



**Addis Ababa University
School of Information Science and School of Public
Health
M.Sc. in Health Informatics Program**

Project Title
***Designing a Web-Based Nutritional Decision Support
system for Diabetic Patients***
By
▪ Dawit Girma (BSC)

**A project submitted to the school of graduate studies
of Addis Ababa University in partial fulfillment of the
requirement for the Degree of Masters of Science in
Health Informatics.**

**June 10, 2016
Addis Ababa, Ethiopia**

Project Title

***Designing a Web-Based Nutritional
Decision Support system for Diabetic
Patients***

By

Dawit Girma (BSC)

Affiliation Addis Ababa University School of Information Science and
School of Public Health

Program M.S.C in Health Informatics

Project Title designing a Web-Based nutritional Decision support system for
Diabetic patients

Student Name and ID Dawit Girma

Date June, 10, 2016

Names of Advisors:

Signature:

Date:

1. Dr. Tibebe Besha

2. Dr. Bilal Shikur

Names of Examiners:

Signature:

Date:

1. Dr Million Meshesha

2. Dr Jemal Haidar

Dedication

I would like to dedicate this project to my uncle Tsegaye Kebede whom I lost because of diabetes and to my sister Beza kindu who recently passed away and finally for my father who gave me everything in life.

Acknowledgment

First and for most my deepest gratitude goes to the almighty God, who made it all possible and helped me finish my project. Next I would like to thank my advisors Dr. Tibebe Besha (PhD) & Dr. Bilal Shikur (Md) of the school of Information science and School of public health respectively. The door to my advisors was always open whenever I ran into trouble spot or had a question about my project. They constantly allowed this paper to be my own work but guided me in the right path whenever they thought I needed it.

I would also like to thank the experts involved in this research like Dr. Zelalem Debebe who helped me out a lot by giving me advices and references because she is a dietician working in the same area as my project and also my dear friend Nebiyu Yared for his support.

Finally I must express my very profound gratitude to my parents especially my dad for all his support and friends for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of preparing this project. THANK YOU all and I couldn't have done it without you.

Table of Contents

Dedication	4
Acknowledgment	5
Abbreviations	9
Abstract	10
Chapter one	11
Introduction	11
1.1. Background	11
1.2. Statement of the Problem	12
1.3. Objective of the Project.....	13
1.3.1. General Objective	13
1.3.2. Specific Objectives	13
1.4. Significance of the project.....	13
1.5. Project Scope and Limitations.....	14
Chapter Two.....	15
Literature Review.....	15
2.1. Overview	15
2.2. Applications of Decision Support Systems.....	16
2.3. Treatment Goals	17
2.4. Related works	18
Chapter Three.....	21
Methodology	21
3.1 Study Design	21
3.2. Study Area and Setting.....	21
3.3. Study population and sampling	21
3.4. Data collection tools and Procedure.....	22
3.5 Data analysis and solution design	22
3.5.1 Data analysis.....	22
3.5.2. Requirement analysis.....	22
3.5.3. Design approach	23
3.5.4. Tools Employed.....	23

3.5.5. Evaluation methods	25
3.6. Methods of dissemination of results.....	25
3.7. Operational definitions.....	25
3.8. Ethical considerations	26
Chapter Four	27
Analysis, Design and Discussion	27
4.1. Overview	27
4.2. Study of Existing Systems	27
4.3. Problems of the Existing Systems.....	28
4.4. Functional Requirements.....	29
4.5. Non Functional requirements.....	29
4.6 New system Architecture	30
4.6.1 Proposed software Architecture.....	30
4.6.2 Content development.....	31
4.7 Object Oriented Analysis and Design.....	32
4.7.1 Use case diagram	33
4.7.2 Use Case Narrations	34
4.7.3 Activity diagrams	42
4.7.4 Class diagram	48
4.7.5. System Deployment Diagram	49
4.8 Implementation and Evaluation	49
4.8.1. Flow Chart Diagram	50
4.8.2. User interface.....	50
4.9 Discussion of Results	57
4.10 Testing and Evaluation.....	57
Chapter Five.....	59
Conclusion and Recommendation	59
5.1 Conclusion.....	59
5.2 Recommendations	60
References.....	61
Annexes.....	64

Listof Figures

Figure1: Proposed System Architecture	31
Figure 2: system use case diagram.....	33
Figure 3: Registration activity diagram	42
Figure 4: Enter Query activity diagram	43
Figure 5: Update Dietary Information activity diagram	44
Figure 6: Respond to Query activity diagram.....	45
Figure 7: Update News activity diagram	46
Figure 8: Manage Accounts Activity diagram.....	47
Figure 9: System Class Diagram.....	48
Figure 10: System Deployment diagram	49
Figure 11: Flow Chart diagram.....	50
Figure 12: Home Page User Interface.....	51
Figure 13: Registration Page User Interface.....	52
Figure 14: Information Page User Interface	52
Figure 15: Foods to Eat User Interface	53
Figure 16: Foods to Avoid User Interface	54
Figure 17: Healthy Cooking Procedure User Interface.....	55
Figure 18: Plate Method Eating Mechanism User Interface.....	56

List of Tables

Table 1: Related Works Summary Table.....	20
Table 2: Summary of Mapping Between Project Tasks & Methods Used	24
Table 3: Recognized Use cases and Their Description.....	34
Table 4: Description of Login use case.....	35
Table 5: Description of Register use case.....	36
Table 6: Description of Enter Query use case	37
Table 7: Description of Update Dietary information use case.....	38
Table 8: Description of Respond to Query use case	39
Table 9: Description of Update News use case	40
Table 10: Description of Manage Accounts use case	41
Table 11: System Evaluation Result Table.....	58

Abbreviations

ADA	American Diabetes Association
CDC	Center for Disease Control
CSS	Cascading Style Sheets
CPOE	Computerized Provider/Physician Order Entry
DIAS	Diabetes Advisory System
DSS	Decision Support System
EDA	Ethiopian Diabetes Association
EMR	Electronic Medical Record
FMoH	Federal Ministry of Health
HTML	Hypertext Markup Language
IDF	International Diabetes Federation
IDSS	Intelligent Decision Support System
IOM	Institute of Medicine
IT	Information Technology
LD	Licensed Dietitian
MNT	Medical Nutritional Therapy
PHP	Hypertext Preprocessor
RD	Registered Dietitian
T2DM	Type Two Diabetes Management
UML	Unified Modeling Language
WHO	World Health Organization

Abstract

Nutritional decision support system is a system that facilitates not only diabetic patients but also anyone in their day to day life by advising them with what nutritional decisions they should be making and what kind of food and drink they should really take or avoid. Medical nutritional therapy is important in preventing diabetics, managing existing diabetics or at least slowing the rate of development of diabetic complications to this end.

The main objective of this Project is to design a Web-Based nutritional decision support system for diabetic patients.

The project used a survey method combined with a design approach followed by an object-oriented system development methodology. For data collection interview and document analysis was done. Different unified modeling language tools such as use case, class, activity and deployment diagrams were used to design the system. The project was conducted from December 2015 to June 2016 in Addis Ababa, Ethiopia.

Since there was no previously designed nutritional decision support systems for diabetic patients in Ethiopia this project is a starting point for the improvement of managing diabetes through nutrition. The project has laid down a platform for using nutritional guidelines. Every contents developed have been selected to match the lifestyle and food types of every Ethiopian where there foods can be found in any market available. The contents were then translated to Amharic and the designed interface was in Amharic.

Furthermore the system also has a registration form where a patient fills his personal information to register and ask a certified dietitian what he feels is missing from the website. After which the dietitian will respond to his queries according to the patient's personal information. It also provides news about diabetes and also provides details about diabetes mellitus illness like causes

Information is a critical component in managing health through nutrition. As a result a proper and standardized way of delivering nutritional recommendations can improve communications among the Diabetes patients and Dietitians and help them obtain the right kind of information to enable themselves manage and controlling their nutrition intake. Therefore this project provides the perfect platform to maintain a healthy lifestyle.

Keywords: Nutritional Decision Support System; Diabetic patients; Web-Based System

Chapter one

Introduction

1.1. Background

Diabetes mellitus is a metabolic disease caused by our body's inability to produce enough insulin or when it is unable to use the insulin produced in a normal way [1]. Diabetes mellitus has been a public health problem throughout the world and it is a means by which many diseases affect our body like blindness, heart diseases, kidney failures and many more. Studies suggest that Diabetes mellitus is the seventh killing disease in the United States [2, 3]. World Health Organization expected Diabetes mellitus cases to increase to one point eight million in two thousand thirty which was estimated to be about eight hundred thousand by the year two thousand in Ethiopia [4].

A decision support system (DSS) is a computer centered information management system that supports any Management activities in order to make decisions [5]. DSSs help people make decisions about problems that are dynamic and not easily identified. DSSs can be either fully computer centered, interactive with humans or a combination of both [5]. It may also be a simple system that provides information for decision making or a complex system with sophisticated elicited decision analysis.

Medical nutrition therapy (MNT) is a method used to prevent, manage or at least minimize the growing rate of diabetes by focusing on creating a healthy way of life by a means of monitoring eating patterns and nutrients. Food types, amounts and eating patterns are all factual causes of obesity and overweightness which are directly related with diabetes therefore that is why we give more dedication to this particular area of study [6].

Indeed, studies suggest a large number of people with Diabetes mellitus suggest that managing their nutrition remains the most difficult situation. They claim Lifelong eating habits are hard to change therefore by solving nutritional problems and understanding if the person is ready to change to what extent is the main concern because if the person is not willing to adjust accordingly then the nutritional advices or any other methods used will create no change [7].

In addition to this sometimes nutrition recommendations diabetic patients receive are inaccurate and conflicting, and originate from sources that are not reliable [7]. Achieving nutrition-related goals requires the person with diabetes to be involved in the decision-making process. It is important that a licensed dietitian, well-informed and experienced in Medical nutritional therapy plays the leading role in providing nutrition care. However it is crucial that all health professionals should be well-informed about MNT and supports its implementation [6].

Basically this project aims to design nutritional decision support system for Diabetes patient's in order to help them take good care of themselves by controlling their eating habits and food intakes.

1.2. Statement of the Problem

Diabetes mellitus causes severe health problems like heart disease, blindness, kidney failure, and many more. Therefore we have to look at any prevention methods possible. However being overweight and obesity are closely linked to diabetes, that's the reason why specific attention is given for nutritional therapy because taking control of your own nutrition will provide a better well organized healthy life [6].

The major problems forcing for the development of the new system were, Lack of access to a certified dietitian, Lack of Amharic interface websites regarding diabetes management through nutrition and also lack of automated nutritional guidelines available through the internet.

Since diabetes is a metabolic disorder closely linked to nutrition the importance of medical nutrition therapy (MNT) in diabetes self-management is clearly visible. Yet the problem is lacking nutritional guidelines designed to help manage one's nutrition in his cultural eating habits and food types especially in a case like Ethiopia with many nations and nationalities having different foods and ways of preparing them [7]. Nutrition is of great topic of interest for all of us, people with and without diabetes.

The project provides a light weight decision support systems, in which any diabetic patient can follow their diet and take control of their health while leading a better and healthy lifestyle but the system is used only by those who read Amharic.

Due to the above reasons developing a web based nutritional decision support system will help improve the management of diabetes mellitus and prevent any member of the society while helping minimize the growth rate and its complications.

1.3. Objective of the Project

1.3.1. General Objective

The main objective of this Project was to design and develop a Web-Based nutritional decision support system for diabetic patients.

1.3.2. Specific Objectives

The specific objectives of this project are:

- ✓ To study existing nutritional support systems for Diabetes.
- ✓ To determine system requirement
- ✓ To design and develop a web based nutritional DSS with Amharic interface
- ✓ To evaluate the prototype of the system

1.4. Significance of the project

The significance of this project is to create a platform where a link between a certified dietitian or a medical doctor and a member of a society meet to achieve goals of the federal ministry of health by standing together and fight diabetes through nutritional therapy by either as a post or pre nutritional counseling methods.

The main focus is changing the eating habits and lifestyles of the society in to leading a better life by introducing them with what a medical nutritional therapy is and what it can offer them to guide the to the right path and Help the country develop by minimizing the risk of diabetes mellitus. Finally the system will provide a nutritional counseling system and a reminder system for patients to remind them to take their insulin injections on time.

Since access to a registered or a certified dietitian is extremely low in Ethiopia the system creates an easier access, and it provides a nutrition guideline that could be understood by any layman in Ethiopian context and in Amharic.

Furthermore people with high risk of developing diabetes can avoid the risk by the system if it is well managed it could be very effectively through healthy lifestyle choices primarily by diet and exercise while people need to recognize signs and symptoms of diabetes mellitus early and be well informed on how to manage or prevent it and its serious health complications.

It can also be used as an educational tool for unqualified medical personnel to help them learn more about diabetes mellitus and become well prepared to attend to patients safely and effectively. In addition to the decision making role, the decision support systems can be used in

the place of a health professional, this might be seen as risky but comparing to the risk of not getting any medical attention at all its better receiving recommendations from the decision support systems. The systems also provide a diabetic's education platform to teach individuals on basic concepts of diabetes mellitus all translated into Amharic and in way they could be understood by any layman.

Due to the above reasons the project will benefit different stakeholders

- The country by reducing cost of medication since diabetes will be reduced by developing a healthy population through time.
- For health care institutions minimizing the number of diabetes patients by sharing and disseminating the knowledge of nutritional therapy and help them provide value-added health care.
- For diabetic's patients to help them improve their health by monitoring their nutrition, and also their high risk family members because both types of diabetes mellitus are hereditary therefore they need to watch out for signs and symptoms to avoid the risk of developing the disease.
- Finally for Ethiopian diabetes association's where it can use this platform to reach its patients and address new issues at hand and create awareness to the society at large.

1.5. Project Scope and Limitations

The scope of this project is designing a web based nutritional Decision support system to improve the health status of diabetic patients through nutritional therapy that encompasses Amharic interfaces in order to be understood by large number of society. The problems covered by the project were only nutritional related issues; the decision support system designed was only a light weight.

The project was geographically limited to Addis Ababa because of time and financial constraints and in terms of developing a nutritional guideline and in the interview section. While the project didn't address issues other than nutrition management like managing insulin doses or hyperglycemia control.

Chapter Two

Literature Review

2.1. Overview

Decision support systems (DSS) offer an attainable answer to the diabetic's drawback, and lots of solutions are planned over the years. A number of these planned solutions are based on supported rules or algorithms for insulin dose adjustment supported on expert knowledge, and a few have used predictions of blood sugar levels supported mathematical models of the carbohydrate metabolism. Despite the various lessons learned from this substantial work, none of the systems has gained wide range of use or acceptance [10]

There could also be many reasons for this apparent lack of success. One reason can be the problem in handling the patient variability, and other reasons can be the uncertainties within the data involved and therefore the proven fact that the glucose metabolism is influenced by several factors, e.g. fever, stress, exercise and hormonal reactions to low blood glucose. Still different reasons for the evident lack of success can be the issues related to analysis of the security and effectiveness of the systems, that many authors have handled [10].

DSS has emerged as one of the dominant IT technologies for management in Health care. However, these has resulted in several technologies being employed similar to DSSs and has created numerous platforms in healthcare domain [11].

According to the diabetes disease management and complications trial research group's diabetes mellitus is a significant chronic disease that is a growing public health problem for every developing and developed country [11]. In 2007, International Diabetes Federation (IDF) revealed standardized world estimates for the prevalence of diabetes. Consistent with military group, worldwide diabetes currently 246 million individuals and is anticipated to affect 380 million by 2025. IDF statistical prediction identifies that each year as a result of 3.8 million individuals die and seven million develop diabetes [12].

Type II Diabetes is increasingly common, mainly because of increase in obesity and inactive way of living. Type II diabetes can be prevented by interventions that have an effect on the lifestyles of patients like diet and exercise [13]. In several fields decision support is broadly applicable notion that supports several activities in living environments. In health care domain the computerized clinical decision support systems are used to assist healthcare staff by assisting them to complete their work more accurately and efficiently and it also improves the quality of patient care.

Nutrition is commonly said to be the cornerstone of diabetes care. The nutritional management process of diabetes disease will have an effect on diabetes health and quality of life. The goal for nutritional management is perfect metabolic management through a balance between food intake, physical activity, and if necessary, medication to avoid complications [14].

All diabetes patients should receive individual recommendation on nutrition from a registered dietician. The registered dietitian can apply the nutrition guidelines while considering current intake, individual energy needs, life stage, lifestyle, and any medical conditions of the individual with diabetes [15].

2.2. Applications of Decision Support Systems

There is a growing recognition that clinical decision support systems (CDSSs), once well-designed and enforced, holds nice potential to enhance health care quality and presumably even increase efficiency and scale back health care prices for the potential to be realized, CDSS mustn't be viewed as a technology or as a substitute for the clinician, however as complex intervention requiring careful thought of its goals, howit's delivered, and who receives it. To achieve optimum benefit, clinician users need to understand its benefits and limitations, and also the distinctive challenges of planning and implementing the various sorts of CDSS [16].

A qualified health care provider (which may include a clinician, dietitian, nursing staff and pharmacist) should give nutrition medical care to a patient diagnosed with T2DM as a part of a global treatment plan [17].

Nutrition therapy specifically stimulates patients by additionally intensively assessing eating and physical activity behaviors and nutrient consumption, and provides counseling that leads to improved health and may reduce complication of T2DM. Diabetes nutrition therapy may end up in value savings and improved outcomes like reduction in alcohol. Nutrition therapy will be customized based mostly upon the patient's desires, comorbidities, existing chronic conditions and alternative key factors [17].

Professionals who don't utilize proof-based standards will promote expensive short-term strategies that limit food choices – lacking scientific evidence – that don't seem to be ultimately effective in improving long-term health. Patient activation will be troublesome and may not be sustainable for the patient long term, and also increased cost value for healthy foods could also be a burden for a few [17].

Diabetes self-management or education by skilled and certified health care professional (which might include a clinician, dietitian, nursing staffs and pharmacist) should be offered to patients diagnosed with diabetes.

Diabetes self-management teaching and support improves patient understanding of the disease, empowers patients to manage their care, and reduces distress [18]. It's cost effective and has been shown to enhance knowledge self-efficacy and self-care behavior skills, and with modesty improves glycemic control. Patients might notice it troublesome to continue education due to the continued time commitment and expense. Benefits-harms Assessment: good thing about providing education and support powerfully outweighs any potential harm [19].

Diabetes self-management education includes the continued processes of facilitating the knowledge, talent and skill necessary for diabetes disorder self-care. It incorporates the requirements, goals and life experiences of the person with diabetes disorder. Education helps people with diabetes initiate effective self-management and deal with diabetes after they first diagnosed. In progress diabetes education helps people with diabetes maintain effective self-management throughout a lifetime of diabetes [20].

2.3. Treatment Goals

The major components to treat diabetes mellitus are nutrition and physical activities combined with oral hypoglycemic control and insulin treatment. And in order to treat diabetes the patient must be willing to learn diabetes self-management and understand medical nutritional therapy so that the patient takes care of his health [22]. Because of the association between nutrition and diabetes management, medical nutrition therapy (MNT) delivered by a licensed dietitian could be a key component in traditional medicinal interventions for diabetic treatment. The usefulness of MNT is by avoiding and managing diabetes, while providing physicians with information regarding a way to refer patients for MNT [29].

Serious Diabetes treatments significantly minimize further complications that could follow diabetes mellitus like heart and foot diseases, blindness, kidney failure and etc. many patients have poor management of their condition despite specialist care therefore other means of interventions must take place. The range of DiasNet has extended from being employed by physicians to provide recommendation on insulin dosage to mutually being used by patients as a tool for education and communication. Patients will experiment with their own information, adjusting insulin doses and meal sizes. This way different treatment and dietary alternatives will be tried out for helping the patient should be well informed in achieving glycaemic management [10].

The relation between diabetes and nutrition has been well recognized, as has the importance of nutrition in combination with therapeutic interventions for diabetes. Patients usually look for medical care looking for recommendation on diabetes management and nutritional therapy; however studies [29] have shown that physicians feel uncomfortable advising patients on the delicate problems of weight loss and diet. Studies are gradually indicating that medical nutrition

therapy (MNT) provided by a registered dietitian, is a key element of diabetic control and a counterpart for treatment of diabetes mellitus by physicians [29].

Diet evolves over time, being influenced by several factors and complicated interactions. Income, food costs (which can have a direct effect on the source and price of healthy foods), individual preferences and opinions, social ethnicities as far as environmental, social and financial factors extremely matter to guide patients eating pattern. Therefore encouraging to have a healthy meal plan together with a variety of well-adjusted health meals, needs involvement across multiple sectors and stakeholders, along with government, and also the public and private sectors [30].

Nutrition is a very important treatment plan. Medical nutritional Therapy concentrates on maintaining optimum nutrition for development within an individual, instructing patients about meal sizes, adjusting methods of cooking, regulating blood glucose level, avoiding and managing further problems related to diabetes mellitus. Attention is on eating patterns, consistency in nutrition intake to reduce glucose variations [21].

The best approach to manage diabetic's complication is by adopting healthier lifestyles thus preventing it in the first place. If complications have already started, it's not too late to manage them and keep them from getting worse. Not all patients develop all the complications that further occur with diabetes [21].

There are easy ways to reduce the risk of developing complications by seeking help from a licensed dietitian making personal changes like stop smoking, minimize drinking alcohol, reduce stress, starting physical exercises that could at least last thirty minutes per day, and make nutritional arrangements like changing cooking methods, eating patterns and selecting meal types, (what to eat and what to avoid) obtaining regularly checkups of eyes and kidneys at least once/year [21]. Hypoglycemic control and insulin treatment with nutrition management are ways to manage diabetes mellitus even though Nutrition is only one method to manage diabetes and combining all the above will help deliver a better outcome that's why but this project mainly focuses on nutritional treatment method only.

2.4. Related works

The aim of intelligent decision support system for diabetic management in electronic health care was to spot the issues of diabetes patients and propose an intelligent decision support system through which they can access the fundamental instruction of diet and exercise at home that improves the quality of patient's life and in the event of emergency, an auto message goes towards care providers [22].

The health status of diabetes patients can be boosted with intelligent decision support system (IDSS). It provides the recommendations regarding nutrition and physical activities at home and provides a communication medium between care providers and patients. It provides an intelligent assessment support for both, care providers and patients. [23]

Intelligent decision support system for diabetic management in electronic health care study demonstrated that a web-based, patient-specific, intelligent decision support system based on meal size and exercise habits. The meal size and exercise routines that are unit core factors in the treatment of type 2 diabetes patients. If we offer treatment to type 2 diabetes patients then we can get significant benefits regarding glycemic control. The study has several limitations at this stage it is quite difficult to cover all the nutrition's and also their accurate amounts. So, IDSS predicted values are in some way near to accurate but not 100% accurate [24].

The Dias Net system is basically designed for physicians to give recommendations on insulin and it is also additionally utilized by patients as a tool for education and communication. Patients can use their personal information to adjust insulin doses or eating patterns and nutrition sizes. In this way patients can try different kinds of therapeutic and eating alternatives; this will help the patient to achieve glycemic control [24].

Clinical decision support systems (CDSS) give clinicians, staff, patients, and other individuals with information and person-specific info, monitor intelligently filtered and presented at applicable times, to enhance health and health care. The Institute of Medicine has recognized these issues with health care quality within the United States, and for quite a decade it has supported using health information technology (IT), including electronic CDSS, to improve quality [16].

The DiasNet system is basically intended for physicians to give advices on insulin and it is also used by patients as instrument for communication and education. Patients can make use of their own data, to adjust insulin doses or meal sizes. In this technique patient can try different therapeutic and dietary options, this will help the patient to achieve glycaemic control [24].

The intelligent decision support system is operated in two modes, the learning and prediction mode. Within the learning mode the Data on weight and height are used to assess the patient's specific information. Within the learning system, it updates itself in keeping with patient's information. In prediction mode the system takes the same data on height and weight and used it to form prediction regarding the routine exercises [25].

A healthy eating pattern, regular physical activity, and sometimes pharmacotherapy are key components of diabetes management. For several people with diabetes, the foremost difficult part of the treatment plan is deciding what to eat? The American Diabetes Association states that there is no "one-size-fits-all" eating pattern for individuals with diabetes [6].

The ADA also distinguishes the essential role of nutrition therapy in overall diabetes management and has generally recommended that each person with diabetes be actively engaged in self-management, education, and making treatment plan with his or her health care provider. Which incorporates the collaborative development of an individualized eating plan [1,2]. Therefore, it is vital that all members of the health care team be knowledgeable about diabetes nutrition therapy and supports its implementation [25].

The Diabetes Advisory System (DIAS) was created to analyses patient information, execute simulations of blood glucose profiles and if required propose adjustments of insulin doses[10].The metabolic model in Diabetes Advisory System has been evaluated, and it has been demonstrated that it can accurately calculate blood glucose in patients without hypoglycemic episodes. Additionally the difference between predicted and measured blood glucose in patients with hypoglycemic episodes has been used to develop a description of the amplitude and time course of hypoglycemic counter-regulations (Even though the DIAS system is for medication purpose the system am planning to design is to solelyadvice nutritional intake) [10].

Table 1: Related works summary table

Author (year)	Objective/purpose	Methods/ tools/ techniques	Key findings	Remark
F. Sahar, 2013	Web Based IDSS for Type 2 Diabetes Patients	calculate Body Mass index of patient	Provide patient-specific meal size and exercise routines	patient empowerment to control his health
S. Plougmann et al, 2001	DiasNet system	The learning mode, the prediction mode, and the advisory mode.	help the patient to achieve glycaemic control	Analyze patient data, blood glucose levels and adjust insulin doses.
Asma Shaheen, Waqas Ahmad khan, 2009	IDSS in Diabetic eHealth Care	Qualitative and Quantitative methods	Patients get basic instruction of diet and exercise at home.	in the case of emergency, an auto message goes to care providers

According to comparisons of this project with the previous works reviewed the new system doesn't calculate body mass index of patients but their weight and height are required for registration while it doesn't guide patients to make insulin doses, or make hypoglycemia control or analyze blood glucose levels while patient specific meal plans are not designed instead a general advices have been provided. The system is different from the above systems since an interface for Amharic language is integrated to provide an Ethiopian version of nutritional guideline for those people who read and write using Amharic witing system.

Chapter Three

Methodology

Generally a qualitative study combined with a design approach was used and the system used an iterative (incremental) approach following an object-oriented system development. The basic idea behind object oriented design is to develop a system through repeated cycles and in smaller portions at a time (incremental).

3.1 Study Design

Object oriented design methodology was used to design as well as to develop the prototype of system. Object oriented design is an advance in the software engineering field which has an iterative and incremental nature. The Object oriented methodology was chosen in order to reduce software development time, and resources required to support existing programs and applications, increase code reusability.

3.2. Study Area and Setting

The project was conducted from December 2015 to June 2016 in Addis Ababa, Ethiopia at Addis Ababa university school of information science and school of public health, the project was done in Tikur Anbesa specialized hospital and the hospital was selected because of easier access to diabetic patients and specialists in that area of study. Requirement Gathering for the project was conducted through interview, document analysis and observation of other systems. Literatures were used to take experiences from different researchers on how nutritional therapies were used in different settings.

3.3. Study population and sampling

The project used health professionals which are licensed by Ethiopian ministry of health some which work with Ethiopian diabetes association. These parties were chosen, because they are the major bodies which are directly concerned with the managing diabetes mellitus. Those selected for the study were health professionals that were working on different governmental and private health care organization mainly focusing on diabetes.

Simple random sampling technique was used to randomly select health professionals from the source population in order to conduct the interview. 10 people were selected for interview due to lack of resources in which five health professionals with specialty in diabetes and five diabetic patients located in AddisAbaba were selected. The inclusion criteria to undertake the interview for requirement determination were Medical doctors, dietitians and the patients that have a basic computer operating knowledge because the project is a web based system, must be diabetic

patients or physicians that work on diabetes and they should also be located in Addis Ababa since constraints of time and finance exist.

3.4. Data collection tools and Procedure

In this project different data collection methods were used to collect requirements, such as interview and document analysis:

Interview

Interviews for requirement Gathering was conducted to the selected project population. The interviews used went through separate interview guide for each interviewee based on their status using in-depth interview. The interviews were carried out by the project investigator. Four diabetic patients, one high risk family member of a diabetic patient and one dietitian, two medical doctors and two nurses were interviewed about diabetic's management, nutrition intake and related issues in order to identify problems they face in their day to day life and ask them if they could suggest means or ways to ease or solve those problems.

Document analysis

Different journals, books and literatures were reviewed to identify system and used by surfing through the web to find journals and articles as well as similar works like nutritional diabetes management system. In addition to that different nutritional guidelines were reviewed in order to translate and develop contents for the system.

3.5 Data analysis and solution design

3.5.1 Data analysis

Before any of the gathered data were used to the development of requirement the data was checked and summarized by identifying different stakeholders and actions to be performed. On analysis phase Information gathered through interview and document analysis in which the current ways medical nutritional therapy functions were identified.

3.5.2. Requirement analysis

Three steps of requirement analysis were followed; understanding the existing situation, identifying improvements and defining requirements for the new system. After requirement was captured using the data collection tools, The result of the system modeling that helps to understand the system models that are used for analysis of the system was done using the :-

Use case diagram is a simplest illustration of interactions of actors of the system showing relationships of actors with uses cases of the system while describing the main actions performed in the system [26].

Class diagram describes the structure of a system by showing its classes, attributes, operations and relationships between objects of the system [26].

Activity diagrams are graphical representations of activities and actions with support for alternative, iteration and concurrency. They're meant to model each process and structure processes, Activity diagrams show the general flow of management [26].

Deployment diagram in the Unified Modeling Language models the physical deployment of artifacts on nodes to explain a web site, as an example, a deployment diagram would show what hardware components exist, what software system elements run on every node [34].

3.5.3. Design Approach

Since communication with users is needed, it combines both data and process and it identifies the relationship and collaboration between end users and the system plus it increases program code reusability. It's also flexible and easily Manageable during changes. The system used a unified modeling language analysis models to represent what objects should be included in the system.

3.5.4. Tools Employed

A software development tool is a software system support that helps produce models or different elements needed within the project. It helps create models and components required in the project. The tools that were used for analysis and styled during this project were:

Frontend (in the Client Side):

HTML: was chosen because it could easily work along with cascading style sheets, hypertext preprocessor, while it's flexible and can be opened by any browser.

CSS: was designed primarily to enable the separation of document content from document presentation, including aspects such as the layout, colors, and fonts and basically designs, This separation can improve content accessibility, provide more flexibility and control of the system.

Backend (in the server side):

PHP: this code was used because it could be embedded into HTML and it uses as link to connect the html with the database. It could be opened with any browser and it could easily be connected

to most databases including MySQL. **MySQL** database server was used because it is an open source easily accessible and compatible with the above applications

The applications used to design the system were: -

- ✓ **Adobe Dreamweaver** was used for the designing of the prototype.
- ✓ **Microsoft Visio** for drawing various modeling diagrams
- ✓ **Wamp server** to access the MYSQL Database
- ✓ **Microsoft office** for documentation purpose
- ✓ **Google chrome** for viewing the web pages.

Table 2: Summary of mapping between project tasks & methods used

Software development Phases	Methods and Techniques	Tools	Methods
Problem learning and articulation Requirement gathering Data collection	✓ Interview ✓ Document analysis	✓ Open-Ended interview ✓ literature review	Iterative /incremental approach
Qualitative data analysis Requirement analysis	✓ Interview ✓ software specification	✓ In-depth interview ✓ Microsoft Visio	
Design of the new system	✓ Object design ✓ User interface design	✓ Microsoft Visio ✓ Adobe Photoshop	
Construction of the new system	✓ Object Oriented Programming	✓ HTML, CSS ✓ JAVASCRIPT, ✓ MY SQL, PHP	
Testing & Evaluation	✓ software Functionality testing	✓ Likert scale	

- This table summarizes the mapping of project tasks with methodologies used, tools and techniques applied.

3.5.5. Evaluation methods

Project evaluation aims at analyzing project development or activities. System evaluation is a method used for evaluating the performance of the system developed. This project used a Likert scale to evaluate the functionality of the system.

A Likert scale could be a psychometric scale usually concerned in research that employs questionnaires. It's the foremost wide used approach to scaling responses in analysis. When responding to a Likert form item, respondents specify their level of agreement or disagreement on a bilaterally symmetric agree-disagree scale for a series of statements. Thus, the range captures the intensity of their feelings for a given item. [9].

3.6. Methods of dissemination of results

After the study is completed, the report will be forwarded to Tikur Anbesa specialized hospital where the study was conducted and is also to be presented in Addis Ababa University as a partial fulfillment of Master's degree in health informatics.

3.7. Operational definitions

Nutritional Decision support system for diabetes is a web based system designed for diabetic's patients in order for them to use it for managing their nutrition intake.

Decision support system (DSS) is a computer-centered information system that supports administrative decision making activities. DSSs serve different levels of organization staff and assist people manage problems that are rapidly changing and not easily understood.

Medical nutrition therapy (MNT) is a therapeutic approach to treating medical conditions like diabetes mellitus and their complications by using specifically prepared meal plans tailored by knowledgeable and licensed dietitian. The diet is based upon the patient's medical history, physical activity level and eating pattern.

Unified Modeling Language (UML) is an all-purpose progressive modeling language in the field of software development that is anticipated to provide a standard way of visualizing design of a system.

3.8.Ethical considerations

Prior to data collection, ethical clearance was obtained from school of public health and school of information science of Addis Ababa University. In addition concerned bodies were informed about the study. And interviewees were asked permission to go on with the interview.

Chapter Four

Analysis, Design and Discussion

4.1. Overview

Data collected from different hospitals, Ethiopian diabetes association, patients and health professionals as well as the experiences of the other researchers taken from the literature used as the base of analysis in this project and especially from the Ethiopian diabetic's association documents and the interview with a certified dietitians currently working as a consultant and owner of Balance Health Nutrition and Dietetics Consulting Plc.

4.2. Study of Existing Systems

Currently there is no medical nutritional therapy recommending DSS developed for Diabetes mellitus in Ethiopia, but in other countries like the United Kingdom and the United States there are nutritional guidelines like "Evidence based nutrition guidelines for the prevention and management of diabetes" and systems developed to support diabetes like "Diabetes Advisor : A Medical Expert System for Diabetes Management" and "Fuzzy Expert System for Type 2 Diabetes Mellitus Management Using Dual Inference Mechanism"

The basic functions of the above system are monitoring and storing patients medical history like age, gender, blood glucose level, body mass index and also the intensity of physical activity as well as caloric diet because the recommendations given to the patients differ based on patients personal information but this project aims to give recommendations on a more general basis due to lack of licensed dietitians in Ethiopia plus resources to design the new system.

Since access to a registered or a certified dietitian is extremely low they propose easier access through this system, and in their country context they provide a nutrition guideline that could be understood by any layman. They also provide education about nutrition so that individuals can manage their own food choices as possible as it is for them; it also educates them on how to maintain their healthiness by managing their nutrition and avoiding unnecessary nutrients.

Since access to dietitians in rural communities particularly in developing countries is extremely limited especially for a case like diabetic's, The system propose easier access to getting help through decision support systems in which it plays a significant role by easing the problem by giving advice on nutrition management, Furthermore people with high risk of developing diabetes can avoid the risk by the system if it is well managed it could be very effectively through healthy lifestyle choices primarily by diet and exercise while individuals must recognize diabetes mellitus early to prevent or at least manage it and avoid its complications before they happen.

It can also be used as an educational tool for family members of Diabetic mellitus patients to help them become well informed in order to take care of their family carefully and effectively. Furthermore in a decision making role, decision support systems can be used in the place of a health professional, this might be seen as risky but comparing to the risk of not getting any medical attention at all its better receiving advise from the decision support systems. They also provide leaflets journals and magazines as an additional information source. The system also provides a diabetic's education section with Amharic interface to teach individuals on the basic concepts of diabetes mellitus.

4.3. Problems of the Existing Systems

According to the interview the source populations of this project gave verdict on existing problems and systems of diabetic's management in Ethiopia and either they are unaware of any previously designed systems or believe there are none available and they believe developing system would be of great topical interest to them and that it would be helpful to manage themselves. They claim getting the proper organized nutritional information would help them manage Diabetes mellitus in a more proper way but since they lack the means and the system for this purpose they suggest they are facing problems to truly go through Diabetic self-management.

Some of the problems observed during the interview and observation of other systems were no web sites were developed for nutritional management intended for Ethiopia even the nutritional guidelines developed are as far as sub Saharan countries. These guidelines are not even easy to be understood by anyone without proper diabetes education knowledge. Even translating of nutritional guideline is also a big problem since it hasn't been translated yet. Language is also another factor everything you find on the web including the Ethiopian diabetic's association websites are in English and they are not easily understood.

The Ethiopian diabetic's association has a website but since the association doesn't have a constant financial support they don't have an IT department or anyone updating the site on a regular basis. The other major problem is finding a certified dietitian in Ethiopia and as far as I understand through interviewing medical doctor's patients and organizations like the Ethiopian diabetes association there is only one person working in this area in the whole country.

When we come to patients they only seek this attention of managing their diet when they only run into a serious of health complications like obesity or heart problems and so on and since there is lack of knowledge about advantages of medical nutritional therapy patients do not really contact a dietitian so often. And the once that do have a little knowledge only focus on avoiding food items like beverages and so on, they don't really know what exactly they need and in what amount. To conclude patients or high risk individuals and the society at large is not informed.

The society doesn't know what its causes diabetes, its symptoms, prevention methods or even its forms therefore this system is aiming to solve all the above problems and help any Amharic reading individual by informing them with the right choices.

4.4. Functional Requirements

Functional requirements define functions of a system or its components and specify particular results of the system and what the basic functions of the system are. It also describes the interaction between the system and the users independent of its implementation while identifying basic business processes and functionalities [27]. Functional requirements were identified based on the concept of what a system is supposed to do the following are functional requirements:

1. The system should provide dietary information from a licensed dietitian.
2. The system should provide news from Ethiopian Diabetic Association.
3. The system should provide diabetes information.
4. The system shall enable registration of patients with an option to ask any question they want while helping the dietitian identify information he needs to know about the patient.
5. The system should give response through a certified dietitian to the questions asked by a patient.
6. The system should grant the System administrator to create, edit and delete user account.
7. The system should provide the users to publish or Update new information or news.

4.5. Non Functional requirements

Non-Functional requirements Specify criteria's that can be used to judge the operation of a system rather than specific behaviors. It defines how a system is supposed to be. Non-functional requirements describe user behavioral properties that the system must have, such as performance and usability the non-functional requirements correspond to the process of explaining the features characteristics attributes, in constraints of the information system used to limit the boundaries of the proposed solution [27]. Non-Functional requirements were identified based on the concept how a system is supposed to be, or what it can offer in terms of design the following are the non-functional requirements:

1. **Usability:** The system should be easy by anyone that can read and understand Amharic since the system is with Amharic interfaces.
2. **Validity:** the system should provide genuine information.
3. **Accountability:** the system should be liable to the information it provides.
4. **Reliability:** The system should be reliable to be used to change the health status of individuals.
5. **Security:** The system should give access to only the once that have login information's and deny access for the once without login information.

6. **Performance:** The system should respond to the request within a reasonable period of time. The system should respond to queries on a timely basis.
7. **Appearance:** The user interfaces should be user friendly and be easy to understand and should also be attractive while language should be of Amharic interfaces.
8. **Privacy and Data Access:** The system should protect personal information and avoid unauthorized access and should be limited to the system administrator and restricted to users by their access level.

4.6 New system Architecture

4.6.1 Proposed software Architecture

The proposed system is applicable for anyone with a network and computer access. It will be implemented using Client-Server based architecture. Based on the functional requirements and the problems identified we propose the following Multi-tier architecture depicted on Figure 1:

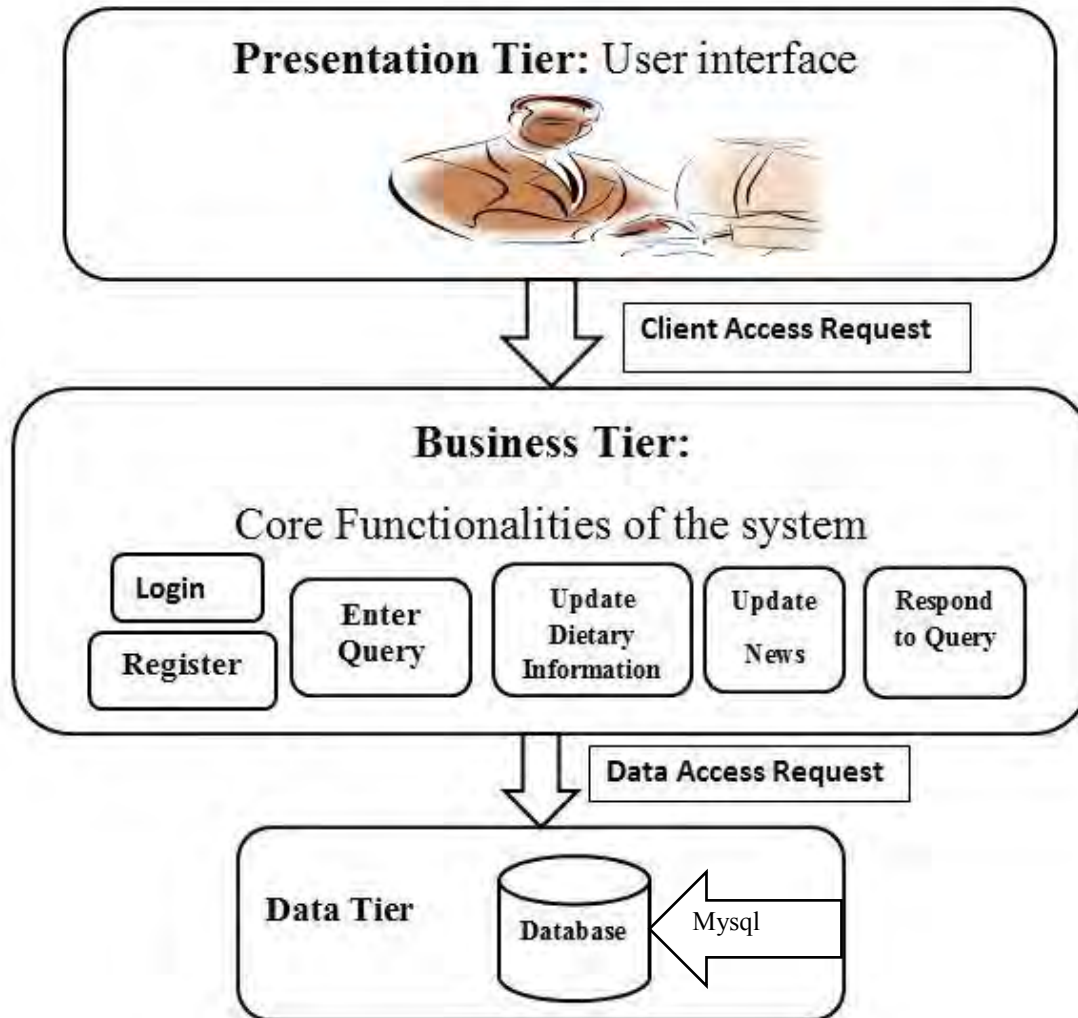


Figure 1: proposed system architecture

- This architecture displays three tier architecture like the deployment diagram below in which it defines what are underneath this layers and what their components are.

4.6.2 Content development

This was by far the most important and difficult part of the project since there is no nutritional guideline developed by the Ethiopian Ministry of Health, finding the closest guideline in terms of geographical setting was important therefore after reviewing guidelines of united kingdom and the united states of America and similar papers until finally finding one close to home sub-Saharan African nutritional guidelines[31] and had to translate the most important parts of the paper in to Amharic so that it could be used in the website. Not only translating it but also organizing it in a way it could be understood by any layman so that it could be used for managing individuals eating pattern and portion of meal sizes plus cooking methods.

4.7 Object Oriented Analysis and Design

Object-oriented analysis and design is a common technical methodology for analyzing and designing an application, system, or business by applying the object-oriented paradigm and visual modeling throughout the development life cycle to foster higher stakeholder communication and product quality [33].

4.7.1 Use case diagram

Use case diagram is a simplest illustration of interactions of actors of the system showing relationships of actors with uses cases of the system while describing the main actions performed in the system [26]. Use cases for the proposed system were identified initially on what actors use the system while what their actions would be and how they interact with it like how a patient registers and enters query to the system while a dietitian reviews the personal information entered by a patient and responds to the query accordingly.

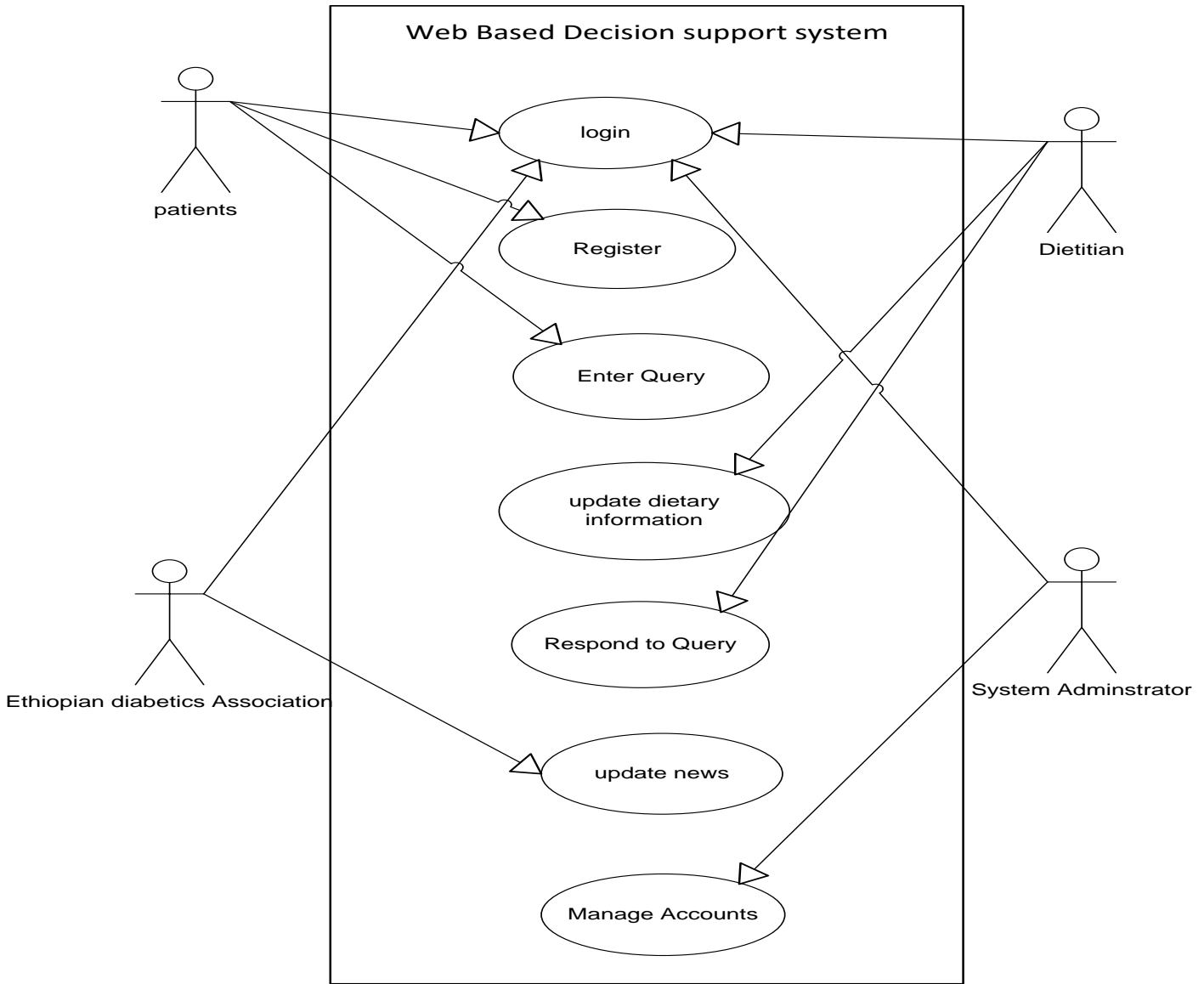


Figure 2: system use case diagram

Table 3: Recognized Use cases and Their Description.

No	Use case	Description
1	Login	Used to allow Actors of the system to get in to page with appropriate privilege.
2	Register	Used to register a patient and create username and password to log into the system.
3	Enter Query	Used by patients to enter query and ask a dietitian diet related questions.
4	Update Dietary Information	Used by dietitians to update new dietary findings to the system.
5	Respond to Query	Used by a dietitian to answer queries entered by patients.
6	Update News	Used by Ethiopian diabetes Association to update news and new information to the system
7	Manage Accounts	Used by a System Administrator to create, delete or update user accounts.

- This table describes use cases used and their particular action and how they interact with actors of the system.

4.7.2 Use Case Narrations

Use case narratives are the most important phases in order to clearly understand the system since they describe each use case and briefly narrate every activity made in the system in what sequence and that's why sequence diagram is intentionally left out. They also play a great role in easing the process of designing class, activity and sequence diagrams [28].

Table 4: Description of login use case

Use Case ID	Use Case - 1
Use Case Name	Login
Use case Description	Used to allow Actors of the system to get in to page with Authentication.
Primary Actor(s)	Patient, Dietitian, EDA and system Administrator
Pre-condition	User must have a user account
Post-condition	User Successfully Logged in
Main Success Scenario	<ol style="list-style-type: none"> 1. Users wants to login to the system. 2. The system presents the login page. 3. The user enters username and password in the login page. 4. The system authorizes the user. 5. The system displays access Text for the allowed user 6. the system directs user to the next page 7. The use case ends
Alternative Scenario	<p>Alternate 1. Login Failed</p> <p>A5. The system displays username or password is incorrect and informs the user to enter the correct username and password.</p> <p>A6. The user returns back to step 3 to correct login information.</p>

- This table briefly discusses what actions are performed when a person logs into the proposed system, what other alternatives there are if login is failed.

Table 5: Description of Register use case

Use Case ID	Use Case – 2
Use Case Name	Register
Use case Description	Used to allow patients Register themselves by filling personal information in to the system.
Primary Actor	Patients
Pre-condition	Patients must login to the system
Post-condition	Patients Successfully filled the required information
Main Success Scenario	<ol style="list-style-type: none">1. Patients want to Register.2. Patients open the registration page.3. Patients fill the required information.4. The system saves patients data into the database.5. The system provides user name and password for the patient according to the patient’s personal information.6. the system directs patient to the next page7. The use case ends
Alternative Scenario	<p>Alternate 1. Registration Failed</p> <p>A5. The system displays “information is missing” and informs the user to complete filling the missing information.</p> <p>A6. The Patient returns back to step 3 to refill the missing information.</p>

- This table briefly discusses what steps are taken when a person registers into the proposed system and what other alternatives there are if registration is failed.

Table 6: Description of Enter Query use case

Use Case ID	Use Case – 3
Use Case Name	Enter query
Use case Description	Used to allow patients ask additional questions and interact with the system.
Primary Actor	Patients
Pre-condition	Patients must login to the system
Post-condition	Patients Successfully entered the query they wanted to ask
Main Success Scenario	<ol style="list-style-type: none">1. Patients want to ask questions.2. Patients open the Enter Query page.3. Patient enters the query they wanted to ask.4. The system saves the query along with the patient information to the database.5. The system displays “successful” Text for the patient.6. the system directs patient to the next page7. The use case ends
Alternative Scenario	<p>Alternate 1. Enter query Failed</p> <p>A5. The system displays “No Query Entered” and informs the patient to Enter Query.</p> <p>A6. The Patient returns back to step 3 to Enter Query.</p>

- This table briefly discusses what actions are performed when a person tries to enter a query into the system and what other alternatives there are if entering query is failed.

Table 7: Description of Update Dietary information use case

Use Case ID	Use Case – 4
Use Case Name	Update Dietary Information
Use case Description	Used to allow Dietitians to update Dietary information in the system.
Primary Actor	Dietitian
Pre-condition	Dietitian must login to the system.
Post-condition	Dietitians Successfully update new dietary information
Main Success Scenario	<ol style="list-style-type: none"> 1. Dietitian wants to update new dietary information. 2. Dietitian opens the Update Dietary Information Page. 3. Dietitian updates new dietary information. 4. The system saves the new dietary information to the database. 5. The system displays “dietary information successfully updated” Text for the dietitian. 6. the system directs dietitian to the next page 7. The use case ends
Alternative Scenario	<p>Alternate 1. Update Dietary Information Failed</p> <p>A5. The system displays “dietary information update unsuccessful” and informs the Dietitian to Re update Dietary Information.</p> <p>A6. The Dietitian returns back to step 3 to update Dietary Information.</p>

- This table briefly discusses what actions are performed when a dietitian updates information into the system and what other alternatives there are if update is failed.

Table 8: Description of Respond to Query use case

Use Case ID	Use Case – 5
Use Case Name	Respond to Query
Use case Description	Used to allow Dietitian answer questions entered by patients.
Primary Actor	Dietitian
Pre-condition	Dietitian must login to the system.
Post-condition	Dietitian Successfully answered the query patients wanted answer for.
Main Success Scenario	<ol style="list-style-type: none"> 1. Dietitian wants to answer questions. 2. Dietitian opens the Respond to Query page. 3. Dietitian answers the query patients wanted answer for. 4. The system saves the answer to the database. 5. The system displays “Query successfully answered” Text for the Dietitian. 6. the system directs Dietitian to the next page 7. The use case ends
Alternative Scenario	<p>Alternate 1. Respond to Query Failed</p> <p>A5. The system displays “No Answer Entered” and informs the dietitian to Respond to Query.</p> <p>A6. The dietitian returns back to step 3 to Respond to Query.</p>

- This table briefly discusses what actions are performed when a dietitian responds to a query entered by a patient into the system and what other alternatives there are if response is failed.

Table 9: Description of Update News use case

Use Case ID	Use Case – 6
Use Case Name	Update news
Use case Description	Used to allow Ethiopian Diabetes Association update the page with new news.
Primary Actor	Ethiopian Diabetes Association (EDA)
Pre-condition	EDA logs in to the system.
Post-condition	EDA Successfully updates the news.
Main Success Scenario	<ol style="list-style-type: none"> 1. EDA wants to update the news page. 2. EDA opens the Update News Page. 3. EDA updates the News. 4. The system saves the news to the database. 5. The system displays “News successfully updated” Text for EDA. 6. the system directs EDA to the next page 7. The use case ends
Alternative Scenario	<p>Alternate 1. Update News Failed</p> <p>A5. The system displays “News update unsuccessful” and informs EDA to Re update news entered.</p> <p>A6. EDA returns back to step 3 to update News.</p>

- This table briefly discusses what actions are performed when Ethiopian Diabetes Association updates current news into the system and what other alternatives there are if update is failed.

Table 10: Description of Manage Accounts use case

Use Case ID	Use Case – 7
Use Case Name	Manage Accounts
Use case Description	Used to allow System Administrator to manage user accounts.
Primary Actor(s)	System Administrator (SA)
Pre-condition	System Administrator Requires new user information.
Post-condition	User accounts successfully created.
Main Success Scenario	<ol style="list-style-type: none"> 1. Users want to get user accounts to access the system. 2. The system Administrator Requires personal information about the user. 3. The System Administrator provides users with new username and password to login the system according to their personal information. 4. The System Administrator authorizes the user. 7. The use case ends
Alternative Scenario	<p>Alternate 1. If user already have an account</p> <p>A5. The system Administrator chooses to either update user’s personal information or Delete user’s information and discard the user name and password to unauthorize the user from accessing the system.</p> <p>A6. The system Administrator returns back to step 3 to provide updated user name and password for user.</p>

- This table briefly discusses what actions are performed when the system administrator tries to create, update or delete a user account and how he chooses to select either one and manage the user accounts.

4.7.3 Activity diagrams

Activity diagrams are graphical representations of activities and actions with support for alternative, iteration and concurrency. They're meant to model each process and structure processes, Activity diagrams show the general flow of management [26]. The following activity diagrams were designed according to the use case and how the system should function.

Registration Activity Diagram

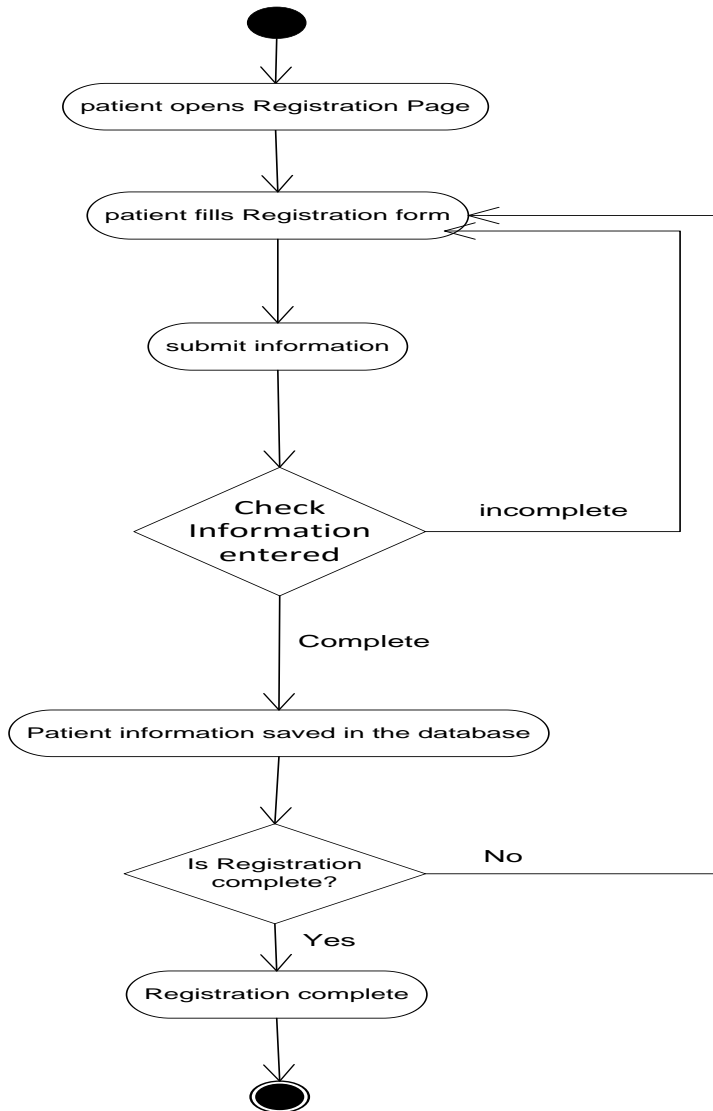


Figure 3: Registration activity diagram

- This diagram illustrates the steps taken to registers into the proposed system and what other alternatives there are if information entered is incomplete or not as well as if the registration is complete or not.

Enter Query activity diagram

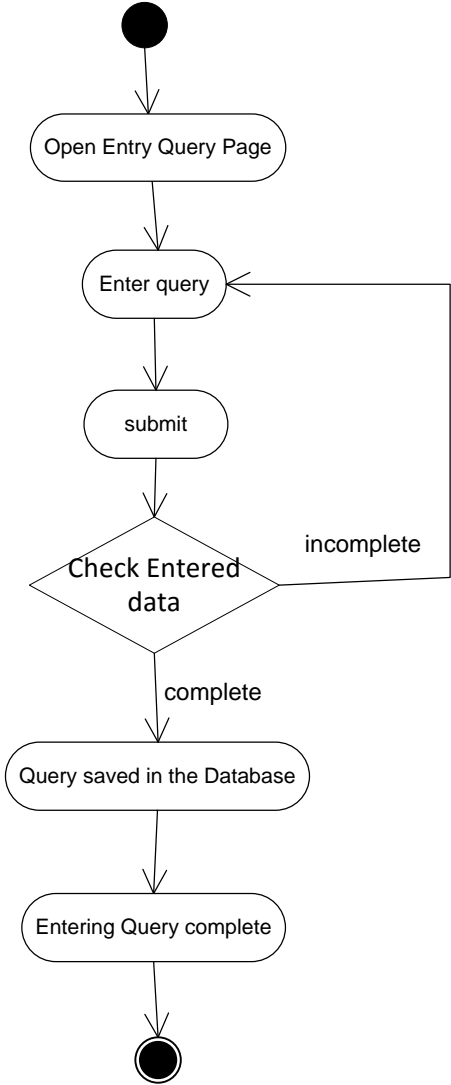


Figure 4: Enter Query activity diagram

- This diagram illustrates the steps taken to enter query into the system and if information entered is incomplete or not.

Update Dietary Information activity diagram

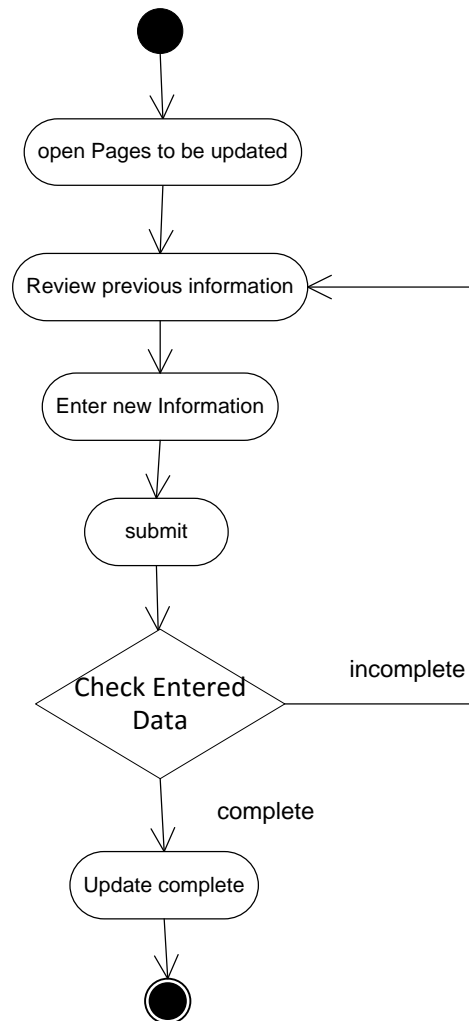


Figure 5: Update dietary information activity diagram

- This diagram illustrates the steps taken to update dietary information into the system and checks if information entered is incomplete or not.

Respond to Query activity diagram

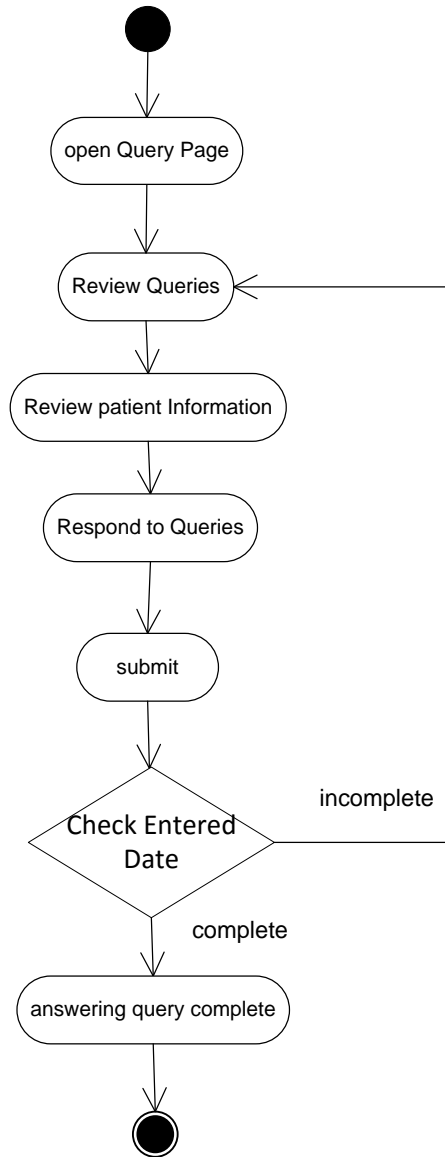


Figure 6: Respond to Query activity diagram

- This diagram illustrates the steps taken by a dietitian on how to respond to a query entered by a patient and if response entered is incomplete or not.

Update news activity diagram

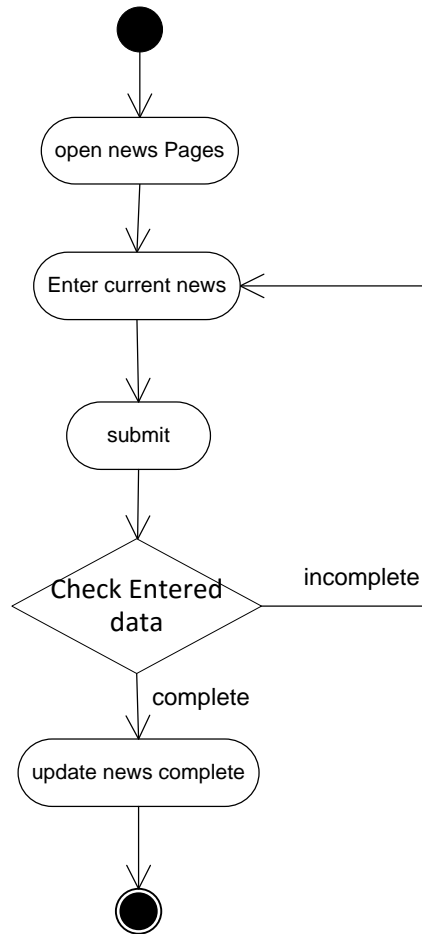


Figure 7: Update News activity diagram

- This diagram illustrates steps followed to update news into the system and checks if the news entered is complete or not.

Manage Accounts activity diagram

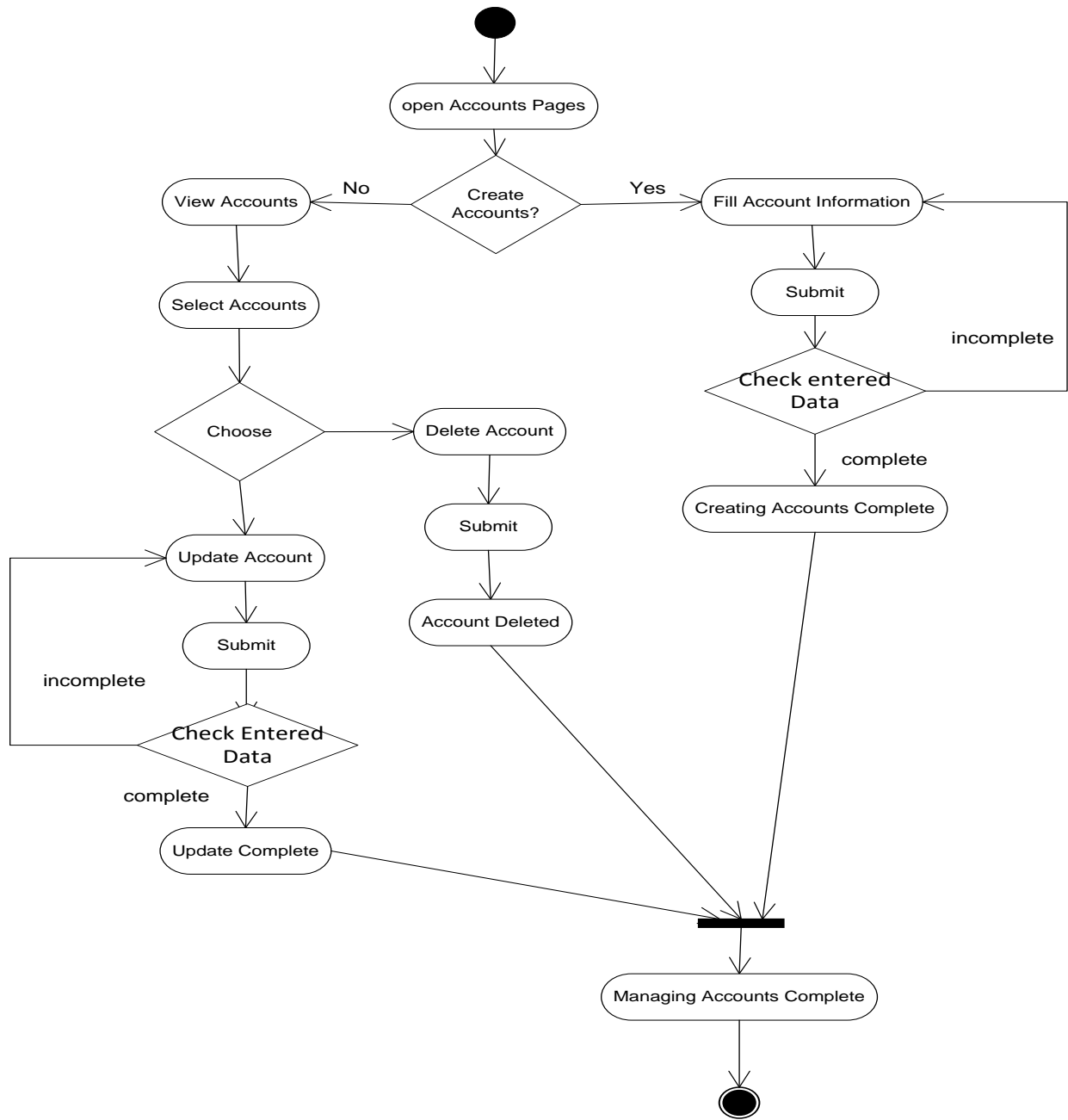


Figure 8: Manage Accounts activity diagram

- This diagram illustrates the steps taken by the system administrator to create, update or delete a user account and how he chooses to select either one and manage the user accounts.

4.7.4 Class diagram

Class diagram describes the structure of a system by showing its classes, attributes, operations and relationships between objects of the system [26]. Components of this diagram were selected based on the use case diagram and the basic functionalities of the system like actors of the system, their interaction with the system (how they interact), what actions the actors perform like registering and when they register what medical history the system expects from them. And how the system saves these files in to the database is used as attributes of the classes.

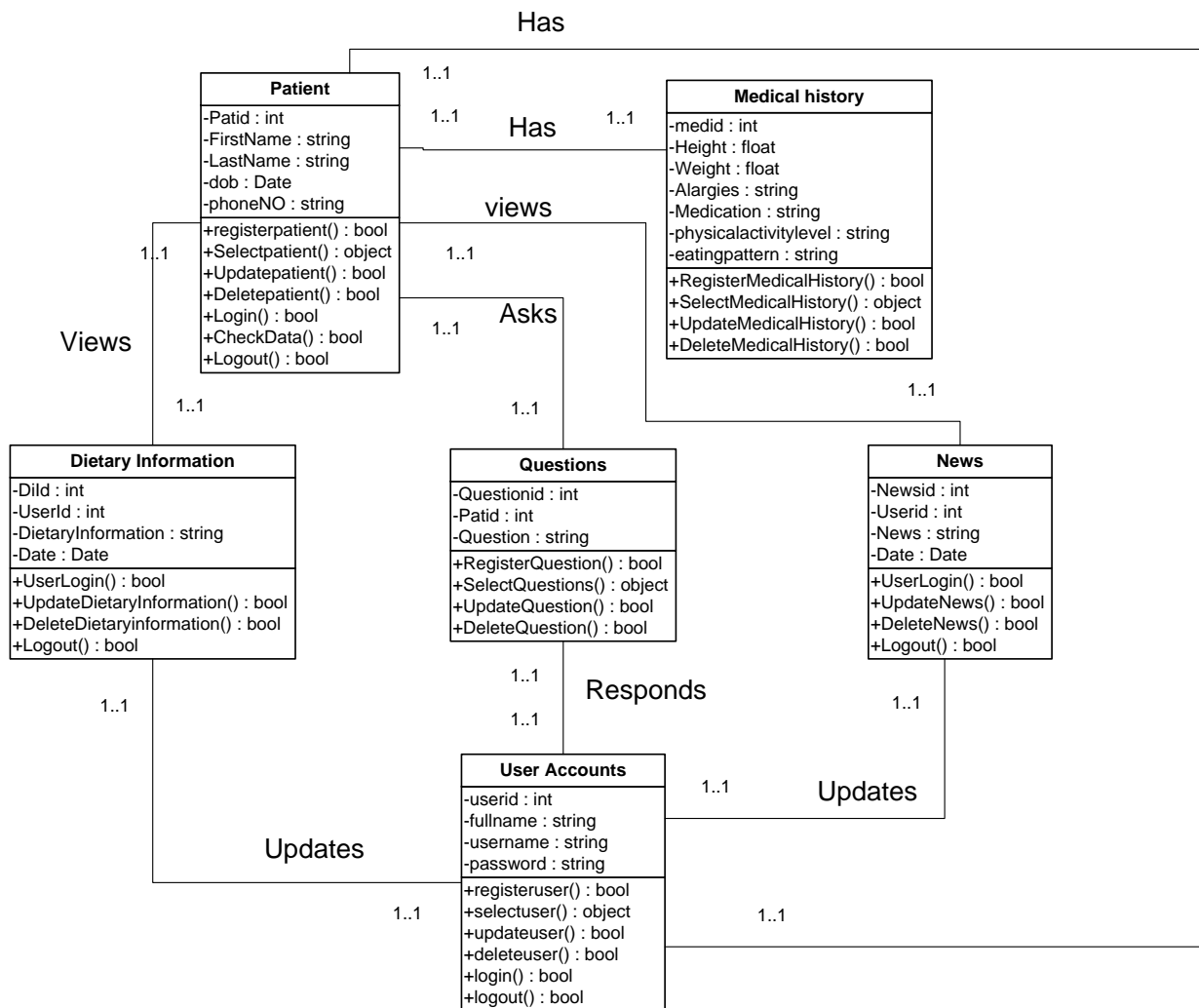


Figure 9: System Class Diagram

4.7.5. System Deployment Diagram

The system deployment diagram represents a Three-tier architecture where the Presentation tier displays information related to services as browsing merchandise basically the user interface, the data tier includes the data persistence mechanisms (database languages like MySQL) and the business logic (Application) tier represents core functionalities of the system deployed.

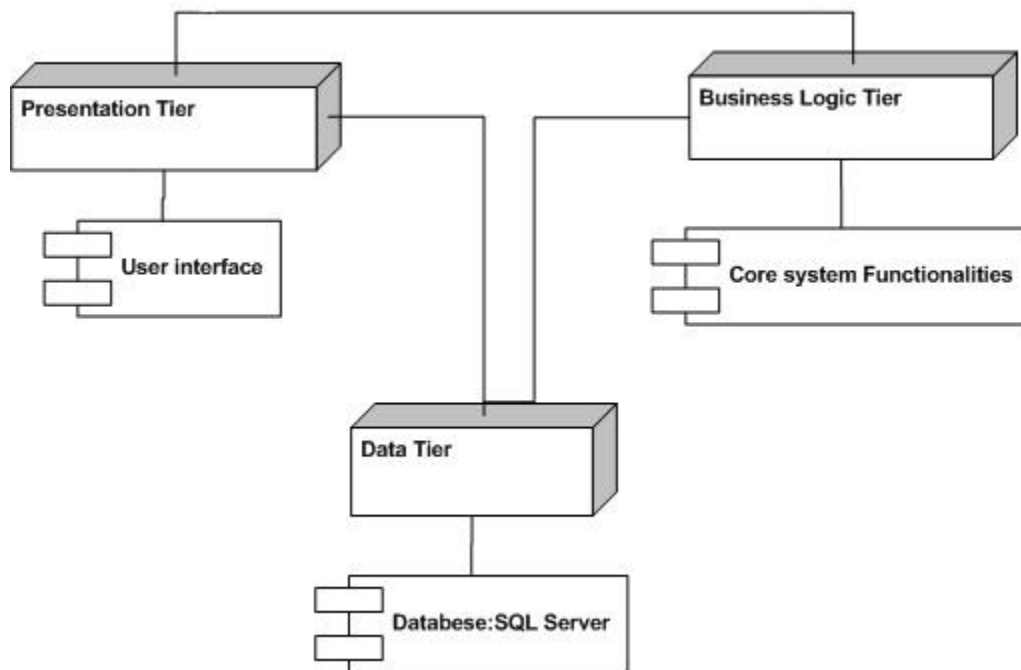


Figure 10: System Deployment diagram

4.8 Implementation and Evaluation

In this section of the project implementation of the proposed system, the different user interfaces designed and the results of evaluating the system have been discussed.

4.8.1. Flow Chart Diagram

A **flowchart** is a type of diagram that represents an algorithm, workflow or process of a system and their order by linking them with arrows. This graphic illustration is used as a solution model to a given problem. [35].

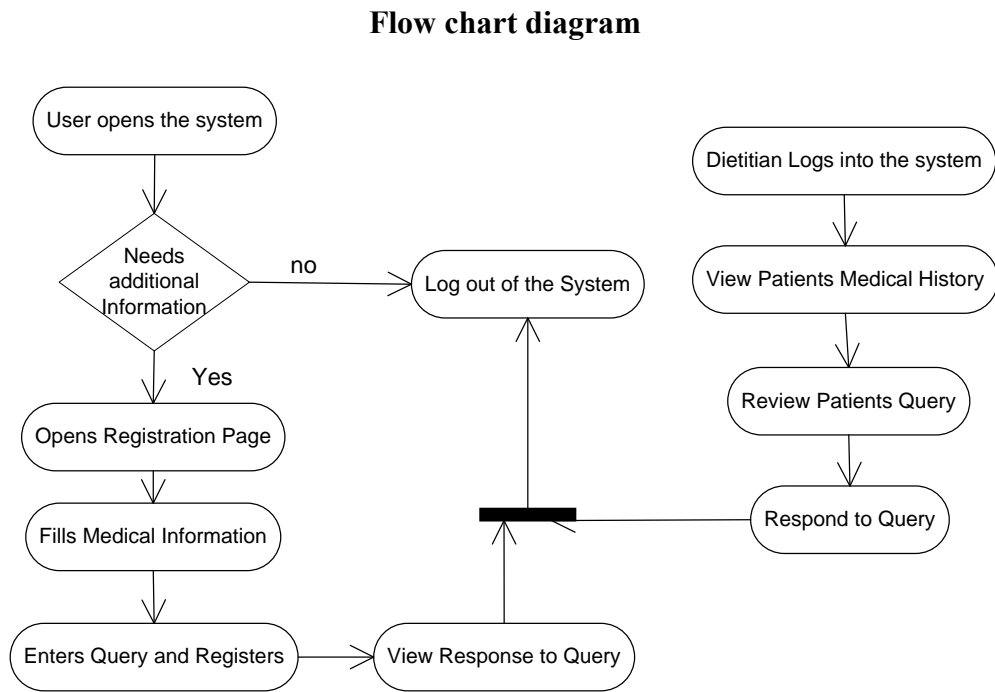


Figure 11: flow chart diagram to represent basic function of the system

4.8.2. User interface

User interface is an implementation part of a system where a user interacts with the system through icons, search options, visual indicators. Below you will find different user interfaces all of which are translated to Amharic language to meet the specific objectives of the project.

Home page

Home page includes 10 tabs of diabetes knowledge, registration tab, dietary information tab, thank you tab, vision tab, news section and address sections. To help guide users and let the user interface become user friendly and easily intractable.



Figure 12: home page User Interface

Registration page

The registration page offers the patient a chance to register to the system while his personal information is saved onto the database which include personal information's like full name, date of birth, Gender, weight, height, physical activity level, Allergies, medications, physical activity levels, phone numbers and finally enter a question and save the information entered.

ምዝገባ

ሙሉ ስም

የትውልድ ቀን

ጾታ

ክብደት ኪ.ግ

ከብደት ሴ.ሜ

የአካላዊ አንቅስቃሴ መጠን

አለጃክ የሆነት ነገር ካለ ይዘርዝሩ

የሚወስዱት መድሃኒት ካለ ይዘርዝሩ

የአመጋገብ ሁኔታ

የስልክ ቁጥር

ጥያቄ

Figure 13: Registration page User Interface

Diabetic's information section

In this section 10 basic diabetic education issues are found like what diabetes is what its causes, different forms, symptom's, types, medications, treatments', prevention methods, complications etc. ... for example the first section is what diabetes is.

የስኳር ህመም ምንድን ነው?

የስኳር ህመም የሚከሰተው ሰውነታችን ለኑሮም ሆነ ለእያንዳንዱ የሚያስፈልገውን ስኳር በትክክል ለመጠቀም ሳይችል ሲቆይ ነው። አንድ ሰው የስኳር ህመም አለው የምንለው በደም ውስጥ ያለው የስኳር መጠን ከሚገባው በላይ ከፍ ብሎ ሲገኝ ነው። በደም ውስጥ የሚገኘው ስኳር መጠን ከመጠን በላይ ከፍ ብሎ የሚገኘው ደግሞ ቆሽት የተባለው የሰውነት ክፍል ኢንሱሊን የተሰጠውን ንጥረ-ቅመም (በአንግሊዝኛ አጠራር ሆርሞን) በበቂ ሁኔታ ወይም ደግሞ ጭራሹን ማመንጨት ሲያቅተው ነው። የስኳር ህመም አንዴ ከያዘ በባህላዊም ሆነ በሳይንሳዊ የህክምና ዘዴ የሚደረግ የሰውነት ልክ ህመም ቢሆንም ትክክልና ቁጥጥር ከተደረገበት አንደኛውም ሰው ጤናማ ኑሮ ሊያስኖር የሚችል ነው። በተጨማሪም መንገድ ከትላልፍ ቁጥጥር ካልተደረገበት ግን የተለያዩ ጠንቆችን ለምሳሌ የዓይን፣ የኩላሊት፣ የነርቭና የልብ ችግሮችን ሊያስከት ይችላል። በተጨማሪም ቁጥጥር ከተደረገ እነዚህን ጠንቆች አንዳይከሰቱ ወይም ደግሞ ተከስተውም ከሆነ መገደብ አንደኛውም በቅርብ ጊዜ የተደረገ ጥናቶች አመልክተዋል።

Figure 14: Information page User Interface

Foods to eat page

In this section there are lists of foods that are good for health therefore we should eat them and they are placed under different forms of foods types.

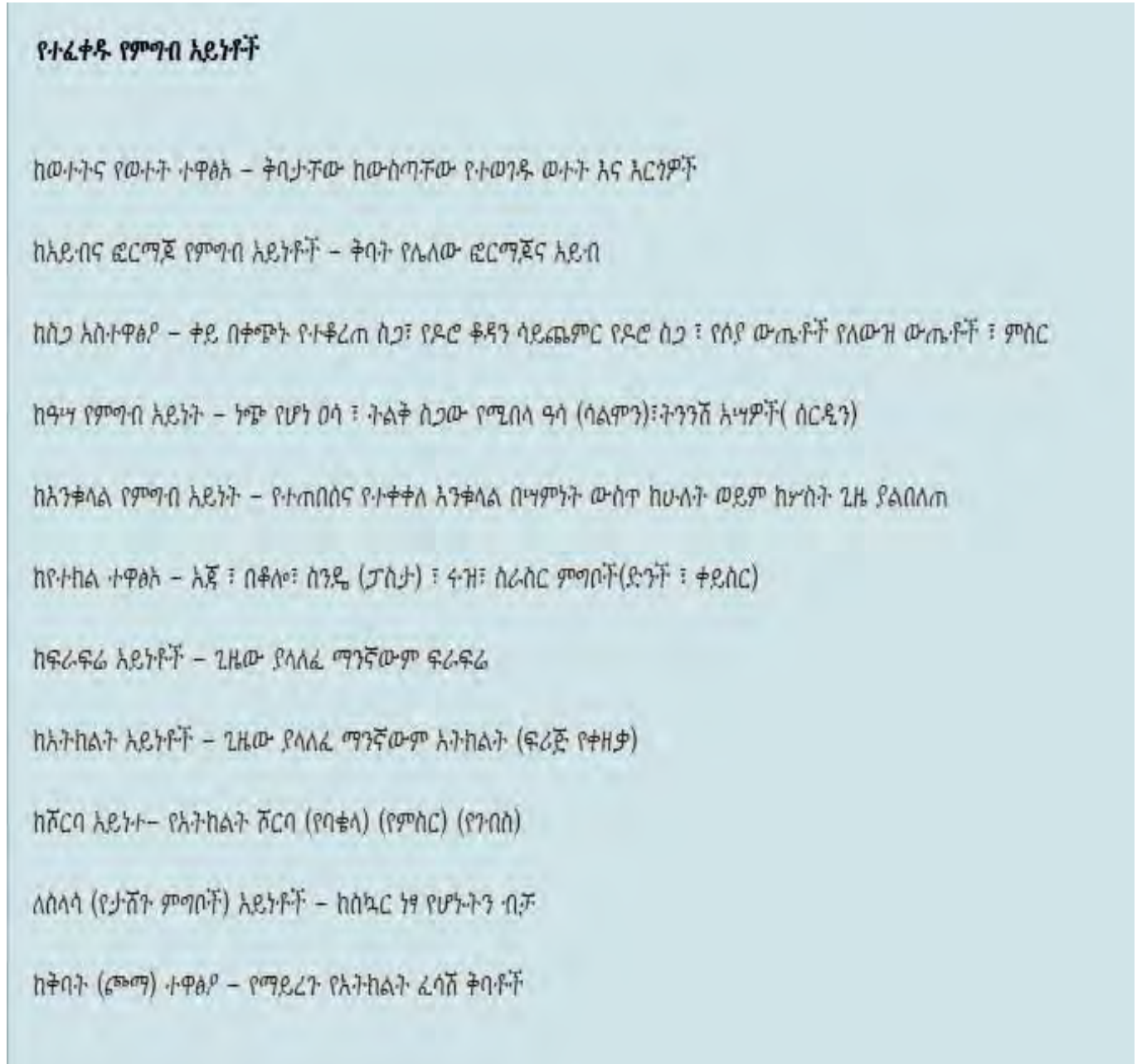


Figure 15: foods to eat User Interface

Foods to avoid page

In this section foods that are harmful for health therefore which should be avoided are listed.

የተከለከሉ የምግብ ዓይነቶች

ከውሳኔና የውሳኔ ተዋፅኦ - ሙሉ ቅባት ያለው ውሳኔ፤ የረጋ ውሳኔ

ከአይብና ጨርማጃ አይነት - ጠንካራ ቢጫ ጨርማጃ

ከሰጋ ተዋፅኦ - ጭማ ያለበት ስጋ፤ የዳክፍ ስጋ ጉብት፤ ከላሊት ምላስ፤ የክብት ብልቶች፤ ቅመምና በጨው ታክተው ቀዝቅዞ የሚበላ የሾርባ ምግብ፤ በአንፋሎት የደረቀ የአሳማ ስጋ፤ በከፊል የበሰለ የሰጋ ተዋፅኦ፤ ተጠቅልለው የተጠበሱ አሳማ ስጋ ውጤቶች

ከዳሣ የምግብ አይነት - ዳሣ የማይመስሉ የባህር አንስሳዎች፤ የሚበላ ሾርባ አሳ፤ ሎብስተር፤ ከራብስ፤ የተጠበሰ የዳሳ ውጤት

ከአንቁላል የምግብ ዓይነት - በዘይት የተጠበሰ አንቁላል

ከቅባት ተዋፅኦ - ንፁህ ቅባት፤ የአሣማ ጭማ፤ ደረቅ የዳቦ ቅባት፤ ለመጋገር ሆነ ለሌላ ምክንያቶች የምንጠቀምባቸውን ቅባት ይጨምራል።

ከፍሬፍሬ አይነቶች - ኮከናት/የዘንባባ ገውዝ

ከአትክልት አይነቶች - በዘይትም ሆነ በቅባት የበሰሉ አትክልቶች

ከሾርባ ምግብ - የስጋ፤ አጥንት፤ የአንገዳይና የራሳቸው ሾርባዎች

ለሰለሳ / የታሸጉ ምግቦች / ስኳር ላቸውን ማንኛውም ለሰለሳ ቸኮሌትና የውሳኔ ጄስ

ከተለያዩ የምግብ ዓይነቶች - ተለዎ የሚደርሱ ምግቦች፤ በርገር፤ ጊዛ፤ ድንች፤ ጥብስ፤ ሳምቡሳ

Figure 16: foods to avoid User Interface

Healthy cooking procedure page

In this section healthy meal cooking procedures have been put.

ጤናማ የምግብ አዘገጃጀት

በምግብ ሠብተኛ የላን የቅብት መጠን ለመቀነስ የሚያረጋግ የምግብ አዘገጃጀት

ውሳኔ :- ቅብትነቱ ከሠብተኛ የወታን የውሳኔ ተዋጽኦ መጠቀም

ቅብት:- ምግብችን ከቅብት ነፃ ወይም መጠኑ ባነሰ መገንደብ ማዘጋጀት።

ለምሳሌ:- ከስጋ ላይ ቀዩን ብቻ መርጦ መጠቀም

በደረቅ መጥበስ፣ መቀቀል፣ በእንፋሎ መጥበስ፣መጋገር ወይም ቅብት ሳይኖረው መጥበስ ቆይታ የሚበሉ የምግብ ማብላያ ዘዴዎች ናቸው።

ምግብችን ለማብላያ ልንጠቀምባችን የሚመከሩ ዘዴት ዓይነቶች

- የማይረገጉ ፈሳሽ ቅብቶች
- በፍፁም የማይረገጉ የአትክልትና የጥሬጥሬ ተዋፅዖ የሆኑ የዘይት አይነቶች
- ከወይራ ዛፍ እና ከለውዝ ተዋፅኦ የተገኙ የዘይት አይነቶች

ዓሳ :- ዓሳውን በደረቅ ያለዘይት ጠብሶ በሎሚ ጄ መቀበታና ከተቻለ በንሽ የዳቦ ቅቤ ቀብቶ መጋገር

ከዛም በቲማቲም፣ ከሽንኩርት ሰይም ከተመሳሳይ አትክልቶች ጋር አድርጎ መመገብ።

አትክልት:- የተቀቀሉ ወይም በእንፋሎት የበሰሉ አትክልቶችን ምንም አይነት ቅቤ ፣ የስኳር ማጣፊጫ ወይም ዘይቶችን ሳይጨምሩ መጠቀም

ቀይሽንኩርት፣ ነጭ ሽንኩርት እንዲሁም ሌላ ቅመማ ቅመሞችን መጠቀም ይቻላል።

ጥብስ ቅጠል እንዲሁም ቀረፋ ካሮት ላይ መጠቀም የተለያዩ ቃና ለምግብ ይፈጥራል።

ድንች :- ድንችን መጋገር ፣ መቀቀል ወይም በእንፋሎት ጠብሶ መመገብ።

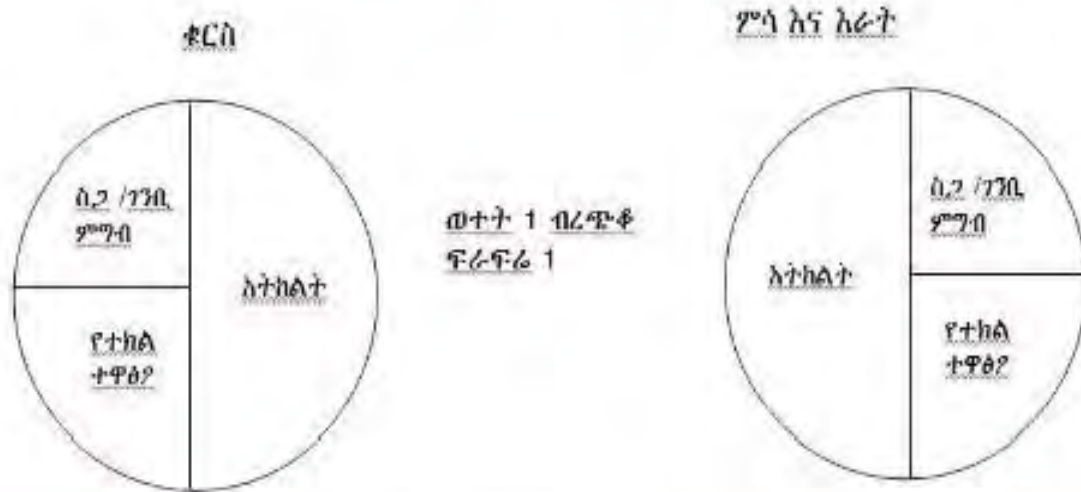
ድንችን ቅቤ በወጣለት ወታት ጋር ጨፍልቆ በመቀላቀል በአጭቶ ወይም በሎሚ ጋር መመገብ ይቻላል።

Figure 17: health cooking procedure User Interface

Plate method eating mechanism page

In this section plate method meal plans and lists of food types according to their food category has been placed.

በሠህን የተሰራ የፖፖብ አወሳሰድ



<u>ገንቢ ምግብ</u>	<u>የተክል ተዋዕያ</u>	<u>ሀይል ሠጪ</u>	<u>ፍራፍሬ</u>
<ul style="list-style-type: none"> ◆ ሰጋ ◆ ዓጣ ◆ ባቱላ ◆ ምስር ◆ ወተት ◆ አይብ/ፎርማጅ/ ◆ አርጎ ◆ እንቁላል ◆ ሰውዝ ◆ ጢፍ ◆ የተክል ዘሮች ◆ ዶር ◆ ዱባ 	<ul style="list-style-type: none"> ◆ ዳቦ ◆ ፍዝ ◆ ፓስታ ◆ ድንች ◆ አጃ ◆ ማሽላ ◆ ስንዴ ◆ በቆሎ ◆ ገብስ ◆ የሰር ተክል 	<ul style="list-style-type: none"> ◆ እህል - ስንዴ ፣ ባቱላ ◆ ጥራጥራ /ፍራ/ ◆ በቆሎ ◆ ወተት/አርጎ/ ◆ የአተክልተ ዘሮች <p style="text-align: center;"><u>ከቅባት</u></p> <ul style="list-style-type: none"> ◆ የማይረጉ ፈላሽ ቅባቶች 	<ul style="list-style-type: none"> ◆ ፖም ◆ ሙዝ ◆ ወይን ◆ ብረቱካን ◆ ኮከ ◆ ዘቢብ ◆ ማንደሪን ◆ ፕሪም ◆ የወይን ፍራ ◆ ሃብሃብ ◆ ትንሽ ማንጎ ◆ ፓፓያ

Figure 18: Plate Method Eating Mechanism User Interface

4.9 Discussion of Results

Since there were no previously designed nutritional decisions support systems for diabetic patients in Ethiopia these projects is a starting point for the improvement of managing diabetes through nutrition. After studying the existing nutritional support systems for diabetes mellitus and determining system requirements It has laid down a platform for using guidelines on what type of foods are good for health and what are harmful and should be avoided in addition to that there are cooking and food preparation mechanisms.

Pyramidal and plate method eating procedures have also been placed in the website, since every content developed have been selected to match the lifestyle and food types of every Ethiopian where there foods can be found in any market available. The contents developed were translated from diabetes education training manual for sub Saharan Africa [31] which is geographically as close to Ethiopia as possible in comparison with guidelines from the United States and United Kingdom since our food types and eating patterns differ [32], the contents were then translated to Amharic and the designed interface was in Amharic.

The system also has a registration form where a patient fills his personal information to register and ask a certified dietitian through the system what he feels is missing from the website or additional queries he wants answers for, after that the dietitian will respond to his queries. To conclude this section the system provides individuals with a way they can manage their health starting from home without any medication.

4.10 Testing and Evaluation

The goal of the Likert scale test was to determine the functionality of a web-based system to support nutritional decision making. The evaluation often refers to the question of how well users can understand the system functionality.

Table 11: System evaluation Result Table

No	Criteria of evaluation	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	The system provides dietary information			0	7	3
2	The system provides news from EDA		1	2	4	3
3	The system provides understandable diabetes information			0	8	2
4	The system provides adequate registration format				1	9
5	The system provides options to enter queries		1	1	2	6
6	The content of the system is clearly understandable				4	6
7	The system responds to queries				3	7
8	There is unnecessary content available in the interface		5	3	2	0
9	Overall interaction to the system is good			1	1	8
10	The system provides secured and reliable information		2		6	2
		Average result	9%	7%	38%	46%
		Total result				84%

To conclude according to the Likert scale system evaluations 84 % of the users have agreed that the system meets with the functional requirements set and have understandable content while some experts also mentioned some weaknesses they observed like the system doesn't provide every kind of food Ethiopians eat according to different nations and nationalities, cultures, cooking patterns and also economic level, registration form doesn't calculate the body mass index of patients or doesn't fully manage diabetes in terms of insulin dosage management, physical activity guidance and blood glucose level control but beside these since the evaluation was based on the prototype not the complete application they have agreed it might be upgraded for the future.

Chapter Five

Conclusion and Recommendation

5.1 Conclusion

Information is a critical component in our day to day life and getting the right kind of information is crucial in leading a better life and making better decisions that have a direct impact on the health of the society. As a result getting proper and standard information can improve the level of healthiness in individuals.

Despite the lack of access to licensed dietitians; using the one's we now have can certainly change the way we perceive information on how to receive an appropriate meal plan to keep ourselves fit and healthy. Since being informed is a lot better than not knowing we can reduce the possibility of developing diabetes mellitus by avoiding influences and unnecessary nutrients from our lives.

The newly designed web based Decision support system can enable us to get an Amharic version, updated and understandable nutritional guidelines and while new information about diabetes is available in an easily accessible manner anytime anywhere.

For the development of the Web-Based Nutritional Decision Support system the investigator assessed different systems and their impact on diabetic patients, other individuals as well as medical doctors and dietitians. The requirements that were developed to the system were gathered from the various health professionals and diabetic patients who have been directly influenced by diabetes.

Based on the requirements gathered the system modeling was done using the unified modeling language (UML). From the different types of the UML designing tools use cases, activity and class diagrams were used which describe the major scenarios, actors of the system, database structures and how objects interact were designed. The system was implemented using HTML, CSS and JavaScript to design the user interface while the database was constructed using MySQL language after which PHP was used to link the user interface with the database. The major problems forcing for the development of the new system were Lack of access to a certified dietitian and, Lack of Amharic interface websites regarding diabetes and lack of automated nutritional guidelines available online.

The system provided dietary information's in four sections, foods to eat, foods to avoid, healthy food preparation procedures, and plate method eating mechanisms. And also have a diabetic education section in which it defines what diabetes is, its cause, symptoms, medications, complications etc....

The system also has a registration section in which a patient fills his personal information which enables him to add additional questions he might feel is missing from the website or any question he wants to ask a certified dietitian any nutrition related questions helping the dietitian understand who the patient really is because the registration form has questions like height, weight, age, medications taken, allergies, eating patterns and also physical activity levels.

After which the dietitian logs in to the system and reviews the patient's personal information and questions to responds to the questions particularly for the patient only based on the patients' medical history. In this case the patient can have both general and specific instruments to manage their diet in a formal and accurate way.

The objectives of this project have been met in a way the system provides options to make dietitians available through the system to answer nutritional questions and also provides nutritional guidelines to help diabetes mellitus patients deal with the illness by maintaining a healthy diet and controlling their nutrition intake and while it lets people give attentions for any causes or symptoms of diabetes and prematurely control it.

5.2 Recommendations

After completing the project we provided the following recommendations for practice and future work

Recommendations for practice

- The FMOH should provide an Ethiopian version of nutritional guidelines according to different nations and nationalities eating patterns and food types.
- Ethiopian Diabetes association should continue updating and providing more information on diabetes using this website.

Recommendations for future work

- Researchers/ students should continue the project to complete translating the whole package of nutritional guidelines to an Amharic.
- Researchers should continue to upgrade this system in to an intelligent decision support system.
- Researchers/ students should make further research on this project.

References

1. Alberti G, Zimmet P, Shaw J, Bloomgarden Z, Kaufman F, Silink M. Type 2 Diabetes in the Young: The Evolving Epidemic: The International Diabetes Federation Consensus Workshop. *Diabetes Care*. 2004; 27(7):1798-1811.
2. Borch-Johnsen K, Mandrup-Poulsen T, Zachau-Christiansen B, Joner G, Christy M, Kastrup K et al. Relation between breast feeding and incidence rates of insulin dependent diabetes mellitus. *The Lancet*. 1984; 324(8411):1083-1086.
3. Barroso I, Luan J, Middelberg R, Harding A, Jakes R, Clayton D et al. Correction: Candidate Gene Association Study in Type 2 Diabetes Indicates a Role for Genes Involved in β -Cell Function as Well as Insulin Action. *PLoS Biology*. 2003; 1(3):e92.
4. Feleke YEnquesselassie F. An assessment of the health care system for diabetes in Addis Ababa, Ethiopia. *Ethiopian Journal of Health Development*. 2006; 19(3).
5. Keen, peter; [1980], *Decision support systems: a research perspective*. Cambridge, mass: center for information systems research, Alfred p. Sloan school of management.
6. Franz M, Bantle J, Beebe C, Brunzell J, Chiasson J, Garg A et al. Evidence-Based Nutrition Principles and Recommendations for the Treatment and Prevention of Diabetes and Related Complications. *Diabetes Care*. 2002;25(1):148-198.
7. Franz M, Powers M, Leontos C, Holzmeister L, Kulkarni K, Monk A et al. The Evidence for Medical Nutrition Therapy for Type 1 and Type 2 Diabetes in Adults. *Journal of the American Dietetic Association*. 2010; 110(12):1852-1889.
8. Centers for Disease Control and Prevention. National diabetes fact sheet: General Information and National Estimates on Diabetes in the United States. United States, Atlanta, GA.: US Department of Health and Human Services; 2007 p. 8-10.
9. Burns, Alvin; Burns, Ronald, *Basic Marketing Research (Second Ed.)*. New Jersey: Pearson Education. p. 245. ISBN 978-0-13-205958-9, 2008.
10. Plougmann S, Hejlesen O, Cavan D. DiasNet—a diabetes advisory system for communication and education via the internet. *International Journal of Medical Informatics*. 2001; 64(2-3):319-330.
11. K. Rajalakshmi, Dr. S. Chandra Mohan, Dr.S.Dhinesh Babu, *Decision Support System in Healthcare Industry*, *International Journal of Computer Applications (0975 – 8887) Volume 26– No.9, July 2011*.
12. Tuomilehto J, Virtala E, Karvonen M, et al, International Diabetes Federation, *Diabetes Facts and Figures*, Brussels: Belgium, 2009.
13. S. Berman, “The AMA clinical quality improvement forum on addressing patient safety,” *Jt Comm J Qual Improv*, vol. 26, pp.428–33, 2000.
14. Bhattacharyya O, Shah B, Booth G. Management of cardiovascular disease in patients with diabetes: the 2008 Canadian Diabetes Association guidelines. *Canadian Medical Association Journal*. 2008; 179(9):920-926

15. Morisset A, Dubé M, Veillette J, Robitaille J, Weisnager S, Tchernof A. Carbohydrate intake in the nutritional management of gestational diabetes mellitus. *Canadian Journal of Diabetes*. 2011;35(2):202.
16. Eta S. Berner, Ed.D, *Clinical Decision Support Systems: State of the Art*: Department of Health Services Administration University of Alabama at Birmingham, AHRQ Publication No. 09-0069-EF June 2009
17. Redmon B, Caccamo D, Flavin P, Michels R, O'Connor P, Roberts J, Smith S, Sperl-Hillen J. Institute for Clinical Systems Improvement. *Health Care Guideline Diagnosis and Management of Type 2 Diabetes Mellitus in Adults*. Updated July 2014
18. Andrews R, Cooper A, Montgomery A, Norcross A, Peters T, Sharp D et al. Diet or diet plus physical activity versus usual care in patients with newly diagnosed type 2 diabetes: the Early ACTID randomized controlled trial. *The Lancet*. 2011; 378(9786):129-139.
19. Yancy W, Dunbar S, Boucher J, Cypress M, Evert A, Franz M et al. Response to Comments on Evert et al. *Nutrition Therapy Recommendations for the Management of Adults With Diabetes*. *Diabetes Care* 2013; 36:3821 –3842. *Diabetes Care*. 2014; 37 (5):e102-e103.
20. Franz M, Bantle J, Beebe C, Brunzell J, Chiasson J, Garg A et al. Evidence-Based Nutrition Principles and Recommendations for the Treatment and Prevention of Diabetes and Related Complications. *Diabetes Care*. 2002;25(1):148-198.
21. RANJITA MISRA. Professor & Research Director Center for the Study of Health Disparities (CSHD) Member, *Indian Foods: AAPI's Guide To Nutrition, Health and Diabetes 2nd ED*, Intercollegiate Faculty of Nutrition Texas A&M University
22. Shaheen Ahmad khan W. *Intelligent Decision Support System in Diabetic eHealth Care From the perspective of Elders [Master Thesis Computer Science]*. Blekinge Institute of Technology, Sweden; 2009.
23. Sahar F. *Web Based Intelligent Decision Support System for Type 2 Diabetes Patients*. *IJET*. 2013;:527-531.
24. Plougmann S, Hejlesen O, Cavan D. DiasNet—a diabetes advisory system for communication and education via the internet. *International Journal of Medical Informatics*. 2001;64(2-3):319-330.
25. Brown AF, Mangione CM, Saliba D, Sarkisian CA; California Healthcare Foundation/American Geriatrics Society Panel on Improving Care for Elders with Diabetes (May 2003). "Guidelines for improving the care of the older person with diabetes mellitus". *J Am Geriatr Soc* 51 (5 Suppl Guidelines): S265–80.
26. Cartwright M, Shepperd M. An empirical investigation of an object-oriented software system. *IEEE Transactions on Software Engineering*. 2000;26(8):786-796.
27. Muftic L. Book Review: Arrigo, B. A. (2006). *Criminal Behavior: A Systems Approach*. Upper Saddle River, NJ: Prentice Hall. pp. xxiii, 340. *Criminal Justice Review*. 2008;33(1):98-99.

28. Roman, G.-C. "A taxonomy of current issues in requirements engineering" *Computer*, April 1985 Volume: 18 Issue: 4, pp. 14–23, ISSN 0018-9162.
29. Booch, G., I. Jacobson and J. Rumbaugh, the Unified Modeling Language User Guide. Addison-Wesley, 1999, pp.
30. Wylie-Rosett J, Morris S, Movsas S. Medical Nutrition Therapy for Diabetes Management and Prevention. *Clinical Nutrition INSIGHT*. 2012;38(1):1-4.
31. Ness A. Diet, Nutrition and the Prevention of Chronic Diseases. WHO Technical Report Series 916. Report of a Joint WHO/FSA Expert Consultation. *International Journal of Epidemiology*. 2004; 33(4):914-915.
32. John M. Diabetes education training manual for Sub Saharan Africa, international diabetes federation Africa region, July 2006
33. Lebovitz H. Therapy for Diabetes Mellitus and related disorders. America Diabetes Association. Pickup J, Williams G (eds). 2003. Textbook of diabetes. Oxford, London: Blackwell Science.
34. Jacobsen, Ivar; Magnus Christerson; Patrik Jonsson; Gunnar Overgaard. Object Oriented Software Engineering. Addison-Wesley ACM Press. (1992) pp. 15,199
35. Rumpe B Sandner R. UML –Unified Modeling Language in Practice. Part 2: Core Language and Application Specific Diagrams. 2001; 49(10/2001).
36. Parker R. Louis A. Schultheiss Don S. Culbertson Edward M. Heiliger. Advanced Data Processing in the University Library *The Library Quarterly*. 1963;33(1):149-149.

Annexes

Interview guide

Interview questions for Health Professionals

1. What systems do you currently use for updating your knowledge on Nutritional therapy?

2. How do you help your patients follow nutritional therapies?

3. How often do they contact you for nutrition related issues?

4. Do patients really know the benefits of nutritional therapy?

5. What do patients face about nutrition?

6. How useful do you think nutritional therapy is for your patients?

7. How accurate do you think advises you give for your patients are?

8. Are there any websites developed for diabetic use in Ethiopia you know about?

9. Are there any nutritional guidelines in Ethiopia you currently use?

10. Would they use the new system being developed?

11. Any Family member or do they personally use the internet to know more about nutrition?

12. What does nutrition Therapy need?

13. What should we offer them through the new website?

14. What questions should the websites be answering about nutrition?

15. Do you consider getting nutritional counseling is changing the health status of patients?

Interview questions for diabetic patients

1. What systems do you currently use for updating your knowledge on Nutritional therapy?

2. How do you get help from Health Professionals on how to follow your nutritional intake?

3. How often do you contact health professionals for nutrition related issues?

4. Do you really are the problems you come across concerning nutrition?

5. How useful do you think nutritional therapies are for you?

6. How accurate do you think advises you get from your health professionals?

7. Are there any websites developed for diabetic use in Ethiopia you know about?

8. Are there any nutritional guidelines in Ethiopia you currently use?

9. Would you use the new system being developed?

10. Any Family member or do you personally use the internet to know more about nutrition?

11. What should we offer you through the new website?

12. What questions should the websites be answering about nutrition?

13. Do you consider getting nutritional counseling is changing your health status?

Likert Scale System Evaluation

This likert scale represents system evaluation questionnaires' according to functional requirements of the system given their response being 1 to strongly agree while 5 to strongly disagree in terms of the functional requirements being met or not.

1. The system provides dietary information

1. 5.

Strongly agree

Strongly Disagree

2. The system provides news from EDA

1. 5.

Strongly agree

Strongly Disagree

3. The system provides understandable diabetes information

1. 5.

Strongly agree

Strongly Disagree

4. The system provides adequate registration format

1. 5.

Strongly agree

Strongly Disagree

5. The system provides options to enter queries

1. 5.

Strongly agree

Strongly Disagree

6. The content of the system is clearly understandable

1. 5.

Strongly agree

Strongly Disagree

7. The system responds to queries

1. 5.

Strongly agree

Strongly Disagree

8. There is unnecessary content available in the interface

1. 2 3 4 5.

Strongly agree Strongly Disagree.

9. Overall interaction to the system is good

1. 2 3 4 5.

Strongly Disagree Strongly Disagree.

10. The system provides secured and reliable information

1. 2 3 4 5.

Strongly Disagree Strongly Agree

1. Diabetes education

ስለስኳር ህመም ምን ያህል ያውቃሉ

1. የስኳር ህመም ስርጭት

የስኳር ህመም በአሁኑ ጊዜ በመላው ዓለም ላይ እየተስፋፋ ያለ ህመም ሲሆን የስርጭቱ መጠንም ወረርሽኝ ወደሚያስብለው ደረጃ ደርሷል። የስኳር ህመም በፍጥነት እያሻቀበ የሚታየው ደግሞ በለሙት ሀገሮችና እንደ አገራችን ባሉ በመልማት ላይ በሚገኙ ሀገራት ነው። የዓለም ስኳር ህመም ፌዴሬሽን እንደሚያስቀምጠው በአሁኑ ጊዜ በዓለም ላይ 387 ሚሊዮን ሰዎች ከስኳር ህመም ጋር የሚኖሩ ሲሆን የመከላከልና የመቆጣጠር እርምጃዎች ጥብቅ ሆነው ካልቀጠሉ ይህ አሁን በ2035 እ.ኤ.አ ወደ 592 ሚሊዮን ያሻቅባል ተተንብዮል። በኢትዮጵያ የስኳር ህመም ከዛሬ30 ዓመታት በፊት አልፎ አልፎ ብቻ ሲታይ የነበረው ቢሆንም ከቅርብ ዓመታት ወዲህ ግን በሚያስደነግጥ መልኩ እየተስፋፋ ለመሆኑ ወደየጤና ድርጅቶች ለህክምና የሚመጡት ሰዎች ቁጥር ብዛት ሊያስረዳ ይችላል።

2. የስኳር ህመም ምንድን ነው

የስኳር ህመም የሚከሰተው ሰውነታችን ለኑሮም ሆነ ለእድገት የሚያስፈልገውን የስኳር በትክክል ለመጠቀም ሳይችል ሲቀር ነው። አንድ ሰው የስኳር ህመም አለው የምንለው በደም ውስጥ ያለው የስኳር መጠን ከሚገባው በላይ ከፍ ብሎ ሲገኝ ነው። በደም ውስጥ የሚገኘው ስኳር መጠን ከመጠን በላይ ከፍ ብሎ የሚገኘው ደግሞ ቆሽት የተባለው የሰውነት ክፍል ኢንሱሊን የተሰኘውን ንጥረ-ቅመም (በእንግሊዝኛ አጠራር ሆሞን) በበቂ ሁኔታ ወይም ደግሞ ጭራሹን ማመንጨት ሲያቅተው ነው። የስኳር ህመም አንዴ ከያዘ በባህላዊም ሆነ በሳይንሳዊ የህክምና ዘዴ የማይድን የዕድሜ ልክ ህመም ቢሆንም ትክክልና ቁጥጥር ከተደረገበት እንደማንኛውም ሰው ጤናማ ኑሮ ሊያስኖር የሚችል ነው። በተገቢው መንገድ ከትትልና ቁጥጥር ካልተደረገበት ግን የተለያዩ ጠንቆችን ለምሳሌ የዳይን፣ የኩላሊት ፣ የነርቭና የልብ ችግሮችን ሊያስከት ይችላል። በተገቢው ቁጥጥር ከተደረገ እነዚህን ጠንቆች እንዳይከሰቱ ወይም ደግሞ ተከስተውም ከሆነ መገደብ እንደሚቻል በቅርብ ጊዜ የተደረጉ ጥናቶች አመልክተዋል።

3. በሰውነታችን ውስጥ ምን ያካሄዳል

አንድን መኪና ለመንዳት ነዳጅ እንደሚያስፈልገው ሁሉ የሰውነታችን ሕዋሶችም ለመኖር፣ ለመተንፈስ ፣ ለማየት እንዲሁም ለማሰብ ኃይል ያስፈልጋቸዋል። ይህ ኃይል ወይም ነዳጅ የሚገኘው ከምንበላው ምግብ ሲሆን በአንጀታችን አማካኝነት ይፈጭና ግሉኮስ ወደሚባለው የስኳር ዓይነት ተለውጦ ወደ ደም ሥራችን እንዲጓዝ ይደረጋል። ስኳርም ከአንጀታችን ወደ ደም ይተላለፍና በደም ዝውውር አማካኝነት ወደ ተለያዩ የሰውነት አካላት ገብቶ በኃይል ሰጪነት ያገለግላል።

በተፈጥሮ ቆሽት /የእንግሊዝኛ አጠራሩ ፓንክሪያስ/ የምንለው የሰውነታችን ክፍል በደም ውስጥ ያለውን ስኳር ወደ ተለያዩ ሕዋሶች የሚያደርስ ኢንሱሊን የተሰኘ ንጥረ ቅመም ያመርታል። ቆሽት የሚገኘው ከጨጓራ በስተጀርባ ሲሆን በሰውነታችን ውስጥ የተለያዩ ጠቀሚ ተግባራትን ያከናውናል። ከላይ እንደተጠቀሰው አንደኛው ሥራው ኢንሱሊንን ማመንጨት ነው። ኢንሱሊን ስኳርን ከደም ወደ ተለያዩ ሕዋሳት እንዲገባ በመርዳት በደም ውስጥ ያለው የስኳር መጠን እንዲስተካከል ይረዳል። የስኳር ህመም ከተከሰተ ግን ቆሽት /ፓንክሪያስ/ ኢንሱሊን ጭራሽ ማምረት ያቅተዋል አሊያም ደግሞ ኢንሱሊንን በበቂ ሁኔታ ማመንጨት ያቅተዋል ስለማይችሉ በደም ውስጥ የሚገኘውን ስኳር በጥቅም ላይ ማዋል ስለማይችሉ በደም ውስጥ የሚገኘውን የስኳር መጠን ከፍ እያለ ይሄዳል።

4. የስኳር ህመም መንስኤ ምንድን ነው

የስኳር ህመም መንስኤ ምን እንደሆነ በውል አይታወቅም። ከላይ ለማብራራት እንደተሞከረው የስኳር ህመም የሚከሰተው ቆሽት ኢንሱሊንን በሚገባ ሳያመነጭ ሲቀር ነው። ምንም አንኳ በስኳር ህመም ላይ ከረጅም ጊዜ ጀምሮ ጥናቶች

እየተደረጉ ቢሆንም ቆሽት ኢንሱሊን የማምረት ተግባሩን ለምን በሚገባ እንደማይካሄድ እስከአሁን ሊደረስበት አልተቻለም፡፡

የስኳር ህመም በእርግጥነት፣ በልክፍት ወይም ብዙ ጣፋጭ በሙብላት የሚመጣ አይደለም፡፡ የስኳር ህመም መከሰት ሊያጋልጡ የሚችሉ ሁኔታዎች በቅርብ የቤተሰብ አባል የህመሙ መኖር (ሁልጊዜ ግን በዘር ሀረግ አይተላለፍም)፣ የኢንዱስትሪዎች መስፋፋትና የህዝቡ ከገጠር ወደ ከተማ መፍለስ፣ ጭንቀትና ውጥረት የተሞላበት ኑሮ፣ ጤናማ ያልሆኑ አመጋገብ መከተል፣ የአካል ብቃት እንቅስቃሴ አለማድረግ እና የሰውነት ክብደት መጨመርና ከልክ በላይ መወፈር ይጠቀሳሉ፡፡

5. የስኳር ህመም ማንን ይይዛል

የስኳር ህመም እድሜ፣ ብሔር፣ ወንድ ፣ ሴት ፣ የኑሮ ደረጃ ሳይል በሁሉም ሰው ላይ ሊከሰት የሚችል ህመም ነው፡፡

6. ለስኳር ህመም ይበልጥ ተጋላጭ ማነው

የስኳር ህመም በማንኛውም ሰው ላይ ሊከሰት ይችላል፡፡ ይሁንና እድሜያቸው ከ40 ዓመት በላይ የሆኑ፣ የሰውነት ክብደታቸው ከፍተኛ የሆኑ ፣ የአካል ብቃት እንቅስቃሴ የማያደርጉና በቤተሰባቸው ውስጥ የስኳር ህመም ያለባቸው ፣ የደም ግፊት ያለባቸው፣ በደም ውስጥ የቅባት መጠኑ (ኮሊስትሮል) ከፍ ያባቸው ሰዎች ፣ ከዚህ ቀደም በእርግዝና ጊዜ የስኳር ህመም የታየባቸውና ከዚህ ቀደም በእርግዝና ጊዜ የስኳር ህመም የታየባቸውና ከዚህ ቀደም ክብደታቸው ከአራት ኪሎ ግራም በላይ የሆኑ ህጻናትን የወለዱ ሴቶች

ይበልጥ ለስኳር ህመም የተጋለጡ ናቸው፡፡ ከላይ ከተጠቀሱት ሁኔታዎች መካከል አንዱ እንኳ የታየባቸው ሰዎች ቢያንስ በዓመት አንድ ጊዜ የስኳሩን ሁኔታ ለማየት የደም ምርመራ ማድረግ ይኖርባቸዋል፡፡

7. የስኳር ህመም ምልክቶች ምንድን ናቸው

በደም ውስጥ ያለው የስኳር መጠን ሲጨምር (ፕሮግላይሴሚያ) ግልጽና የማያሻሙ ምልክቶች ያሉት ሲሆን እነዚህ ምልክቶች ሲታዩ ፈጥኖ ወደ ህክምና ባለሙያ በመሄድ መመርመር ያስፈልጋል፡፡ እነዚህም አሁንም ውሃ ማለት /ከፍተኛ የውሃ ጥም/፣ ቶሎ ቶሎና ብዙ መሽናት ፣ ከፍተኛ የረሀብ ስሜት፣ ድካም፣ ኃይል ማጣት ፣ ምክንያቱ ያልታወቀ የክብደት መቀነስ ናቸው፡፡ ሌሎች ምልክቶች ደግሞ የማየት ችሎታ ለውጥ /ብሽብሽብ ማለት/፣ የእግርና የእጅ መደንዘዝ ፣ ግብረ ሥጋ ግንኙነት ለማድረግ አለመቻል፣ ሰውነት ሲቆረጥ፣ ሲቆስል ፣ ሲያብጥና ሲያሳክክ ቶሎ ያለመዳን፣ በሴቶች ላይ ደግሞ ማህጸን አካባቢ ማሳከክና ነጭ ፈሳሽ መውጣት አልፎ አልፎ የሰውነት መቆነጣጠጥና ውስጥ ውስጡን የሚሄድ ዓይነት ስሜት መሰማት ሁኔታዎች ናቸው፡፡ ሁን እንጂ በአንዳንድ የስኳር ህመምተኛ ላይ ምንም ዓይነት የሕመም ምልክቶች አይታዩባቸውም፡፡

8. የስኳር ህመም ዓይነቶች

የስኳር ህመም ዓይነቶች በርካታ ሲሆኑ ዋና ዋናዎቹ የሚከሉት ናቸው፡፡

1. የመጀመሪያው ዓይነት የስኳር ህመም የሚከሰተው ቆሽት /ፓንክሪያስ/ ኢንሱሊን ማምረት ሲያቆም ነው፡፡ ይህ አብዛኛውን ጊዜ የሚከሰተው ከ30 ዓመት በታች በሆኑ ወጣቶች ላይ ሲሆን በልጆችና ከተወለዱ ትንሽ ጊዜ በሆናቸው ሕፃናት ላይም ሊታይ ይችላል፡፡ ሕመሙ ሲከሰት ድንገተኛና ፈጣን ሂደት ይኖረዋል፡፡ የመጀመሪያ ዓይነት የስኳር ህመም ያለባቸው ሰዎች በሕይወት ለመቆየት በየቀኑ የኢንሱሊን መርፌ መወጋት ይኖርባቸዋል፡፡ የሚወሰደው የኢንሱሊን መጠን ከሚወሰደው ምግብና ከአካል ብቃት እንቅስቃሴ ፕሮግራሞች ጋር ጥንቃቄ በተሞላበት መንገድ የተስተካከለ መሆን አለበት፡፡ አንደኛው ዓይነት የስኳር ህመም ከጠቅላላው የስኳር ህመምን ቁጥር ከ10-15 ከመቶ ያህሉን ያጠቃልላል፡፡

2. ሁለተኛው ዓይነት የስኳር ህመም የሚከሰተው ቆሽት/ፓንክሪያስ/ የሚያመርተው ኢነሱሊን በቂ ያልሆነ ወይም በደንብ የማይሰራ በሚሆንበት ጊዜ ነው። ከ85% – 90% የሚጠጉ የስኳር ህመምን ሁለተኛው ዓይነት የስኳር ህመምተኞች ሲሆኑ ሕመሙ ያለባቸው አብዛኞቹ ሰዎች ሁኔታውን በሚመለከት ምርመራ አድርገው የማያውቁ ናቸው። ብዙኃኑ የሁለተኛ ዓይነት የስኳር ህመምን ከ40 ዓመት በላይ ያት ናቸው። አብዛኛውን ጊዜ የሰውነት ክብደታቸው ከፍተኛ ሲሆን የአካል ብቃት እንቅስቃሴም አያደርጉም። ክብደት መቀነስ በራሱ በደም ውስጥ ያለውን ስኳር መጠን ሊቀንሰው ይችላል።

የአካል ብቃት እንቅስቃሴና ጤናማ የሆነ የአመጋገብ ሥርዓት ስኳሩን በጥሩ ሁኔታ ለመቆጣጠር የሚያስችሉ አስፈላጊ ነገሮች ናቸው። ይሁን እንጂ ቁጥጥሩን ሁኔታ ለማሻሻል እንክብሎች ሊታዘዙ ይችላሉ።

ሁለተኛ ዓይነት የስኳር ህመምን እድሜያቸው እየጨመረ ሲመጣ ኢነሱሊን ወደሚሰውዱበት ደረጃ ይደርሳሉ። ምንም እንኳን ሁለተኛው ዓይነት የስኳር ህመም ወዲያውኑ ሕይወት አደጋ ላይ የሚጥል ባይሆንም ከአንደኛው ዓይነት የስኳር ህመም ጋር ስናወዳድረው በብዙ መልኩ ይበልጥ አደገኛ ኖሮ የምናገኘው ሕመሙ የሚዳብረው ቀስ በቀስ በመሆኑና ህመሙ እንዳለ ለመጠቆም መቻልም ከባድ ስለሆነ ነው።

በደም ውስጥ ያለው የስኳር መጠን ለረዥም ጊዜ በሰውነት ውስጥ ከቆየ በሰውነት የተለያዩ ክፍሎች ላይ የከፋ ጉዳት ያስከትላል።

3. ሦስተኛው ዓይነት የስኳር ህመም እርግዝና ጋር ተያይዞ የሚከሰት ሲሆን የሚታየውም በእርግዝና ወቅት ብቻ ነው። እርግዝና ወቅት ብቻ ነው። እርግዝና ነክ የስኳር ህመም ብዙውን ጊዜ የሚከሰተው እርግዝና ከጀመረ ከ24-28 ሳምንት በኋላ ነው።

ይህ ዓይነቱ የስኳር ህመም ከእርግዝና በኋላ የሚጠፋ ሲሆን በአንዳንድ ሴቶች ላይ ግን ከወሊድ በኋላም ለቀጥል ይችላል። ከወሊድ በኋላ የስኳር ህመም ቢጠፋም ህመሙ ወደ ፊት እርግዝና ጊዜም ሆነ ከእርግዝና ውጪ ሊከሰት ስለሚችል ይህ ሁኔታ ያጋጠማቸው ሴቶች ለስኳር ህመም ክትትልና ቁጥጥር ማድረግ ይኖርባቸዋል።

ቀላል ሊባል የሚችል የስኳር ህመም እንደሌለ ሊታወቅ ይገባል። መለስተና የስኳር ህመም ወይም ደግሞ ትንሽ ስኳር አለችብኝ የሚባል ነገር የለም። ስኳር ህመም ሁልጊዜም ጥብቅ ቁጥጥርና ክትትል የሚሻ ህመም ነው።

4. አራተኛው ዓይነት ስኳር ህመም የሚከሰተው በሌሎች በሽታዎች ወይም በመድኃኒቶች ሳቢያ ምንስኤው ግልጽ የሆነ የስኳር ህመም ዓይነት ሲሆን የሚከሰተው አልፎ አልፎ ነው።

9. የስኳር ህመምን መቆጣጠር

የስኳር ህመምን የመቆጣጠር ዓላማ በደም ውስጥ ያለውን የስኳር መጠን ወደ ትክክለኛው ለማምጣት ያም ማለት በደም ውስጥ ያለው የስኳር መጠን ከ90- 130 ሚሊግራም /ኤሲ ሊትር መካከል እንዲሆን ማድረግ ነው።

9.1. የእርስዎ ሚና

የስኳር ህመምን በመቆጣጠር ረገድ እርስዎ ሚና በጣም ከፍተኛ ነው ። ክትትል በሚያደርግልዎ ደክተርና ሌሎች የጤማ ባለሙያዎች እርታ ቢታገዝ ራስን እንዴት መንከባከብ እንዳለብዎትና በህይወት ባሉበት ዘመን በሙሉ የስኳር ሕመምን ዕለት ዕለት መቆጣጠር የሚችሉት እንዴት እንደሆነ መማር ያስፈልግዎታል።

9.2. ለቁጥጥር የሚረዱ መሰረታዊ ነገሮች

9.2.1. ጤናማ አመጋገብ

በስኳር ህመም ህክምና የምግብ ቁጥጥር ያለው ሚና ከፍተኛ ነው። ቁጥጥሩን ተግባራዊ ለማድረግ ደግሞ የግለሰብ/ቧ ጥረት ላቅ ያለ ድርሻ አለው። የስኳር ህመምተኛ ምግብ ተብሎ ለእያንዳንዱ ሰው የሚሰጥ ዝርዝር ወይም ደግሞ ለስኳር ህመምተኛ ሁሉ የሚሰማማ አንድ ወጥ መመሪያ ሊሰጥ አይችልም። ማንኛውም ሰው ሊከተለው የሚገባ ጤናማ የሆነ ተብሎ የሚመከረው አመጋገብ ሥርዓት ለእርስዎም ያገለግላል። ምግብና መጠጥ በደም ወስጥ ያለውን የስኳር መጠን ይጨምራል። ምግብን በሚመርጡበት ጊዜ ዋነኛው ግብዎ መሆን ያበት በደም ውስጥ ያለውን የስኳር መጠን እንዳይበዛ ወይም ደግሞ እንዳያንስ መጠንቀቅ ነው።

ምን ያህል መጠን ያው ምግብ እንደሚወስዱና መቼ መመገብ እንዳለብዎት ማወቅ ወሳኝ ነው እያንዳንዱ ሰው ፍላጎት የተለያየ ስለሆነ ከስኳር ህመም ጋር የሚኖር ሰው የምግብ ባለሙያዎችን ቢያማክር ጥሩ እንደሆነ ይታመናል።

- ዋና ዋናዎቹ መርሆች የሚከተሉት ናቸው።
 - በደም ውስጥ ያለው ስኳር የመብዛት ሁኔታ ሳያንስ ተመሳሳይ ሁኔታ ላይ ይገኝ ዘንድ ሶስት ጊዜ በተወሰነ ሰዓት ልዩነት ተመሳሳይ ይዘት ያላቸውን ምግቦች ሳያበዙ በትንሹ ይውሰዱ።
 - በፍጥነት ወደስኳር የሚለወጡትን ወይም ንፁህ ስኳር ያለባቸውን ምግቦች በጣም ይቀንሱ ወይም ችራሹኑ ይታወቁ።
 - ቅባታቸው አነስተኛ የሆነ ምግቦችን ይምረጡ። ስብና ቅባት የበዛባቸውን ምግቦች ያስወግዱ። ምግብን በሚያበስሉበት ጊዜም በጣም ትንሽ ቅባት /ዘይት፣ ቅብ/ ይጠቀሙ። የረጉ የአትክልት የዘይት አይነቶችን ሳይሆን ፈሳሽ የሆኑትን የዘይት አይነቶች ብቻ ይጠቀሙ።
 - አሰር የበዛባቸውን ምግቦች ማትም ያልተፈተጉ እህሎችንና ጥራጥሬዎችን በብዛት ይመገቡ። የተፈተጉ እህሎችና ጥራጥሬዎች ቶሎ ወደ ስኳርነት ይቀየራሉ።
 - ምግብ የሚወስድበትን ጊዜ መድሃኒት ከሚወስድበት ጊዜ ጋር ያዛምዱ።
 - በየቀኑ ፍራፍሬና አትክልት /ቅጠላቅጠል ለመመገብ ይሞክሩ።
 - ሰውነትዎ ከሚፈለገው መጠን በላይ አይመገቡ። ምን መመገብ እንዳለብዎት ማወቅ አስፈላጊ የሆነውን ያህል የሚመገቡት ምግብ መጠንም ለስኳር ቁጥጥር ወሳኝነት አለው።
 - በጣም ትንሽ ጨው ይጠቀሙ፤
 - የአልኮል መጠጥ አጠቃቀምም በጣም ውሱን ይሁን።
 - ከብደት ላለመጨመር ይጠንቀቁ። ይህን ከተቆጣጠሩ ከብደት በቆሽት/ፓንክሪያስ/ ላይ የሚያሳድረውን ጫና ለመቀነስ ይችላሉ።

9.2.2. አካላዊ እንቅስቃሴ

የአካል ብቃት እንቅስቃሴ ማድረግ በደም ውስጥ ያለውን የስኳር መጠን ይቀንሳል። አካላዊ እንቅስቃሴ ማድረግ ለማንኛውም ሰው ይበጃል። የስኳር ህመም ካለብዎ ደግሞ የተለየ ጠቀሜታ ይኖረዋል። አዘውትረው የአካል ብቃት እንቅስቃሴ የሚያደርጉ ከሆነበደም ውስጥ የሚገኘውን የስኳር መጠን ለመቆጣጠር ከመርዳቱም በላይ የሰውነት የሰውነት ከብደት እንዳይጨምሩም ያግዝዎታል። እንቅስቃሴ ላይ በሚሆኑበት ጊዜ የሰውነት በደም ውስጥ ያለው ስኳር በፈጣን ሁኔታ ይጠቀምበታል።

በተጨማሪም እንቅስቃሴ የሰውነት ህዋሳት ኢንሱሊን የሚፈልጉበትን ሁኔታ በመቀነስ በደም ውስጥ ያለውን የግሉኮስ መጠን የተስተካከለ ለማድረግ የሚያስፈልገው የኢንሱሊን መጠን እየቀነሰ እንዲሄድ ያደርገዋል። የሰውነት እንቅስቃሴ ሁሉንም ዓይነት የአካል እንቅስቃሴዎች ለምሳሌ፡- የእግር ጉዞ፣ የቤት ውስጥ ሥራዎን ፣ አትክልት መኮትኮትና ሌሎች ስፖርታዊ እንቅስቃሴዎችን ይጨምራል።

9.2.3. መድሃኒት

መድሃኒት በመውሰድ በደም ውስጥ ያለውን የስኳር መጠን መቀነስ ይቻላል። ለአንደኛው ዓይነት የስኳር ህመም ኢንሱሊን በመርፌ የሚወድብን ምክንያት ኢንሱሊን ፕሮቲን በመሆኑ በአፋችን ከወሰድነው ምግብን ለመፍጨት የሚያስፈልጉት ፈሳሾች ይዘቱን ስለሚያጠፉት ነው። እርስዎና የጤና ክትትል የሚያደርጉሎት ባለሙያዎች መቼና ምን ያህል መጠን ኢንሱሊን በየቀኑ መውጋት እንሚኖርብዎት ይወስናሉ። ዓላማዎ ጤናማ የሆነ ቆሽት /ፓንክሪያስ/ የሚሰራውን ስራ በተቻለ መጠን በመኮረጅ ኢንሱሊንን ከምግብ አወሳሰድ እቅድዎ ጋርና ከአካል ብቃት እንቅስቃሴ ጋር የተጣጣመ ማድረግ ነው።

ሁለተኛው ዓይነት የስኳር ህመም ሲይዝዎት በምግብና በአካል ብቃት እንቅስቃሴ አማካኝነት በደም ውስጥ ያለው ያለው የስኳር መጠን ለመቀነስ ካተቻለ ዶክተርዎ በሶስት መንገድ ሊሰሩ የሚችሉ እክባሎችን ሊያዘልዎት ይችላሉ።

- ቆሽት/ፓንክሪያስ/ ብዙ ኢንሱሊን እንዲያመርት ሊያነቃቁት ይችላሉ።
- ወይ ደግሞ ሰውነት ያመረተው ኢንሱሊን በተሸለ መንገድ እንዲሰራ ሊያደርጉት ይችላሉ።
- አለበለዚያም ምግብ የመፈጨት ሂደቱን ሊያዘገዩ ይችላሉ።

የሚወዱት እንክብሎችም ሆነ የምግብ ቁጥትር ወይም የአካል ብቃት እንቅስቃሴ በደም ውስጥ ለውን ስኳር መጠን ተቀባይነት ወዳለው መጠን ለማውረድ ካልቻሉ ሁለተኛው ዓይነት የስኳር ህመም ያለባቸው ሰዎች ኢንሱሊን መጀመሩን አስፈላጊ ሆኖ ያገኙታል።

ተማሪዎች ለመምህራን፣ ሰራተኞች ለቅርብ የሥራ ባልደረቦቻቸው የስኳር ህመም እንዳለባቸው ቢያሳውቁ ችግር ሲገጥማቸው እርዳታ እንዲያገኙ ያስችላቸዋል። ማንኛውም የስኳር ህመምተኛ የስኳር ህመም እንዳለውና የሚወስደውን የመድሃኒት ዓይነትና መጠን የሚገልጽ መታወቂያ ቢየዝ/ብትይዝ በአጋጣሚ ህሊናውን/ዋን ቢስት/ብትስት የሕክምና እርዳታ በአፋጣኝ እንዲያገኝ ይረዳዋል/ይረዳታል።

እንክብል ሆነ ኢንሱሊን የሚወስድ ህመምተኛ ሁልጊዜም ቢሆን ስኳር ወይም ከረጫላ መያዥ ይኖርበታል /ይኖርባታል። የስኳር ማነስ ማስጠንቀቂያ ምልክቶች ሲሰሙ በቶሎ ራስን ለመርዳት ይህ ይጠቅማል። አንድ የስኳር ህመምተኛ በተደጋጋሚ የስኳር ማነስ ምልክቶች ከተሰማው/ከተሰማት የሚወስደውን የመድሃኒት መጠን ማስተካከል ሊያስፈልግ ስለሚችል የህክምና ክትትል የሚያደርግለትን ባለሙያ ማማከር ይኖርበታል/ይኖርባታል።

የስኳር ህመምን መከላከል

በአሁኑ ጊዜ አንደኛው አይነት የስኳር ህመም እንዳይከሰት አስቀድሞ መከላከል ይቻላል። በሰውነታችን ውስጥ ኢንሱሊንን ለማምረት የሚረዱትን ህዋሳት ሙሉ ለሙሉ የሚያጠፏቸው ነገሮች ምን እንደሆኑ በትክክል ለማወቅ ከፍተኛ ምርምር እየተደረገ ነው ። ወደ ሁለተኛው ዓይነት የስኳር ህመም ስንመጣ ግን አኗኗር ዘይቤያችንን በመለወጥ ማለትም ጤናማ አመጋገብ በመከተል ፣ ከቁመት ጋር ተመጣጣኝ የሆነ የሰውነት ክብደት እንዲኖረን በማድረግና መጠነኛ የአካል ብቃት እንቅስቃሴ በማድረግ ይህ ህመም እንዳይከሰት ለማድረግ እነ ደሚቻል በካርታ ጥናቶች እያመለከቱ ነው። በቀን ቢያንስ ለ30 ደቂቃ ያህል የሚደረግ የአካል ብቃት እንቅስቃሴ ለሁለተኛው ዓይነት የስኳር ህመም የመጋለጥን ስጋት በ40 በመቶ ይቀንሳል ።

ከሰውነት ቁመት ጋ የማይመጣጠን ትርፍ ውፍረት ፡- በተለይ የሆድ አካባቢ ውፍረት (ቦርጭ) ሁለተኛውን ዓይነት የስኳር ህመም እንዲከሰት የሚያደርግ መሆኑን በርካታ ጥናቶች አመለክተዋል ። የሰውነትን ክብደት መቀነስ ህዋሳት የኢንሱሊንን ምርት በደንብ እንዲቀበሉ ከማድረግም በላይ የደም ግፊቱንም የከላከላል ። ከመጠን በላይ የወፈሩ ወይንም ጤናማ የሰውነት ክብደት የሌላቸው ክብደታቸውንና ቁመታቸውን በማመጣጠን ጤናማ ሰውነት ክብደት እንዲኖራቸው ይመከራል ።

የአካል ብቃት እንቅስቃሴ ፡- የአካል ብቃት እንቅስቃሴ ማዘውተር የስኳር ህመምን ለመከላከል ከሚረዱን መንገዶች ቀዳሚውን ቦታ ይይዛል። የአካል ብቃት እንቅስቃሴን ማዘውተር የሰውነት ክብደትን ለመቆጣጠር ፣ ትርፍ ክብደትን ለመቀነስ ፣ የደም ግፊት መጠናቸንን ለማስተካከል ፣ ጤናማና የተስተካከለ የልብ ምት እንዲኖረን ለማስቻል ፣ በደማችን ውስጥ ያለውን የስኳር መጠን ለማስተካከል በተለይ የሰውነት ህዋሶች ኢንሱሊንን በተገቢው መንገድ ተቀብለው

እንዲጠቀሙበት ለማስቻል እንዲሁም የተመጣጠነና የተስተካከለ የሰውነት አቋም እና አዎንታዊ ስነልቦና እንዲኖረን ይረዳናል ። ጤናማ አመጋገብ የተመጣጠነ ጤናማ ምግብ ለጤናችን እጅግ ያስፈልገናል ። ጤናማ አመጋገብ ለልብ ህመምና ለሌሎች ተላላፊ ህመሞች የመጋለጥን ስጋቶች ይቀንስልናል ።

ሌሎች ተያያዥነት ያላቸው አጋላጭ ሁኔታዎች የሚከተሉት ናቸው ፡-

ሲጋራ ማጨስ፡- ሲጋራ ማጨስ ለተለያዩ ህመሞች ተጋላጭነት በመጨመር ረገድ ተወዳዳሪ የለውም ። በስኳርም ህመምና ከስኳር ህመም ጋር ተያይዘው ለሚመጡ የጤና ጉዳዮች መጋለጥ ብቻም ሳይሆን ሲጋራ ማጨስ በሆድ አካባቢ የስብ ክምችት እንዲኖር በማድረግ የሰውነት ህዋሶች ኢንሱሊንን መቀበል እንዲያቆሙ ያደርጋል ። ሲጋራ የሚያጨሱ ሰዎች ማጨስ እንዲያቆሙ ይመከራል ። ሲጋራ ማጨስ በምናቆምበት ጊዜ የሰውነት መጨመር ቢያጋጥመን ቢችልም ይህንን ጤናማ አመጋገብ በመከተል ማስተካከል እንችላለን።

ጭንቀትና ድብርት ፡- ከስኳር እና ከልብ ህመም ጋር ግንኙነት እንዳላቸው ጥናቶች ጠቁመዋል ።

የእንቅልፍ ስርዓት መዛባት ፡- አጭር የእንቅልፍ ሰዓት ማለትም ከ ስድስት ሰዓት ያነሰ በተቃራኒው ደግሞ ረጅም የእንቅልፍ ሰዓት ማለትም ከ ዘጠኝ ሰዓት የበለጠ ለ ሁለተኛው አይነት የስኳር ህመም ከሚያጋልጡ መንስኤዎች መካከል እንደሆኑ የቅርብ ጊዜ ጥናቶች ዕድልላክቱ ነው ። የእንቅልፍ መብዛት የምንመገበው ምግብ እንዲፈጭ የሚያገለግሉ ንጥረቶች እንዲዛቡ ያደርጋል ። ለረጅም ሰዓት መተኛት ለድብርት ወይም የእንቅልፍ ሰዓት የአተነፋፈስ ሂደት መዛባት ምልክት ሊሆን ስለሚችል የህክምና እርዳታ የሚያስፈልግ ጉዳይ ሊሆን ይችላል። ከመጠን ያለፈ ውፍረት እና የእንቅልፍ ሰዓት የአተነፋፈስ ስርዓት መስተጓጎል ጥብቅ ቁርኝት አላቸው ።

2. Healthy eating plan

የተከለከሉ የምግብ ዓይነቶች

ከወተትና የወተት ተዋፅኦ - ሙሉ ቅባት ያለው ወተት፣ የረጋ ወተት

ከአይብና ፎርማጆ አይነት - ጠንካራ ቢጫ ፎርማጆ

ከስጋ ተዋፅኦ - ጮማ ያለበት ስጋ፣ የዳክዬ ስጋ ጉበት፣ ከላሊት ምላሽ ፣ የክበት ብልቶች፣ ቅመምና በጨው ታከተው ቀዝቅዞ የሚበላ የሾርባ ምግብ፣ በእንፋሎት የደረቀ የአሳማ ስጋ፣ በከፊል የበሰለ የስጋ ተዋፅኦ ፣ ተጠቅልለው የተጠበሱ አሳማ ስጋ ውጤቶች

ከዓሣ የምግብ አይነት - ዓሣ የማይመስሉ የባህር እንስሳዎች ፣ የሚበላ ሸርጥ አሳ፣ ሎብስተር፣ ክራብስ፣ የተጠበሰ የዓሳ ውጤት

ከእንቁላል የምግብ ዓይነት - በዘይት የተጠበሰ እንቁላል

ከቅባት ተዋፅኦ - ንፁ ቅቤ ፣ የአሣማ ጮማ ፣ ደረቅ የዳቦ ቅቤ፣ ለመጋገር ሆነ ለሌላ ምክንያቶች የምንጠቀምባቸውን ቅቤ ይጨምራል።

ከፍራፍሬ አይነቶች - ኮኮናት/የዘንባባ ገውዝ

ከአትክልት አይነቶች - በዘይትም ሆነ በቅቤ የበሰሉ አትክልቶች

ከሾርባ ምግብ - የስጋ ፣ አጥንት፣ የእንጉዳይና የቲማቲም ሾርባዎች

ለስለሳ /የታሽጉ ምግቦች / ስኳር ላቸውን ማንኛውም ለስላሳ ቸኮሌትና የወተት ጁስ

ከተለያዩ የምግብ ዓይነቶች - ቶሎ የሚደርሱ ምግቦች፣ በርገር ፣ፒዛ ፣ድንች ፣ ጥብስ ፣ ሳምቡሳ

የተፈቀዱ የምግብ አይነቶች

ከወተትና የወተት ተዋፅኦ - ቅባታቸው ከውስጣቸው የተወገዱ ወተት እና እርጎዎች

ከአይብና ፎርማጆ የምግብ አይነቶች - ቅባት የሌለው ፎርማጆ

ከስጋ አስተዋፅዖ - ቀይ በቀጭኑ የተቆረጠ ስጋ፣ የዶሮ ቆዳን ሳይጨምር የዶሮ ስጋ ፣ የሶያ ውጤቶች የለውዝ ውጤቶች ፣ ምስር

ከዓሣ የምግብ አይነት - ነጭ የሆነ ዐሳ ፣ ትልቅ ስጋው የሚበላ ዓሳ (ሳልሞን)፣ትንንሽ አሣዎች(ሰርዲን)

ከእንቁላል የምግብ አይነት - የተጠበሰና የተቀቀለ እንቁላል በሣምነት ውስጥ ከሁለት ወይም ከሦስት ጊዜ ያልበለጠ

ከየተክል ተዋፅኦ - አጃ ፣ በቆሎ፣ ስንዴ (ፓስታ) ፣ ሩዝ፣ ስራስር ምግቦች(ድንች ፣ ቀይስር)

ከፍራፍሬ አይነቶች - ጊዜው ያላለፈ ማንኛውም ፍራፍሬ

ከአትክልት አይነቶች - ጊዜው ያላለፈ ማንኛውም አትክልት (ፍሪጅ የቀዘቃ)

ከሾርባ አይነት- የአትክልት ሾርባ (የባቄላ) (የምስር) (የገብስ)

ለሰላሳ (የታሸጉ ምግቦች) አይነቶች - ከስኳር ነፃ የሆኑትን ብቻ

ከቅባት (ጮማ) አስተዋፅዖ - የማይረጉ ፈሳሽ ቅባቶች

የገንቢ ምግብ

የተክል ተዋፅዖ

ከቅባት

ስጋ

ዳቦ

የማይረጉ ፈሳሽ ቅባቶች

ዓሣ

ሩዝ

ባቄላ

ፓስታ

ምስር

ድንች

ወተት

አጃ

አይብ/ፎርማጆ/

ማሸላ

እርጎ

ስንዴ

እንቁላል

በቆሎ

ለውዝ

ገብስ

ዶሮ

የሰር ተክል

ዱባ

የተክል ዘሮች

ጤፍ

ሀይል ሠጪ

እህል - ስንዴ ፣ ባቄላ

ጥራጥሬ /ፍሬ/

በቆሎ

ወተት/እርጎ/

የአትክልት ዘሮች

ፍራፍሬ

- ፖም
- ሙዝ
- ወይን
- ብረቱካን
- ኮከ
- ዘቢብ
- መንደሪን
- ፕሪም
- የወይን ፍሬ
- ሃብሃብ
- ትንሽ ማንጎ
- ፓፓያ

በምግብ ውስጥ ያለን የቅባት መጠን ለመቀነስ የሚደረግ የምግብ አዘገጃጀት ወተት :- ቅባትነቱ ከውስጡ የወታን የወተት ተዋጽኦ መጠቀም
 ቅባት:- ምግቦችን ከቅባት ነፃ ወይም መጠኑ ባነሰ መንገድ ማዘጋጀት።

ለምሳሌ:- ከስጋ ላይ ቀድን ብቻ መርጦ መጠቀም

በደረቁ መጥበስ፣ መቀቀል፣ በእንፋሎ መጥበስ፣መጋገር ወይም ቅባት ሳይኖረው መጥበስ ቆንጆ የሚበሉ የምግብ ማብሰያ ዘዴዎች ናቸው።

ምግቦችን ለማብሰል ልንጠቀምባች የሚመከሩ ዘይት ዓይነቶች

- የማይረጉ ፈሳሽ ቅባቶች
- በፍፁም የማይረጉ የአትክልትና የጥራጥሬ ተዋፅዖ የሆኑ የዘይት አይነቶች
- ከወይራ ዛፍ እና ከለውዝ ተዋፅኦ የተገኙ የዘይት አይነቶች

ዓሳ :- ዓሳውን በደረቁ ያለዘይት ጠብሶ በሎሚ ጁ መቀበታና ከተቻለብንሽ የዳቦ ቅቤ ቀብቶ መጋገር

ከዛም በቲማቲም፣ ከሽንኩርት ሰይም ከተመሳሳይ አትክልቶች ጋር አድርጎ መመገብ።

አትክልት:- የተቀቀሉ ወይም በእንፋሎት የበሰሉ አትክልቶችን ምንም አይነት ቅቤ ፣ የስኳር ማጣፈጫ ወይም ዘይቶችን ሳይጨምሩ መጠቀም

ቀይሽንኩርት፣ ነጭ ሽንኩርት እንዲሁም ሌላ ቅመማ ቅመሞችን መጠቀም ይቻላል።
 ጥብስ ቅጠል እንዲሁም ቀረፋ ካሮት ላይ መጠቀም የተለያዩ ቃና ለምግብ ይፈጥራል።

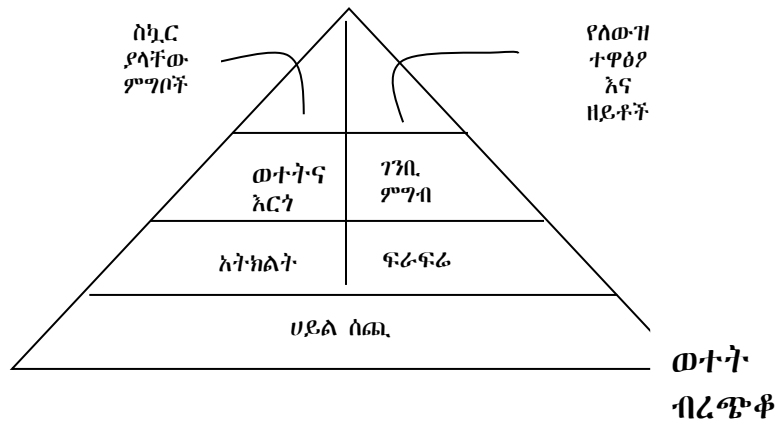
ድንች :- ድንችን መጋገር ፣ መቀቀል ወይም በእንፋሎት ጠብሶ መመገብ።

ድንችን ቅባቱ በወጣለት ወተት ጋር ጨፍልቆ በመቀላቀል በእጅቶ ወይም በሎሚ ጋር መመገብ ይቻላል።

ማጣጣሚያ :- /ተከታታይ ምግብ/

ትኩስ አዲስ የተቀነጠሱ ንፁህ ፍራፍሬዎችን አስፈላጊ ከሆነ ቅባት ከሌለው አርጎ ጋር መውሰድ ታሽገው የሚሸጡ ኬኮችንም ሆነ ብስኩቶችን መውሰድ አይቻልም።

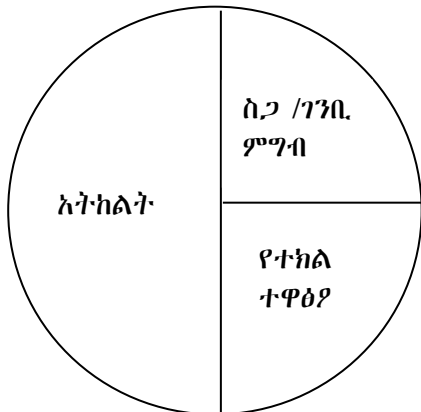
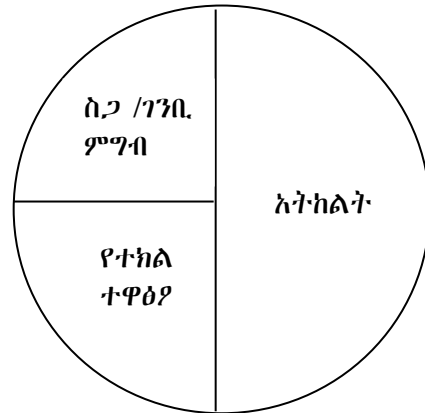
በሥህን የተሰራ የምግብ አወሳሰድ



1

ቁርስ

ምሳ እና እራት



ፍራፍሬ 1

ወተት 1 ብርጭቆ