal*.
10. Berry, L., & Parasuraman, A. a. (1994). Improving service quality in America: lessons learned". *8*.
11. Bhat, R. (1996). Regulation of private health sector in India, *International journal of health planning management*, 11.
12. Bowers, M. R. (2002). Measuring health-care quality: Comparing and contrasting the medical and the marketing approaches. *17*(4).
13. Buyukozkan, G., & Guleryuz, G. Ç. (2011). Strategic analysis of healthcare service quality using fuzzy AHP methodology.
14. C, G. (1984). A service quality model and its marketing implications, *18*(4).
15. Cameron, P., & P. Scown, A. D. (2002). *Managing access block.* Australia: *Australian Health Review*.
16. Caruana, A. (2002). Service loyalty: the effects of service quality and the mediating role of customer satisfaction, *36*(7/8).
17. Chakravarty, C. A. (2011). Evaluation of service quality of hospital outpatient department services. *67*(3).

18. Chang, D. (1992). Extent analysis and synthetic decision, optimization techniques and applications, *1*.
19. Choi, T. &. (2001). Determinants of Hotel Guests' Satisfaction and Repeat Patronage in the Hong Kong Hotel Industry. *20*.
20. Chopra, S. (2001). Designing the Distribution Network in a Supply Chain. In S. Chopra, *Supply Chain Management.*
21. Crainic, T. G. (2002). *A Survey of Optimization Models for Long-Haul Freight Transportation.*
22. Country Cooperation Strategy of World Health Organization (CCS), 2012-15, Ethiopia.
23. Dag, E. O. (2013). Combining Analytical Hierarchy Process and Topsis Approaches for Supplier Selection in a Cable Company, *2*(2).
24. Dey, P., & S. Hariharan, A. N. (2006). Managing Healthcare Quality Using Logical Framework Analysis, *Managing Service Quality*, *16*(2).
25. Dhote, S., & I.P, K. (2012). Evaluation of service quality in hospital using fuzzy reasoning approach,*1*(4).
26. Dimitriadis, G. K. (2008). structured interviews to collective conversations.
27. Donabedian, A. (1988). The quality of care-how can it be assessed. *26*, 1743-48.
28. Dubrovski, D. (2001). The Role of Customer Satisfaction in Achieving Business Excellence. *12*(7).
29. Eriksson, H., Bergbrant, M., & Mörck, I. B. (2010). Reducing queues - demand and capacity variations. *International journal of health care quality assurance, 24*(8).
30. Ethiopian Health Reform Implementation Guidline (EHRIG) (2007), Ethiopia.
31. Evers, M. M. (1996). Distribution network design: an integrated planning support framework. *9*(1).
32. Faezipour, M., & Ferreira, S. (2013). A system dynamics perspective of patient satisfaction in healthcare. *Conference on Systems Engineering Research.* Atlanta: Elsevier B.V.
33. Fatovich, D., & Y. Nagree, a. P. (2005). Access block causes emergency department overcrowding and ambulance diversion in Perth, Western Australia. *22.*
34. Feeney, A., & Zairi, M. (1996). *TQM in Healthcare, 22*(1), 35-45.
35. Feigenbaum, A. (1991). Total Quality Control.
36. Forrester, J. (1961). Industrial Dynamics. Cambridge: MIT Press.
37. Ganiyu, R. A., & Elizabeth, I. I. (2012). The Building Blocks of Total Quality Management: Processes, People, Measurement and Management Systems, *4*(7).
38. GTP. (2010). *Ethiopian Growth and Transformation Plan I.*

39. GTP. (2015). *Draft of Ethiopian Growth and Transformation Plan II.* Ethiopia.
40. Hariharan, P. K. (2006). Integrated approach to healthcare quality management: a case study. *The TQM Magazine, 18*(6), 583-605.
41. Haron, S. N., & Talib, M. Y. (2012). Towards Healthcare Service Quality: An Understanding of the Usability Concept in Healthcare Design. *ASEAN Conference on Environment-Behaviour Studie 42*,-73.
42. Helmer, D., Sambamoorthi, U., Shen, Y., Tseng, C.-L., Rajan, M.,& Tiwari, A. (2008). Opting out of an integrated healthcare system: Dual-system use is associated with poorer glycemic control in veterans with diabetes. *Primary Care diabetes, 2*, 73-80.
43. HSDP-IV. (2010). *Heath Sector Development Plan.*
44. Iacobuta, A.O. (2012). Patients' evaluation of access and quality of healthcare in EU countries. A comparative Analysis. *Social and Behavioral sciences. 62*, pp. 896-900.
45. III, C. R., Mcfadden, K. L., Hoobler, J. M., & Tallon, W. J. (2006). Exploring the efficacy of healthcare quality practices, employee commitment, and employee control. *Journal of Operations Management, 24*, 765-778.
46. JCI. (2014). Joint Commision International Accreditation Standards for Hospitals,*Fifth Edition. Joint Commission International*.
47. Jianghong, M. (2010). An Integrated Supply Chain Modeling and Simulation Based on System Dynamics. (pp. 1-4).
48. Kahraman, C., & Ulukan, U. C. (2003). Multi-criteria supplier selection using fuzzy AHP, *6*(6).
49. Kampstra, R., & Gattorna, J. A. (2006). The International Journal of Logistics Management 'Realities of supply chain collaboration', *17*(3).
50. Kay, J. F. (2007). *Health Care Benchmarking.* Hong Kong: The Hong Kong Medical Bulletin.
51. Kaye, M. &. (1999). Customer value-driven strategies,Total Quality Management.
52. Kitzinger, J. (2005). The methodology of focus groups: the importance of interaction between research participants. *Sociology of Health, 16*(1), 103-21.
53. Kodner, D. L., & Spreeuwenberg, C. (2002). Integrated care: meaning, logic, applications, and implications– a discussion paper international Journal of Integrated Care, *2*.
54. Konrad, R. A., & Lawley, M. A. (2009). Input Modeling for Hospital Simulation Models using Electronic Messages. *Proceedings of the 2009 Winter Simulation Conference.*
55. Kothari, C. (2004). *Reserach Methodology:Methods and Techniques* .
56. Labiris, G., & Niakas, D. (2004). Policy and Regulatory Analysis Demand management and the EU healthcare market integration. *Journal of Medical , 5*.

57. Lasser, W., & Manolis, C. A. (2000). Service quality perspectives and satisfaction in private banking. *Journal of Services Marketing, 14*(3), 244-71.
58. Lee, C. L. (2004). Multi-objective Optimization of Multi-echelon Supply Chain Networks with Uncertain Product Demands and Prices, *28*(7).
59. Lent, T. M. (2007). An Overview of Six Signa Applications in Healthcare Industry. *Intrnational Journal of Healthcare Quality Assurance*, 329-340.
60. Li, Q. (2013). A novel Likert scale based on fuzzy sets theory, 40.
61. Liamputtong, P. (2010). Cross-Cultural Research and Qualitative Inquiry. *Turkish Online Journal of Qualitative Inquiry, 1*(1).
62. Lidia, W. M., Arai, T., & Ishigaki, A. (2012). Applying System Dynamics Approach to Fast Fashion Supply Chain :Case Study of an SME in Indonesia. *International Journal of BRIC Business Research (IJBBR), 1*(1), 15-29.
63. Mahmodi, J., & Minaee, H. M. (2010). Using System Dynamics to Model Rod Bar Supply Chain in Iranian Market. *International Journal of Industrial Engineering & , 21*(3), 129-135.
64. Mansuri, Y., & Maroofi, S. R. (2013). Factors Affecting Demand Management in the Supply Chain, *6*(14).
65. McAlearney, A. (2008). UsingLeadershipDevelopment Programst oImproveQualityand Efficiency inHealthcare. *Journal of Healthcare Management, 53*(5), 319-331.
66. McLaughlin, P., & Kaluzny, A. (1994). Continuous Quality Improvement in Heathcare: Theory,Implementation and Applications.
67. McNatt, Z., Thompson, J. W., Mengistu, A., Tatek, D., Linnander, E., & Ageze, L. (2014). Implementation of hospital governing boards:views from the field. *14*(178).
68. Melo, M., & Gama, S. N. (2007). Facility Location and Supply Chain Management – A comprehensive review.
69. Misra, V., & U.K.Singh, M. (2010). Supply Chain Management Systems: Architecture, Design and Vision. *Journal of Strategic Innovation and Sustainability*.
70. MLI. (2011). *Ministerial Leadership Initiative for Global Health Report.*
71. Murray, J. C. (2000). Understanding Patient Flow.
72. Nair, V. D., Morankar, S., & Tushune, C. J. (2010). Private Hospital Sector Development : an Exploratory Study on Providers Perspective in Addis Ababa, Ethiopia, *21*(Special Issue).
73. Natarajan, R. N. (2006). Transferring best practices to healthcare: opportunities and challenges. *The TQM Magazine, 18*(6), 572-582.

74. Neely, A. (2010). *Benchmarking: lessons and implications for health systems Unpublished report for the World Health Organization,European Region.*
75. Niakas, G. L. (2004). Policy and Regulatory Analysis Demand management and the EU healthcare market integration. *Journal of Medical , 5*.
76. Niveen El Saghier, D. N. (2013). Service Quality Dimensions and Customers' Satisfactions of Banks in Egypt. *Proceedings of 20th International Business Research Conference.*
77. Nolte, E. (2010). *International benchmarking of healthcare quality;A review of the literature.* London: RAND Corporation.
78. Nuo, L., & Xiao-jie, W. (2010). System Dynamics Modelling and Simulation of Multi-Stage Supply Chain Under Random Demand. International Conference on E-Business and E-Government. *International Conference on E-Business* ,3306-3309).
79. Osewe, P. (2006). Strengthening the role of the private sector in expanding health coverage in Africa.
80. Parasuraman, A., & Zeithaml, V. a. (1985). A conceptual model of service quality and its implications for future research, *49*(1).
81. Peter H, K. F., & Hellbardt, S. (1995). The TQM Journal.
82. Powers, T. L., & Jack, E. P. (2009). A review and synthesis of demand management, capacity management and performance in healthcare services. *International Journal of Management Reviews, 11*(2), 149-174.
83. Revees, C. (1994). Defining Quality:altrnatives and implications. *19*, 419-445.
84. Rexhausen, D., & Kaiser, R. P. (2012). Customer-facing supply chain practices-The impact of demand and distribution management on supply chain success. *Journal of Operations Management, 30*.
85. Rispoli, S. C. (2006). Selction Criteria for a Network Design Model with Uncertain Demand, 12.
86. Rogelio, S. (2001). Quality Erosion in the Service Industry,*Management Science*.
87. Ross, D. J. (2010). Nova Scotia Emergency Care Standards.
88. Rowley, D. J., & Slack, D. F. (2004). Conducting a Literature Review, *27*(6), 31-39.
89. Saddique, A. A. (2012). Development of Clinical Pharmacy services at King Khalid University Hospital and its impact on the quality of healthcare provided, *Saudi Pharmaceutical Journal.*
90. Samuel, C. ,(2010). Supply Chain Dynamics in Healthcare Services. *23*.
91. Satty, T. L. (1989). Decision marking, scaling and number crunching, Decision Sciences.
92. Schull, M., & K. Lazier, M. V. (2003). Emergency department contributors to ambulance diverision: a quantitative analysis. Annals of Emergency Medicine.

93. Shah, N. (2004). Pharmaceutical supply chains: key issues and strategies for optimisation. *28*.
94. Shapiro, J. F. (2003). *Modeling the Supply Chain.*
95. Silvestro, R. e. (1992). Towards a classification of service processes. *3*(3).
96. Simchi-Levi, D., & Kaminsky, P. A. L. (2004). *Managing the Supply Chain: The definitive.* McGraw-Hill .
97. Singh, V., Pallaghy, C. K., & Singh, D. (2006). Phosphorus nutrition and tolerance of cotton to water stress: Water relations, free and bound water and leaf expansion rate.
98. Sommers, P. (1998). Medical Group Journal in Terbulent Times, 26.
99. Sterman, J. D. (2010). *Business Dynamics: Systems Thinking and Modelling for a Complex World.* New York: McGraw-Hill.
100. Talwar, B. (2009). Comparative Study of Core values of Excellence Models vis-vis human value,Measuring Business Excellence. *13*, 34-46.
101. Tarafdar, M., & Scott, N. (2012). Information Separation in Service Supply Chains at the Bottom of the Pyramid: An Illustration through Telemedicine. Proceedings of SIG GlobDev Fifth Annual Workshop. Orlando, USA.
102. Teo, C.-P. A. (2004). Warehouse-retailer network design problem. (52).
103. Towill, D. R. (2009). Enabling effective change in healthcare delivery systems. Leadership in Health Services, 22(2), 176-188
104. VanVactor, J. D. (2011). A case study of collaborative communications within healthcare logistics. Leadership in Health Services, 24(1), 51-63.
105. Veillard, J., Garcia-Armesto, S., & Kadandale, S. a. (2010). International Health System Comparison: from measurement challenge to management tool,in Performance Measurement for Health System Improvement. Cambridge.
106. Wait, S., & Nolte, E. (2005). 'Benchmarking health systems: trends, conceptual issues and future perspectives', Benchmarking. 12(5).
107. Wang, W. (2011). Analysis of Bullwhip Effects in Perishable Product Supply Chain-Based on System Dynamics Model. Fourth International Conference on Intelligent Computation Technology and Automation (pp. 1018-1021). IEEE.
108. WHO. (2007-2014). World Health Organization.
109. Wilkinson, S. (2004). Focus groups: A feminist method. Oxford university Press.
110. WU, W.-Y., & KUO, S.-W. H.-P. (2004). Fuzzy Set Theory Based Decision Model for Determining Market Position and Developing Strategy for Hospital Service Quality.

111. Xiao-yan, W., & Jian-hua, Z. (2011). Simulation Research on Risk Measure in Hospital Service Supply Chain Based on System Dynamics. 169-172.
112. Y. T. Lin, C. L. (2010). A Novel Hybrid MCDM Approach for Outsourcing Vendor Selection: A Case Study for a Semiconductor Company in Taiwan,Expert Systems with Applications. 37(7).
113. Yasin, J. A. (2008). The role of quality improvement initiatives in healthcare operational environments: Changes, challenges and responses. International Journal of Health Care Quality Assurance, 21(2), 133-145.
114. Yin, R. K. (2003). Case study Research design and Methods .
115. Zeithaml, V., & Parasurama, A. B. (1990). Delivering Quality Service :Balancing customer perceptions and expectations.
116. Zhang, Q., & Liu, H. W. (2012). Distribution network optimization of supply chain with grey demands. 41(5/6).
117. Zivaljevic, V., Markovic, I., & Zivic, R. (2011). Surgical anatomy of the pyramidal lobe and its significance in thyroid surgery. 49(3).

Appendix A: Observation

1. The core services types given in the sector are observed.
2. The major steps in providing the core services in the sector especially in the referral and in the emergency cases are deeply observed. As a result, the presence of long steps which needs further study and improvement are identified in addition to evaluation of the recorded data about waiting time.
3. The way in which information about patients is recorded and managed was also studied.
4. The core activities in Addis Ababa Dispatch Centre for Emergency Cases are studied and identified through observation.
5. The major points on which delays for emergency services occur are identified.
6. The overall demand management approach in healthcare sector is observed.
7. The distribution of pharmaceutical products and equipments is also observed.
8. Existing improvement moves in the sector are observed.

Appendix B: Interviews

Addis Ababa Institute of Technology

School of Graduate Studies

School of Mechanical and Industrial Engineering

Dear Participants;

I am Shewit Woldegebriel, working on my PhD dissertation entitled "Integrated Demand Management for Quality Improvement in the Ethiopian Healthcare Sector" in Addis Ababa Institute of Technology (AAiT), School of Mechanical and Industrial Engineering. My Supervisor is Dr.-Ing. Daniel Kitaw from Addis Ababa Institute of Technology and Co-Supervisor is Professor Carlo Rafele from Politechnico Di Torino.

As Part of my study, I am also working on the way demand of the patients in Addis Ababa highest referral hospitals and in Addis Ababa Dispatch Center are managed in the country. In addition Thus, to fulfill the information I need in my work, I should have the detail working activity of your organization.

I would like to extend my gratitude to your organization and the staff for the willingness and cooperation in undertaking this valuable research and give information regarding the existing working situation as well as problems(if any) that the company is facing.

I request your compassionate cooperation in answering the questions as truthfully as possible. Your response will be highly confidential and will be used only for academic purpose. For other questions pertaining to this study, please contact Addis Ababa Institute of Technology, School of Industrial and Mechanical Engineering.

Thank you in advance!

Shewit Woldegebriel

Part I-Personal Information

Personal data

Current position _____

Qualification _____

Service year _____

Gender _____

Part II- questions related to demand management in dispatch center

Interview Questions (Addis Ababa Dispatch Center)

1. What does the existing service delivery in the Addis Ababa Dispatch Center look like?
2. Is the existing work of Addis Ababa Dispatch Center focusing only on emergency cases? What about providing service to other cases? Is there a plan of doing so?
3. How do you determine the needed specialty clinic for patients after receiving a call from patients? Is the decision based on proximity? What if the specialty clinic is beyond its proximity?
4. What is your comment on the bed report of hospitals? What measure do you take or plan to take to know the exact figure of free bed report from hospitals?
5. What is your effort in helping hospitals to use their ambulances?
6. What is the working condition of Addis Ababa Dispatch Centre in different sub cities?
7. What about the existing human resource in your company? And its organizational structure?
8. How do you evaluate the performance of the major duties in your office?
9. How do you evaluate the existing working activity in being responsive? Is there a plan to enhance the existing service?
10. How do you evaluate the current resource enhancement in the company?

Interview Questions (Tikur Anbessa Specialized Hospital)

1. How do you evaluate the existing service delivery mechanism on emergency cases and referral case in TASH? How do you prioritize the service for the patients in both emergency and referral cases in TASH?
2. Are there applied quality improvement activities in the hospital? What about the results achieved as a result of the implementation?
3. What is your effort in helping hospitals to use their resources effectively?
4. How do you evaluate the responsiveness of the hospital?
5. What about the existing human resource in your company?
6. How do you evaluate the performance of the major duties in your office?
7. How the company does handle the complaints from internal and external customers?
8. How do you evaluate the access of pharmaceuticals and medical equipment in the hospital?
9. What is the duty and responsibility of quality management department in the hospital?
10. Is the concept of integrated demand management familiar in the hospital?
11. Does the company use tools to manage and see the property of demand flow in the organization?
12. How do you evaluate the hospital about its delivery of quality service compared to other countries experience?

Interview Questions (St. Paul's Hospital Millennium Medical College)

1. How do you evaluate the existing service delivery mechanism on emergency cases and referral case in SPHMMC? How do you prioritize the service for the patients in both emergency and referral cases in SPHMMC?
2. Are there applied quality improvement activities in the hospital? What about the results achieved as a result of the implementation?
3. What is your effort in helping hospitals to use their resources effectively?
4. How do you evaluate the responsiveness of the hospital?
5. What about the existing human resource in your company?
6. How do you evaluate the performance of the major duties in your office?
7. How the company does handle the complaints from internal and external customers?
8. How do you evaluate the access of pharmaceuticals and medical equipment in the hospital?
9. What is the duty and responsibility of quality management department in the hospital?
10. Is the concept of integrated demand management familiar in the hospital?
11. Does the company use tools to manage and see the property of demand flow in the organization?
12. How do you evaluate the hospital about its delivery of quality service compared to other countries experience?

Interview Questions (Pharmaceutical Funds and supply Agency)

A) Interviews with the Director of the Agency

1. How do you define supply chain management based on the context of your agency?
2. What are the major challenges and opportunities of pharmaceutical supply chain in Ethiopia?
3. What about the total integration, collaboration and coordination along the supply chain? (Inbound logistics, focal company (PFSA), and outbound logistics).
4. What look like the detailed process maps of the supply chain network of pharmaceutical products in Ethiopia?
5. What are the challenges not to meet the requirements of the customers?
6. How your agency communicate, integrate and coordinate with external organizations like MOH, national health program unit, regional health bureau/zonal health departments?
7. Who are your stakeholders?
8. What about the tariffs and incentives from the government when you import from outside and inside?
9. What about the general awareness of the employee about supply chain?
10. Do you believe that your agency provide the right quantity and quality of pharmaceutical products for the customers? If not why?
11. How do you evaluate the average lead time for your immediate customers?
12. How do you evaluate the affordability and availability of pharmaceutical products by your agency?
13. What are the major challenges not to satisfy the need of your customers?
14. Do you believe that there is delay in providing service? If yes, why this happens? And what efforts your agency made to reduce the delay?

B) Interviews with storage and distribution directorate

1. How do you define supply chain management based on the context of your agency?
2. What mode of transportation you use for local and international market?
3. Where do you locate your warehouses and what is their capacity?
4. What is the rate of your transportation by mode?
5. What about the shipment size and frequency for your customer delivery?
6. What type of design options or distribution strategies your agency implemented? And what are your distribution obstacles?
7. What are the mode of transport for distribution and how you control the distribution system? Like usage of GPS system etc.
8. Do you believe that your agency provide the right quantity and quality of pharmaceutical products for the customers? If not why?
9. How do you evaluate the average lead time for your immediate customers?
10. How do you evaluate the affordability and availability of pharmaceutical products by your agency?
11. What are the major challenges which are satisfying the need of your customers?
12. Do you believe that there is delay in providing service? If yes, why this happens? And what efforts your agency made to reduce the delay?

Appendix C: Questionnaire-1

Addis Ababa Institute of Technology

School of Graduate Studies

School of Mechanical and Industrial Engineering

Questionnaire on Prioritization of Quality Improvement Needs in Healthcare

Dear Participants;

I am Shewit Woldegebriel, working on my PhD dissertation entitled "Integrated Demand Management for Quality Improvement in the Ethiopian Healthcare Sector" in Addis Ababa Institute of Technology (AAiT), School of Mechanical and Industrial Engineering. My Supervisor is Dr.-Ing. Daniel Kitaw from Addis Ababa Institute of Technology and Co-Supervisor is Professor Carlo Rafele from Politechnico Di Torino.

As Part of my study, I am working on the way demand of the patients in Addis Ababa highest referral hospitals are managed. In addition I am working on prioritizing the area in need of immediate solution in the service delivery of the healthcare sector. Thus, as an aid to prioritize the customers' requirements regarding the service given in Addis Ababa Highest Referral Hospitals, questions on how the dimensions are given priority by the customers are provided in the questionnaire. Please refer to the weightages given to fill your priority choice.

I would like to extend my gratitude to your organization and the staff for the willingness and cooperation in undertaking this valuable research and give information regarding the existing working situation as well as problems(if any) that the company is facing.

I request your compassionate cooperation in answering the questions as truthfully as possible. Your response will be highly confidential and will be used only for academic purpose.

For other questions pertaining to this study, please contact Addis Ababa Institute of Technology, School of Industrial and Mechanical Engineering.

Thank you in advance !

Shewit Woldegebriel

Relative importance	**Value**
Extremely more importance(EMI)	(8,9,10)
Very strong importance(VSI)	(6,7,8)
Strong importance(SI)	(4,5,6)
Moderate importance(MI)	(2,3,4)
Equal importance(EI)	1,1,2)

Service Quality Dimensions and major departments	**Reative Improtance of the service quality dimensions in the major departments**			**Priorityweight**
Tangibles	**Emergency case**	**Referral case**	**Outpatient case**	
Emergency case				
Referral case				
Outpatient case				
Reliability				
Emergency case				
Referral case				
Outpatient case				
Responsiveness				
Emergency case				
Referral case				
Outpatient case				
Empathy				
Emergency case				
Referral case				
Outpatient case				
Assurance				
Emergency case				
Referral case				
Outpatient case				

Appendix D: Questionnaire-2

Questionnaire on the Distribution of Pharmaceutical products by PFSA

NO	General	Response		
		Yes	No	No response
1	Do you have a role in the supply chain?			
2	Does your company have an organized structure?			
3	Does the organizational structure create suitable working environment?			
4	Does the employees in the agency aware about supply chain network?			
5	Does your company ever identify the problems related to supply chain?			
6	Does your agency accept and implement any research conducted before?			
7	Do you believe that there are proper monitoring systems to ensure the rational use of pharmaceutical products?			
8	Does your agency accept and implement any research conducted before?			
9	Do you have knowledge about supply chain network?			
10	Do you actively facilitate the supply chain within and outside your agency?			
	Customers requirements			
11	Does your agency identified customer requirements?			
12	Does the agency have customer compliant handling mechanisms?			
13	Does your agency conduct need assessment to satisfy the need of your customer?			
14	Does the agency's pharmaceutical products satisfy customer?			
15	Do you agree that your agency provide the right quantity of			
	Pharmaceutical products for the customer?			
	Procurement			
11	Do you agree in the purchasing procedures in your agency?			
12	Does your agency have enough working capital?			
13	Does the company have a procedure for evaluating suppliers or vendors?			
14	Has the company established criteria for removing vendors in case of			
	Unsatisfactory performance with suppliers?			
15	Does your supplier have enough capacity?			
16	Do your suppliers deliver items at the right time?			

	Finance					
17	How do you evaluate the affordability of the pharmaceutical products	Very cheep	Cheep	Expensive	Very expensive	Unknown
18	How do you evaluate the financial capacity of your agency to purchase local and international market?	very high	high	Low	very low	Unknown
	Distribution and fleet management					
19	How do you evaluate the availability of transport vehicles at PFSA	very high	high	Low	very low	Unknown
20	How do you evaluate the arrival time of transport vehicles	Very long	long	Short	Very short	Unknown
21	How do you evaluate the frequency of delivery of items	very high	high	Low	very low	Unknown
22	How do you evaluate the usage of management information system to control transport vehicles by PFSA	very strong	strong	Weak	very weak	Unknown
23	How do you evaluate the overall distribution capacity of items by PFSA	very high	high	Low	very low	Unknown
	Human resource					
24	How much is the level of skill and knowledge of employee about supply chain	very high	high	Low	very low	Unknown
25	How do you evaluate the availability of skilled man power at PFSA	very high	high	Low	very low	Unknown
26	How much is the degree of believe that the presence of skilled manpower can determine the availability of items	very high	high	Low	very low	Unknown
	Forecasting and capacity building					
27	How much is the degree of believe that there is a good practice of forecasting demand at PFSA	very strong	strong	Weak	very weak	Unknown
28	Dow do you evaluate the training given to follow the right forecasting techniques at PFSA	very strong	strong	Weak	very weak	Unknown
29	How much is the degree of believe that there is a strong coordination among health facilities, , PFSA, MoH and RHO in forecasting the demand	very strong	strong	weak	very weak	Unknown
30	How do you evaluate the training given to the employee at health facility and PFSA	very high	high	Low	very low	Unknown
	Storage					
31	How do you evaluate the volume of PFSA's warehouses	very high	high	Low	very low	Unknown
32	How do you evaluate the available branches of PFSA's warehouse	Many	enough	Few	very few	Unknown
33	How do you evaluate the warehouse facilities at PFSA	highly advanced	advanced	not advanced	manual	traditional
34	How do you measure the item tracking system at PFSA warehouse	highly advanced	advanced	not advanced	manual	traditional
35	How do you evaluate the security of the warehouse	very strong	strong	Weak	very weak	Unknown

Appendix E: Focal Group Discussion

Discussion Points	Participants	Date	Place
Working system, existing problems and comments for improvement in referral systems as well as model development.	Nurse Teshome Tegenie ,Nurse Tigist Ayele, Nurse Almaz Taddese	July23,2013, September,25,2014, January 3,2015	TASH
Working system, existing problems and comments for improvement in referral systems as well as model development.	Dr. Tigist Belay, Nurse Taddese Alemu, Nurse Abeba Wolde, Nurse Tewodros Kefyalew	September 16,2013, October 4,2014,February o3,2015	SPHMMC
Working system, existing problems in emergency demand management of Addis Ababa dispatch centre and comments for improvement and model development.	Nurse Hirut Tamiru, Nurse Kiros Alem, Nurse Seble Tessema	September 30,2014,December 15,2015,February 10,2015	AADC

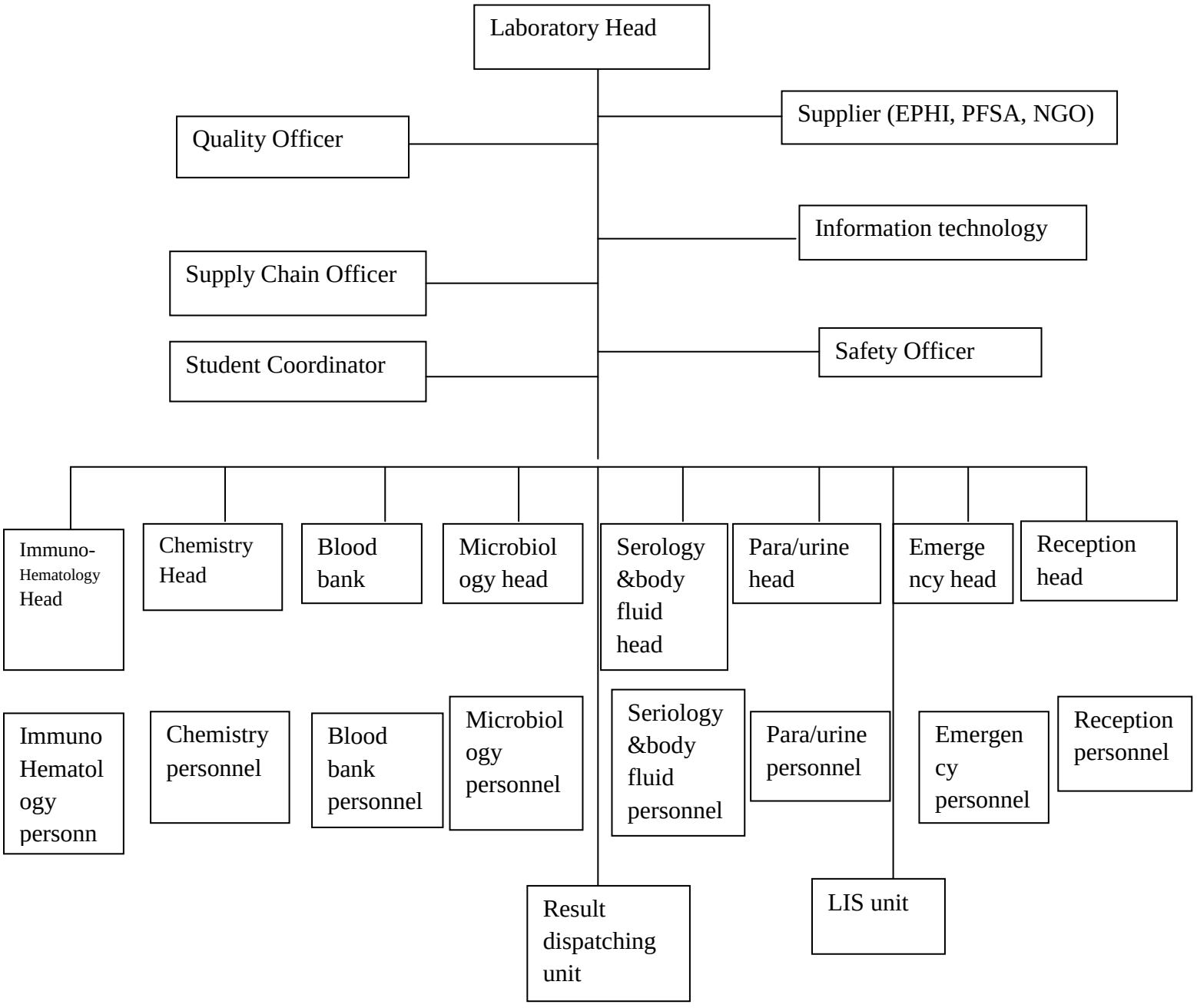
Appendix F: Population of Ethiopia

Year	Population	Yearly % Change	Yearly Change	Median Age	Fertility Rate	Density (P/Km²)	Urban Pop %	Urban Population	Country's Share of World Pop	Global Rank
2014	96,506,031	2.56%	2,405,275	18.4	4.72	87	18%	17,172,948	1.33%	13
2010	87,095,281	2.72%	2,185,608	17.5	5.26	79	17%	14,594,556	1.26%	14
2005	76,167,240	2.90%	2,028,608	16.8	6.13	69	16%	11,958,257	1.17%	15
2000	66,024,199	2.97%	1,800,136	16.6	6.83	60	15%	9,731,307	1.08%	16
1995	57,023,519	3.49%	1,796,153	16.7	7.09	52	14%	7,884,642	0.99%	21
1990	48,042,755	3.33%	1,453,113	16.8	7.37	44	13%	6,063,476	0.90%	23
1985	40,777,189	2.96%	1,107,196	17.0	7.43	37	11%	4,670,211	0.84%	23
1980	35,241,209	1.59%	534,260	17.6	7.18	32	10%	3,668,610	0.79%	26
1975	32,569,908	2.77%	830,982	17.6	7.10	29	9%	3,081,113	0.80%	26
1970	28,414,999	2.58%	680,290	18.0	6.87	26	9%	2,440,280	0.77%	26
1965	25,013,551	2.46%	572,467	18.1	6.90	23	8%	1,897,778	0.75%	26
1960	22,151,218	2.12%	440,791	18.1	6.90	20	6%	1,424,988	0.73%	25
1955	19,947,265	1.93%	363,846	18.0	7.17	18	5%	1,085,929	0.72%	25

Appendix G:Professionals in TASH

No	Professional list	Number
1.	Internist	32
2.	Surgeon	52
3.	Pediatrician	14
4.	Gynecologist and Obstetrics	9
5.	Radiologist	11
6.	ENT	4
7.	Ophthalmologist	10
8.	Pathologist	8
9.	Anesthesiologist	4
10.	Other specialist	32
11.	General practitioner	42
12.	BSC Nurse	573
13.	Diploma Nurse	32
14.	Midwife	20
15.	Laboratory technologist	66
16.	Pharmacist	61
17.	Anesthetist	36
18.	Environmental Health	3
19.	Image	23
20.	Technical staff	25
21.	Administrative staff	698

Appendix H: Laboratory Service in Referral Hospitals



Appendix I: Total Number of Bed in SPHMMC

Wards in different Departments	Section	
First West	Medical	30
	Psychiatry	5
	Dialysis	6
First East	Medical	24
	Intensive Care Unit Medical	3
	Surgery	2
	Gynecology	1
second west	Post dental	14
	Antenatal	8
	Feeding	10
second East	Post dental	18
	Antenatal	8
	Delivery	8
Neonatal Intensive Care Unit(ICU)	Normal Bed	16
	Ward with Incubator	2
	Ward with Warmer	2
	Ward with Phototherapy	1
Pediatric	Emergency	9
	Ward	44
Third East	Surgery	24
	Orto	12
	septic	7
Third West	Pediatric ward 1	2
	Pediatric ward 2	6
	Urology	12
	Maxilla	6
	Ophthalmology	6
fourth West	Surgery	24
	Orthopedics	6
	Maxilla	7
	septic	6
	Recovery	6
	Emergency	7
	Surgical	7
Gynecology	Surgical	24
	chemo	4
	septic	4
	Enhanced Primary Care	6

Brief Curriculum Vitae
Major Accomplishment during the PhD Program

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Publications

- Shewit Woldegebriel, Daniel Kitaw and Birhanu Beshah. Quality Improvement Models and Approaches. *OMICS Publishing Group. Industrial Engineering and management Journal, Volume 3, Issue 3.*
- Shewit Woldegebriel, Ephrem Gidey and Yonas Workie. Statistical Quality Control Applications in Solar Energy Foundation. *Asian Academic Resource Associates, Volume 1, Issue 2.*
- Shewit Woldegebriel, Daniel Kitaw and Carlo Rafele. Application of Fuzzy Logic for Prioritizing Service Quality Improvement in Healthcare, *International Journal of Science and Engineering Research, Volume 6, Issue 5.*

B.Sc and M.Sc Courses Delivered

- Technical Drawing (Meng 1001)……..**2011**
- Statistical Quality Control and Reliability (Meng 5246)..……**.2012-2015**

Theses Co- Advised in Industrial Engineering M.Sc. Program

- Lean Manufacturing Principles in the Service Organization with Focus on Ethiopian Health Care Facilities, **Ibrahim Bedane (2012)**
- Causes and Trends of Machineries Failure in Almeda Textile Industry, **Medina Mustofa (2013)**
- Muti stage and multi response process optimization based on application of design of experiments for reducing product performance variation, **Goitom Desta (2013)**
- Re-design of Pharmaceutical distribution Network: The case of PFSA, **Eyob Lissanework (2013)**
- Quality Control Circle Implementation for Healthcare Quality Improvement :Case of Tikur Anbessa Specialized Hospital, **Mesfin Demisse (2013)**

Term papers Co-Advised

- Term paper on project planning & management ……..……**Bethelihem seyifu (2011)**
- Term paper on project planning & management ……..…….. **Mihiret Demisie (2011)**
- Term paper on project planning & management ……..**Berihun Kasaw (2011)**
- Term Paper on project planning & management ……...**Habtamu Bazezewu (2011)**
- Term paper on project planning & management ……...……**Mikiyas Habtie (2011)**
- Term paper on project planning & management ……..…….....**Motuma Muktar (2011)**
- Term paper on project management ……..…….....**Arebu Dejene (2011)**
- Term paper on Statistical Quality Control ……...……...…… **Abiyot Ayele (2011)**
- Term paper on Statistical Quality Control ……...……...…. …..**Edris Hashim (2011)**
- Term paper on Statistical Quality Control ……...……...…… **Dejene Segni (2011)**
- Term paper on Statistical Quality Control ……...…….....**Temesgen Tamirat (2012)**
- Term paper on Statistical Quality Control ……**Bhalbi Demoz (2012)**
- Term paper on Statistical Quality Control ……**Henok Ketema (2012)**

- Term paper on Statistical Quality Control ……**Mekidelawit Abebe (2012)**
- Term paper on Statistical Quality Control ……..**Polik Haile (2012)**
- Term paper on Statistical Quality Control ……**Medina Mustofa (2012)**
- Term paper on Statistical Quality Control ……**Lia Asmelash (2012)**
- Term paper on Statistical Quality Control ……**Tizita Meteken (2012)**
- Term paper on Statistical Quality Control ……**Eyob Lissanework (2012)**
- Term paper on Statistical Quality Control ……..**Assefa leta (2012)**
- Term paper on Statistical Quality Control ……**Mariam Demelash (2012)**
- Term paper on Statistical Quality Control ……**Messele kassaw (2012)**
- Term paper on Statistical Quality Control ……..**Dereje Dejene (2012)**
- Term paper on Statistical Quality Control ……**Mesfin Demisse (2012)**
- Term paper on Statistical Quality Control ……....**Tigist Yiheyis (2012)**
- Term Paper on Ergonomics ……..…….…… **Abiyot Ayalew (2011)**
- Term Paper on Ergonomics ……..…….……. ……**Dejene Segni (2011)**
- Term Paper on Ergonomics ……..…….…… **Temesgen Tamirat (2012)**
- Term paper on Supply Chain Management …..….. ……..**Temesgen Tamirat (2012)**
- Term paper on Supply Chain Management……..……**….Abiyot Ayelew (2011)**
- Term paper on Supply Chain Management …….. ……..**Lelissa Feyera (2012)**
- Term paper on Reverse Logistics…… ……...**Edris Hashim (2011)**
- Term paper on Warehouse Design ……....**Yehualashet Teleke (2011**)
- Term paper on Warehouse Design ……..…….**Habtamu Bazezew (2011**)
- Term paper on Warehouse Design ……..……..**Mikiyas Habtie (2011)**
- Term paper on Warehouse Design …….....**Polik Haile (2011)**
- Term paper on Warehouse Design ……..**Tizita Meteken (2012)**
- Term paper on Warehouse Design …….**Mesfin Demisse (2012)**
- Term paper on Warehouse Design ……..…..**Daniel Ashagrie (2011)**
- Term paper on Warehouse Design ……..**Bhalbi Demoz (2012)**
- Term paper on Application of TQM ……....**Goitom Desta (2012)**
- Term paper on Application of TQM……..…… ….**Habtamu Bekele (2012)**
- Term paper on Work Study …….……. ..……..**Benga chala (2012)**

Workshop, Training Attended and Educational Visit

- The first Congress of Ethiopian Academy of Sciences (EAS) held under the theme: "Challenges and prospects of Engineering and technology education in Ethiopia' on **October 8, 2011.**
- A Professional Education Course in Complex Systems Engineering, **July 2013** New Mexico State University and Addis Ababa University.
- Three Months Educational Stay in Politecnico di Torino, Italy **(March 6th -May, 30 2015)**

Public Service & Volunteer Work

- I reviewed two literature reviews for one case study for Total Quality management and Business Excellence Published on Taylor and Francis.

Professional Memberships

- A member of Ethiopian Industrial Engineering Association