Shendi University

Faculty of Graduate Studies and Scientific Research

Research about

Designing and Application of training program for nurses to teach diabetic patients self care practice

A thesis submitted for fulfillment of Ph-D in medical surgical nursing

Submitted by/

Higazi Mohammed Ahemd Abdallah Awad

Supervised by/

Dr / Hayat Fadllalah Mukhtar

Associate professor of medical surgical nursing

Karrari University

2012

الآية

قال تعالي

﴿ وَقُلِ اعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ وَسَتُرَدُّونَ إِلَى عَالِمِ الْغَيْبِ وَالشَّهَادَةِ فَيُنَبِّئُكُمْ بِمَا كُنْتُمْ تَعْمَلُونَ ﴾

(التوبة:105) صدق الله العظيم

Dedication

To my Family my parents

brothers & sisters.

To my wife (Salma)

To my kid Remaz

To my collages

Who have been the winds

beneath my wings until I

completed this work?

Acknowledgement

I would like to express my gratitude to all those who gave me the possibility to complete this thesis.

I want to thank the all staff of Elmek Nimer hospital for giving me permission to commence this thesis and the staff for their participation in this study.

I am deeply indebted to my supervisor. Dr. Hayat Fadllalah Mukhtar from the Karrari University whose help, stimulating suggestions and encouragement helped me in all the time of research for and writing of this thesis.

My former colleagues from the faculty of high nursing – Shendi University whom supported me in my research work. I want to thank them for all their help, support, interest and valuable hints. Especially I am obliged to Dr Nabila Hassan, Us/ Ahmed Bagy, Us/ Mohammed Jebra Eldar, Us/ Limya Eltyb, Us, Najwa Risig, and Us, Mariam. I also want to thank Miss Widad Bushra for all her assistance on the ministerial computer.

Abstract

Diabetes Self-Management Education (DSME) is the cornerstone of management for all individuals with diabetes who want to achieve successful health-related outcomes.

This study was Quasi interventional study that had been conducted in Sudan, Shendi locality at Elmek Nimer diabetic outpatient clinic to apply a training program for nurses about self practice for diabetic patients in order to evaluate the impact of the program on nurses and patients self management skills and knowledge from the period extended from June 2008 to September 2011.

In this study two hundred diabetic patients and forty nurse were included, and the data was collected in three phases before implementation of the education program (pretest data), in which the questionnaire was distributed for nurses and each one was allowed sufficient time to fill it. Then each nurse was observed by checklists for their skills. After collection of pretest data the nurses were received the training program, the training was continued for one month and half, then information's had been taken from patient`s after explanation the purpose of the study, then the researcher filled the interview questionnaire, and then each patients was observed by simplified checklist regarding foot care, how to perform exercise, diet control, and using of insulin.

The study showed that, the mean of nurses knowledge pre intervention was 28.5(71.25 %) regarding insulin administration, 21.3(53.25%) about foot care, 20(50%) for diet regiment program, while 22.8 (57 %) regarding application of exercise. the present study indicated that, nurse knowledge had been improved during the post test evaluation to be better. Concerning the practical issues of nurses the

study showed that the mean of nurses practice pre intervention regarding teaching patients about exercise regiment was 15(37.5%), diet control 31.1(77.75%), foot care 26.3(65.75%), and insulin administration 25(62.5%),these findings has been improved to be more skillful while teaching patients these elements.

Furthermore the study show that the mean patients knowledge before implementation of the program had been inadequate regarding insulin administration 36.8(18.45%), exercise program 63.8 (31.9%), foot care 74(37%),while they have better knowledge about diet regiment program 131.3(65.65%). More over the practical background of the patients pre intervention had been very weak because the mean of patients skills regarding insulin administration 72(36%), exercise program 34.1 (17.05%), foot care 58.6(29.3%),while they have adequate knowledge about diet regiment program 77.3(38.65%).but their skills had been improved during the post test evaluation and follow-up phase.

The study reveal, supports and justifies the effectiveness of diabetes education and behavioral interventions in improving knowledge and skills of the patients by using intense educational program supported by simplified hand book. Nurse's skills and knowledge had been gradually improved during the study period and these reflect on patient's attitude and knowledge. Patients were distributed equally in Shendi town and other rural area, and this may be due to facilities of transportation or absences of diabetic centers.

Finally , the study recommend that, nurses should be encourage, motives, trained by continuing nursing education program, to be skillful in order to improve and change patient's skills and knowledge. The program have to be implemented in Naher EL Neel state then around the whole country under the responsibility of ministry of health

ملخص البحث

إن الركيزة الرئيسية في علاج مرض الداء السكري هو التعليم، والذي ثبت أنه يساعد بشكل كبير على التقليل من مضاعفات المرض سواء المضاعفات الحادة أو المزمنة، ويعتبر التثقيف الصحي أكثر الوسائل فعالية .

اجريت هذه الدراسة بالسودان بولاية نهر النيل محلية شندي بغرض تطبيق برنامج للممرضين الذين يقدمون الرعاية لمرضي الداء السكري عن الرعاية الشخصية في الفترة من يونيو 2008 حتي سبتمبر 2011م. و ذلك للتاكد من مدي فعالية هذا البرنامج في تغيير نمط و سلوك المرضي مما ينعكس ايجابا في ضبط و تنظيم مستوي السكر في الدم و منع حدوث المضاعفات.

تم جمع المعلومات عن طريق تصميم استبيان قياسي مغلق الاسئلة و قائمة تحقق عن كيفية العناية بالقدم ,التمارين الرياضية , تنظيم الغذاء , و طرق تجهيز وحقن الانسولين لتقييم مهاراتهم و قدراتهم في كيفية تعليم المرضي,و شملت الدراسة الممرضين العاملين بمستشفي المك نمر الجامعي و عددهم اربعين, و المرضي المصابين بالنوع الاول من السكري و عددهم مائتان , حيث جمعت المعلومات في ثلاث مراحل :في المرحلة الاولي تم جمع المعلومات من الممرضين بواسطة الاستبانة المعدة لذلك ثم تم ملاحظتهم بواسطة قائمة التحقق الخاصة بطرق العناية بالقدم , كيفية إعطاء الانسولين , النظام الغذائي , و طرق تطبيق التمارين الرياضية اثناء تدريبهم المرضي ,بعدها تم جمع المعلومات ا لاولية من المرضي ثم مراقبتهم في كيفية العناية باقدامهم , إعطاء الانسولين , النظام الغذائي , و طرق تطبيق التمارين الرياضية. في المرحلة الثانية تم تطبيق البرنامج علي الممرضين في مدة شهر ونصف حيث تم تقسيمهم لاربعة مجموعات صغيرة بواقع درسين في الاسبوع لمده شهرو نصف ثم تم تعليم المرض في مجموعات صغيرة لمدة اربعة اشهر بواسطة الممرضين , المرحلة الثالثة شملت جمع المعلومات من المجموعتين بنفس خطوات المرحلة الاولي و تكررت بعد اربعةاشهر .

ثم تم تحليل البيانات بإستخدام برنامج التحليل الحزمي للبيانات الحيوية بالحاسوب و توصلت الدراسة الي عدة نتائج اهمها ,المستوي المعرفي للممرضين تحسن تدريجيا خلال مراحل البحث مما انعكس ايجابا في تحسن المستوي المعرفي و السلوكي للمرضي , حيث كان مستوي المعرفة ضعيف لدي المرضي قبل تطبيق البرنامج و كذلك السلوك لذا اثبتت الدراسة اهميتها و فعاليتها في تغيير نمط الحياة لمرضي الداء السكري بإختلاف مستوياتهم التعليمية و المعيشية و الجغرافية.

و توصلت الدراسة الي عدة توصيات تمثلت في ضرورة التوسع في طبيق البرنامج ليشمل كل المرضي المصابين بالداء السكري بالولاية ثم علي مستوي السودان تحت رعاية وزارة الصحة الاتحادية, إضافة الي العمل علي تحفيز و تشجيع الممرضين للمواصلة في ادائهم بكفاءة عالية عن طريق تفعيل نظام التدريب المستمر .

List of abbreviations

Abbreviations	Meaning
DSME	Diabetic self management education
WHO	World health organization
A1C	Glycosylated hemoglobin, formerly known as HbA1C
DM	Diabetes mellitus
DHC	Diabetes health care
UK	United kingdom
ADA	American Diabetes Association
SMBG	Self management of blood glucose
HPLC	High performance liquid chromatography
NPH	Neutral protamine hagedorn
NPL	Neutral protamine lispro
DNA	Deoxyribonucleic acid
HDL	High -density lipoprotein
DCCT	Diabetic control and complications
VLDL	Very low-density lipoprotein
MDI	Multiple daily injection
TDI	Total daily insulin
BID	Twice daily
CSII	Continuous subcutaneous insulin injection
VIDS	Variable insulin dose scale
MRI	Magnetic resonance image

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Introduction

Diabetes mellitus is a chronic systemic syndrome characterized by hyperglycemia and disorder of carbohydrates, fat and protein metabolism. It was caused by disturbance in production, action, or metabolic rate of utilization of insulin hormone, which is secreted by beta cell in the island of langerhans in pancreas.[1,3]

Diabetes is an important health problem for the aging population; at least 20% of patients over the age of 65 years have diabetes. The number of older persons with diabetes can be expected to grow rapidly over the coming decades.[4]

Approximately three-quarters of all newly diagnosed cases of type 1 diabetes occur in individuals younger than 18 years of age. Care of this group requires integration of diabetes management with the complicated physical and emotional growth needs of children, adolescents, and their families. Diabetes care for children of this age group should be provided by a team that can deal with these special medical, educational, nutritional, and behavioral issues. At the time of initial diagnosis, it is extremely important to establish the goals of care and to begin diabetes self management education. A firm educational base should be provided so that the individual and family can become increasingly independent in the self management of diabetes. Glycemic goals may need to be modified to take into account , the fact that most children younger than 6 or 7 years of age have a form of “hypoglycemic unawareness,” in that they lack the cognitive capacity to recognize and respond to hypoglycemic symptoms and may be at greater risk for the sequelae of hypoglycemia.

Sudan has, for a long time, suffered economic collapse, drought and civil war. Diabetes mellitus is currently emerging as an important health problem, especially in urban areas. The actual prevalence of diabetes is unknown although one small study showed a prevalence of 3.4%. Diabetes is the commonest cause of hospital admission and morbidity due to a non-communicable disease (7 and 10% respectively). The problems of diabetes care in Sudan include the lack of efficient diabetes care centres, lack of specially trained personnel, the high cost of anti-diabetic treatments, poor compliance with therapy or diet, ignorance and wrong beliefs, food and dietary factors and gender-related problems. The goal of efficient diabetes care can be achieved through implementing a national diabetes program. This program should be responsible for personnel training, establishing model care centers, patients'

education, availability and affordability of insulin, scientific and clinical research and primary prevention.

The majority of people in Africa with diabetes are between 45 and 64 year of age. African diabetic patients are to 70-90% composed by type 2 diabetes and 25% type 1 diabetes. The prevalence of type 2 DM in the adult population ranges from 0% in Togo to 10.4% in Northern Sudan, and the prevalence of type 1 DM in all ages ranges from 0.3/1000 in Nigeria to 0.95/1000 in Sudan .[5]

Diabetes in Africa is more often taking a severe course and shows high rates of acute and chronic complications and a poor outcome.

In England about 2% of people currently have diabetes mellitus , and this represent increase with age as about 5% of people over 65 years are diabetics.[5] The average prevalence of diabetes mellitus above the age 10 years allover Egypt has been estimated to 4.3% with distinct geographical differences,5.7 % in urban areas and 4.1% in rural agricultural areas.[6]

During the last century there is an increase in the number of people with chronic illness , so the role of patient is changing from passive to active participation in care management , and new trends emphasize self – care especially on life long disease.[8] Because uncontrolled diabetes can lead to different types of macrovascular complication as coronary artery disease , cerebrovascular disease and peripheral vascular disease , as well as many microvascular complications or microantipathy which have main clinical categories such as retinopathy that can lead to blindness , nephropathy which can lead to kidney failure, and neuropathy affecting either peripheral or autonomic nerves.[7]

Orem defined self care as the practice of activities that individuals personally initiate and perform on their own behalf in maintaining life health and wellbeing. Further more, Meleis, Algleton, and Rouke [14, 15] defined self care as an adult's personal continues contribution to his own health and wellbeing. [14, 15]

Rational

Diabetes mellitus is one of the common endocrine diseases affecting all age groups with over one million people in the United Kingdom (UK) having the condition. Effective control and monitoring can reduce mortality and morbidity. Much of the management and monitoring of diabetic patients, particularly patients with Type 2 diabetes is undertaken by the general practitioners and members of the primary care team.

Successful diabetes care depends on the daily commitment of the person with diabetes mellitus to self-management through the balance of lifestyle and medication. Diabetes care should be organized around a multi- and interdisciplinary diabetes healthcare (DHC) team that can establish and sustain a communication network between the person with diabetes and the necessary healthcare and community systems. Both the organization and delivery of diabetes care should be comprehensive, according to evidence-based clinical practice guidelines, equitable in access and continuous throughout a person's life time. Where possible, diabetes programs and services should be culturally appropriate, community based and respectful of age, gender and socioeconomic conditions.[8]

Within a model of chronic disease, diabetes care should be patient centered and focused on self-management'. It is most effective when delivered in a manner that provides ongoing education and comprehensive care together as essential components. It can be enhanced through the use of a variety of educational and behavioral approaches as well as community supports. The timeliness of referral for self management education should be based on the severity of presenting symptoms, the degree of metabolic control and the person understands of immediate survival and safety skills and long-term management practices.[8]

Diabetes education is effective in enhancing knowledge, skills and behavioural change. It has been shown to improve self-care and clinical outcomes. It should be interactive, solution focused and based on the experiences of the learner, as well as staged and tailored to meet individual needs and abilities. Group education and sustained, long term follow-up have both been shown to enhance knowledge and produce positive outcomes.[9]

Self-management support programs assume a complex sequence of effects. Developers expect these programs to change patients' behavior by increasing the patients' self-efficacy and knowledge. Improved behavior is expected to lead to better disease control which should, in turn, lead to better patient outcomes and reduced utilization of health care services, particularly preventable emergency room visits and hospitalizations, and ultimately to reduced costs. This sequence of assumptions gives self-management support programs multiple objectives and multiple endpoints for evaluation. The pivotal objective, however, is to change people's behavior.

Most individuals need help and encouragement to actively participate in their care and successfully perform a variety of tasks. So-called "self-management support" is "the systematic provision of education and supportive interventions by health care staff to increase patients' skills and confidence in managing their health problems, including regular assessment of progress and problems, goal setting, and problem-solving support.

So, the professional nurse has the challenge and responsibility to help patients gain the knowledge, skills and attitudes necessary for self care .[17] For assuming this responsibility the nurse must assess self care activities of diabetic patient to detect, delay and mange the complication when it occurs.

Objectives

General objective:-

To examine the effectiveness of the program on patients and nurses knowledge and practice

Specific objectives:-

- To evaluate nurses knowledge, and practice in relation to patient education about self care practice regarding diet regiment , foot care , exercise and medications
- To develop a patient self-management training and assessment program, successful completion of which will equip patients with the knowledge and skills needed to actively participate in managing their diabetes
- To apply an educational program about self care practice among group of nurses to trained diabetic patients.
- To examine the impact of the educational program on patients knowledge and practice.

2-Education of diabetic patient

Education is a lifelong process and an opportunity to improve self-care techniques and to recognize the onset of complications. Accesses to printed educational materials and to the services of skilled diabetes nurse educators will help facilitate this process. Access to diabetes educational materials on the Internet is increasing, and providing advice about the most reliable sites for information can be an important part of the educational process. The diagnosis of diabetes, either type 1 or type 2, is a difficult time emotionally for the patient, and the physician must be a source of encouragement as well as a provider of treatment. The family should participate in the educational process as much as possible. In adults with diabetes, involving the spouse in the educational process can be very rewarding; however, the patient must be encouraged to accept responsibility unless there are mitigating conditions. The initial goals of education are to help the family understand the basic Pathophysiology of diabetes and the differences between the insulin-dependent and non-insulin-dependent forms.[5, 8]

Diabetes education has been criticised for focussing on assessing improvements in knowledge. Nonetheless, it is now widely agreed that, knowledge alone is not sufficient to effect behaviour change, it is a vital prerequisite to such changes. The main goals of diabetes patient education have been expressed as promoting selfmanagement that in turn may lead to long-term diabetes control to reduce associated morbidity and mortality, and to help people with diabetes balance short and long-term quality of life against the burden of daily intensive self-management.

So, diabetes educators help diabetic patients to learn about the effect of food on blood glucose and sources of carbohydrates, protein, and fat, make healthy food choices, adjust portion sizes, read labels, count carbohydrates, and plan and prepare meals. Diabetes educators and their patients collaborate to address barriers, such as physical, environmental, psychological, and time limitations. They develop an appropriate activity plan that balances food and medication with the activity level. Diabetes educators can instruct patients about self-monitoring blood glucose equipment choice and selection, timing and frequency of testing,

target values, and interpretation and use of results. Patients are taught to regularly check their blood pressure, urine ketones, and weight, as appropriate.9

The goal is for the patient to learn about each medication, including its action, side effects, efficacy, toxicity, prescribed dosage, appropriate timing and frequency of administration, effect of missed and delayed doses, and instructions for injection, storage, travel, and safety. Collaboratively, diabetes educators and patients address barriers, such as physical, emotional, cognitive, and financial obstacles, and develop coping strategies. Also diabetes educators assist patients in gaining knowledge about standards of care, therapeutic goals, and preventive care services to decrease risks. Skills taught include smoking cessation, foot inspections, blood pressure monitoring, self-monitoring of blood glucose, aspirin use, and maintenance of personal care records. And they can identify the patient's motivation to change behavior, and then help the patient set achievable behavioral goals, address barriers, and develop coping skills. 9

Education and ongoing support process

The overall objectives of DSME are to support informed decision-making, self-care behaviors, problem-solving, healthy coping and active collaboration with the health care team and to improve clinical outcomes, health status, and quality of life. While there is no one "best" education approach, programs that incorporate behavioral and psychosocial strategies demonstrate improved outcomes.10

The overall objectives of DSME are to support informed decision-making, self-care behaviors, problem-solving, healthy coping and active collaboration with the health care team and to improve clinical outcomes, health status, and quality of life. While there is no one "best" education approach, programs that incorporate behavioral and psychosocial strategies demonstrate improved outcomes.

Communication strategies

Effective communication can improve self-efficacy, support patients' behavior change efforts, and facilitate healthy coping. Effective strategies such as motivational interviewing are designed to assist patients to identify their own concerns, supports, and challenges and strategies to overcome barriers.

Conversation maps are self-discovery learning tools that can help engage patients around self-management issues.10

Self-management training

Diabetes educators and other health care team members provide DSME to address the educational, clinical, behavioral, and emotional needs of the individual patient in a supportive environment. Using a patient-centered approach engages the patient in active collaboration with the diabetes team and enables the patient to create a workable self-management plan based on age, school, or work schedule, as well as daily activities, culture, religious practices, competing priorities, family demands, eating habits, physical abilities, and health problems. These experts are able to help the patient achieve the highest possible level of self-care and quality of life.10

Nurse Managers and prescribers must explicitly support the patient-teaching role of the inpatient nurses upon their employment, by providing the resources they need and rewarding their efforts.8 Continuing education for nurses during new employee orientation and periodically thereafter can include information applicable to ambulatory care, as well. This will allow hospital nurses to convey accurate information to patients regarding their care after discharge. Continuing education offerings afford an opportunity to address the additional barriers for nurses who want to improve outcomes for their patients with diabetes.38

Various types of additional support are also needed to ensure that quality care is ongoing. Medication delivery systems, nutrition services, and other hospital functions must become more technically supportive to nurses at the bedside to allow efficient use of their time. Today, most hospitals use a combination of inpatient and outpatient educational services, especially if there is a formal outpatient educational system in place locally. Some home health agencies recognizing discharge trends have developed ADA nationally recognized educational programs to fill this need.

At a minimum, inpatient nurses should receive procedural and institution-specific diabetes care educational updates supported by their institutions.36

Dozens of tools and methods have been developed for keeping staff nurses informed. However, it seems we might consider the lessons from our diabetes patient education experience. It has not been sufficient to ensure that patients (or nurses) are knowledgeable. Additional strategies are needed if behavior change is expected. Hospital care systems need revamping to deliver better diabetes care.

The potential benefits of an effective patient education programme for people with type I diabetes include:

- Improving knowledge, health beliefs, and lifestyle changes.
- Improving patient outcomes, e.g. weight, hemoglobin A1c, lipid levels, smoking, and psychosocial changes such as quality of life and levels of depression.
- Improving levels of physical activity.
- Reducing the need for, and potentially better targeting of, medication and other items such as blood testing strips

Patients with type 1 diabetes and their families learn basic skills necessary for the patient's survival. Such necessary skills include (a) insulin administration; (b) blood glucose and testing for urine glucose and ketones; (c) food intake for exercise; and (d) sick-day care and prevention of ketoacidosis and treatment of hypoglycemia.[1,3]

Patients with type 2 diabetes are taught similar skills, although the emphasis is very much on the nutritional program and weight control. It is important for patients to realize that the loss of weight up to (10 to 20 lb) can be very beneficial for overall glucose control.

The ability to self-monitor blood glucose also is important in these patients. Exercise helps obese patients lose weight, and if they request more than a simple exercise prescription, it is appropriate for the physician to refer them to an exercise physiologist. Care should be taken in prescribing vigorous exercise programs to older patients, especially those with diabetic complications such as neuropathy or retinopathy. There is also the issue of coronary disease and silent

ischemia. If a question arises about the presence of coronary artery disease and whether exercise can be undertaken with safety, the patient should be referred to a cardiologist for appropriate testing. A study showed that in (37) of 203 patients with type 1 or type 2 diabetes noted that 20.9% of male patients with type 2 diabetes had silent myocardial ischemia with significant lesions on cardiac catheterization[56]. The authors thus recommended routine screening for men with type 2 diabetes of more than 10 years' duration or even less for those with more than one cardiovascular risk factor. Once the patient is cleared for an exercise program, he or she should exercise three to four times a week for at least 30 minutes for the program to be benefit.

Those patients who will be receiving oral hypoglycemic therapy must become knowledgeable about the action of these medications and their adverse effects. They also must understand that many patients will fail to respond to these agents with time and will need insulin therapy. When medication is prescribed, it is essential not only to instruct patients on how to take the pills but also to counsel them on when to stop taking them to avoid potentially serious adverse side effects. This is very important, because the number of new medications for diabetes has increased rapidly and, for many of them, we do not know the long-term effects.[1, 2, 3]

2-1-Clinical Goals

It is evident that the type of diabetes influences the form of therapy chosen. In the patient with new-onset diabetes who has acutely decompensated type 1 diabetes or in the patient with previous diagnosed diabetes who is in poor control, the goals will include (a) elimination of ketosis; (b) elimination of symptoms of hyperglycemia such as polydipsia, polyuria, vaginitis, fatigue, and visual blurring; (c) restoration of normal blood chemistry values; (d) regaining of lost weight; and (e) restoration of sense of well-being. At this time, the emphasis for patients with previously diagnosed diabetes is on restoring those behaviors that will improve diabetes control and that will allow them to once again fully participate in their care. Glucose control at this time is directed toward getting patients to monitor their blood glucose,

to improve adherence to prescribed medications, to become more confident at administering insulin, and to gather data on the patterns of glucose testing. This information becomes very important when one is working with the patient to plan the changes in insulin dosage and timing that will ensure that the glycemic goals set will be achieved.[4, 1, 8]

Once the initial goals have been met, one can proceed to work on the plan necessary for long-term success. The general aim is the maintenance of health and well-being through control of the disease. It is important not to foster a lifestyle that is completely dominated by diabetes. Patients should control their diabetes and follow their desired lifestyle as much as possible. This is not always easy to accomplish, especially in patients with very unstable or “brittle” type 1 disease. A minority of patients are severely incapacitated, and care must be taken to set realistic goals and promote behavior that is not self-deprecating. For many patients and parents of young children, working with a counselor, psychologist, or psychiatrist can help alleviate feelings of guilt and depression.

For young children the goals are the maintenance of normal growth and development. Again, the lifestyle should be as close to normal as possible, without diabetes becoming the focal point of the family's existence. Ideally, children should be comfortable at school, participate in sports, and socialize with their peers without being made to feel different.1

Marrying and having a family is important for young adults with diabetes. Helping women who wish to have children achieve a successful pregnancy is a very important aspect of diabetes care. Unless the physician has considerable experience in this area, it is preferable for the patient to be referred to a multidisciplinary team skilled in managing these high-risk pregnancies. However, all physicians should educate young women with diabetes on appropriate birth control methods and the importance of good glycemic control before conception.[1,2]

Underlying all these goals is the desire to control the diabetes optimally so that long-term microvascular and macrovascular complications can be minimized. Since there currently is no way to predict who will develop long-term

complications, it seems prudent to set a goal of optimal glycemic control, within the limits of safety, for all patients.

Assessment of the level of diabetes control is best accomplished by measuring biochemical parameters. Clinical indexes such as body weight, frequency of polyuria, polydipsia, number of hypoglycemic reactions, fatigue, and sense of well-being are important clinical parameters but can be misleading about the overall level of control. It is true that patients with very poor control often can be identified easily by their symptoms; however, patients whose fasting glucose levels are 140 to 180 mg/dL and postprandial glucose levels are 180 to 240 mg/dL can feel quite well and present a false clinical picture of satisfactory diabetes control. In the past, daily urinary glucose measurements and random office glucose tests were relied on. However, the accuracy of urine testing can suffer in the presence of a high renal threshold, renal disease, or bladder neuropathy, and these limitations are not eliminated by the use of a double-voided urine specimen. Testing for the presence of ketones is still best accomplished with a urine sample.

2-2-Self-Monitoring of Blood Glucose

Since its development, Self blood glucose monitoring has developed into a sophisticated monitoring system. A variety of glucose-monitoring devices are now available that give a digital readout of the blood glucose concentration. The devices continue to be improved, and the time required for the test to be completed is now as short as 5 seconds. In addition, the size of the blood samples required has decreased, and many meters use a direct activation system. Some of the newest meters allow blood sampling both from the finger and from the forearm, thereby reducing the overuse and callousing of the fingers. These devices appear accurate enough for routine use by patients. For convenience, mechanical lancet devices are available for obtaining blood. Some of the newer glucose monitors include computerized memory to record the blood glucose levels, and some can be used in conjunction with more elaborate personal computers. Special machines are available for visually impaired patients. One concern about SMBG is the accuracy of the recordings as compared with those obtained in the laboratories of large clinics or research settings that use more

sophisticated instruments. The patient may encounter many problems with SMBG in everyday use, even after receiving careful instruction on the technique by a diabetes nurse educator. One such difficulty involves the patient's ability to obtain a drop of blood, place it accurately on the reagent strip, and time the monitor carefully. Newer monitors that do not require wiping or timing and that allow the use of very small amounts of blood can help minimize these errors.

For Self blood glucose monitoring to be effective, its use must be accompanied by an educational program that helps the patient understand the factors affecting any particular blood glucose level and that provides appropriate options for corrections or adjustments. This knowledge is particularly necessary for patients involved in intensive insulin treatment programs.

There has been some discussion about the value of routine SMBG in patients with type 2 diabetes who are using diet or oral agents for control . Although these patients rarely will make treatment changes on the basis of information from SMBG, it can reinforce dietary principles and reveal the benefits of exercise and medication. Patients with type 2 diabetes who are receiving insulin should definitely use SMBG. Hypoglycemia occurs both in patients being treated with sulfonylurea drugs and those receiving insulin; in this setting SMBG can confirm a low glucose level and may help the healthcare provider adjust therapy on a more timely basis. The frequency of monitoring can easily be adjusted to the individual patient's needs and circumstances. SMBG is therefore an extremely valuable tool for daily diabetes management. The recent introduction of a subcutaneous continuous glucose-sensing monitor that can obtain a 3-day profile of blood glucose levels (240 readings) can be a very useful tool in selected patients. Such data can be very important in assessing the dose of preprandial insulin, in identifying unrecognized hypoglycemia, and in revealing the dawn effect.[3, 10, 11]

2-3-Glycosylated Hemoglobin Assays

In the last decade a number of studies on glucose control and diabetic complications have been completed, and all use HbA_{1c} as a surrogate marker for risk. The standards of care of the ADA were revised based on the fasting blood glucose level as well as on the HbA_{1c} from these studies. Currently, laboratories

can measure either the total glycosylated hemoglobin or the A_{1c} fraction. The latter is the test used in the large outcome studies. However, the assays have not been standardized, and because commercial laboratories use different methods, the reference ranges vary, making it difficult for the clinician to use the results if they vary constantly. Clinicians should use the same laboratory to measure A_{1c} in the same patient over time.

In normoglycemic subjects, a carbohydrate moiety is attached to a small proportion of hemoglobin A, thus creating what is called *glycosylated* or *glycated* hemoglobin . The glycosylated hemoglobin can be separated into three distinct fractions, which are designated A_{1a}, A_{1b}, and A_{1c}. Because of electrophoretic behavior of these minor hemoglobins, they are referred to as *fast hemoglobin*. The A_{1c} fraction is the most reactive site of the *N* -valine terminal of the B-chain, which accounts for 60% of the bound glucose.

In conditions of sustained hyperglycemia, such as in diabetes mellitus, the proportion of hemoglobin that is glycosylated increases substantially . This glycosylation is the result of posttranslational modification of hemoglobin A molecules; the binding of glucose is a nonenzymatic process that occurs continuously during the life of the red blood cell. Thus, the amount of glycosylated hemoglobin reflects the glycemic control of a patient during the 6- to 8-week period before the blood sample was obtained, given the average life span of a red blood cell of 120 days . The amount of glycosylated hemoglobin correlates well with fasting and postprandial blood glucose levels. Currently, the glycosylated hemoglobin can be measured by ion-exchange high-performance liquid chromatography (HPLC), affinity chromatography, and immunologic methods.

Glycosylated hemoglobin values must be assessed with caution in patients with unstable diabetes. Levels of blood sugar in these patients fluctuate from very low to very high on an almost daily basis, a situation that can lead to unwanted symptoms of hyperglycemia and dangerous episodes of hypoglycemia . A study by Brewer et al. suggested that using a pie-shaped graph of SMBG data with defined target-range parameters can aid patients and their families attain the desired HbA_{1c} goals. The authors set the target range for SMBG values for

different times of the day and then determined the number of values that needed to be within or above that range to achieve the desired HbA_{1c}. For young adults 17 to 35 years of age using a target range of 70 to 150 mg/dl, at least 38% of the values needed to be in the target range and no more than 48% above the range to achieve an HbA_{1c} of less than 8%. The assay of glycosylated hemoglobin should be done every 3 to 4 months, with the goal of adjusting therapy to obtain the lowest value that does not place patients at undue risk for hypoglycemic reactions. In patients who have reached a goal and are very stable, the test can be done every 6 months. However, it is important that the information obtained from the test be communicated to the patient to use to improve adherence to the prescribed treatment plan. At present the HbA_{1c} is the best surrogate marker we have for setting goals of treatment. Efforts are under way to standardize the procedure for measuring glycosylated hemoglobin. Ultimately, this would result in a certification process for manufacturers and thus ensure standardization of the results used by the healthcare professional in setting glucose control goals for their patients.[6, 7, 14]

2-4-Initiation of Therapy

For most adult patients, initiation of treatment is safely accomplished in the outpatient setting. Very young children and patients with diabetic ketoacidosis or severe, uncontrolled diabetes usually require hospitalization. Although the decision to use insulin usually is made by the physician, it is extremely important to explain the rationale to patients and to include them in the decision process. Many have an understandable fear of injections and often regard this therapy as an indication of the presence of a more severe form of the disease. Insulin therapy needs to be presented as any other treatment option, and patients should be made to understand that one, two, or three injections per day may be needed, depending on their response. The physician also should review the issue of control and complications and develop initial goals with the patient.

At the Clinic, the decision to start insulin therapy is followed by a referral to a diabetes nurse educator, who will instruct the patient or a family member on the techniques that will be required. Patients will administer their first injection at this time under supervision. This also provides an opportunity to teach

patients about the types of insulin available and their characteristic peaks and durations of activity and to review strategies for dealing with hypoglycemia and hyperglycemia. The present availability of very-fast-acting human insulin analogues, as well as a nonpeaking basal human insulin analogue, has increased the need to emphasize to patients the importance of coordinating the timing of meals and insulin injection according to the type of insulin used. The techniques for mixing regular with intermediate-acting insulins may be reviewed if the physician believes that these are appropriate insulin formulations for a specific patient. Premixed insulin [70% neutral protamine Hagedorn (NPH) and 30% crystalline zinc insulin or 75% neutral protamine lispro (NPL) and 25% lispro] can be used initially in patients who may not be able to master the mixing of insulins. This simplifies the treatment program, especially when patients have problems understanding and performing the mixing maneuvers. Furthermore, these premixed insulins are now available in prefilled syringes with a simple dose-dialing mechanism. In many cases, limitations in mixing insulins are due to problems such as cataracts, degenerative joint disease, previous cerebrovascular accidents, or severe neuropathy.

Most new patients who require insulin will receive human insulin of recombinant DNA origin. Allergy and lipoatrophy are uncommon with human insulins. Beef insulin and mixed beef-pork insulin should be avoided unless there are specific indications for their use or if human insulin is not available. These latter insulins are now being phased out in the United States. Patients also are instructed on SMBG at this time and are asked to maintain close contact with the nurse educator, who in turn reviews adjustments in insulin therapy and the patient's progress with the physician. In most patients, the blood glucose levels can be expected to be brought under control over a 4- to 6-week period. The patient often is seen several times within this interval so that the physician can monitor progress, modify therapy, and review any interim problems or concerns.

Most patients are not started on an intensive management program at this time, as it is necessary to allow the patient to adjust to the emotional and lifestyle changes that follow a diagnosis of diabetes. Intensive therapy with multiple daily injections or continuous subcutaneous insulin infusion is used for

women who plan a pregnancy, patients who cannot control their glucose levels by conventional therapies, or patients whose lifestyles or complications, especially hypoglycemic unawareness, demand the greater flexibility and control that intensive programs offer.

Patients with type 2 diabetes may require insulin when they are first seen, particularly if they are very symptomatic and have lost weight. In some instances, insulin can be discontinued when control is achieved and adherence to diet has taken effect. However, many patients will require insulin indefinitely; this becomes obvious when they become ketonuric and hyperglycemic with a reduction in insulin dose.

The basis of therapy in type 2 diabetes is to promote lifestyle changes with a nutritional program designed to reduce calories and encourage weight loss. An exercise program is an essential part of any effort to lose weight. Glycemic control can often be improved by caloric restriction alone, even before significant weight loss occurs. At the same time, it is also important to pay close attention to the risk factors for macrovascular disease. This means controlling lipids and hypertension and counseling on smoking cessation and the value of glucose control. Patients with type 2 diabetes also are taught SMBG, and the frequency of testing is individualized. SMBG is always the preferred method of glucose monitoring, with urine testing being used only in special situations.

The decision to use oral antidiabetic therapies is generally made after a trial of nutritional therapy unless the initial random glucose level is higher than 350 mg/dL. In general, a 4- to 12-week trial period of diet and lifestyle modification is reasonable, and if the fasting glucose concentration remains higher than 140 mg/dL or postprandial values are higher than 200 mg/dL, treatment with oral pharmacologic agents is initiated. The last 5 years have seen the introduction not only of new sulfonylureas but also of new nonsulfonylurea insulin secretagogues. The latter drugs are often more rapid acting than the sulfonylureas and may be very well suited in treating postprandial hyperglycemia. The biguanide metformin, which has been available in many parts of the world for decades, was introduced into the United States relatively recently. The α-glucosidase inhibitors offer another option for controlling blood

glucose levels, especially after meals. A totally new class of oral medication, the thiozolidinediones, also is available. Drugs in this class are novel insulin-sensitizing agents that work through specific nuclear receptors.

The physician now is presented with a number of choices and tries clinically to match the presumed underlying abnormality in the individual patient to a particular pharmacologic approach. Because type 2 diabetes involves a dual defect, the early use of combination therapy may be very advantageous. Customarily, the patient will start with a sulfonylurea or an insulin sensitizer. It is very important for the healthcare provider to be aware of the contraindications to the use of each drug as well the monitoring requirements to avoid serious adverse reactions. Failure of control with a single drug will result in the use of a combination regimen that can take advantage of the different mechanisms of action. Substitution of drugs from one class to another is rarely successful; however, the addition of a drug from another class often improves glucose control.

For every patient, diabetes management must include a careful nutritional assessment and the implementation of a *realistic* dietary program. The goal of nutritional therapy in type 2 diabetes is the control of blood glucose levels, normalization of lipid levels, and maintenance of ideal body weight. For young children with diabetes, the goal should be the maintenance of normal growth and development, as well as of a reasonable body weight.

In general, the dietitian will prescribe a meal plan based on the individual patient's type of diabetes and mode of treatment. Patients receiving exogenous insulin must pay particular attention to the timing of meals and snacks to prevent undue fluctuation of the blood glucose levels. The meal plan is individualized with respect to weight goals, personal food preferences, and exercise habits. Many obese patients with diabetes may require special weight-loss programs and behavior modification therapy to maintain weight loss. Unfortunately, most patients do not succeed in their efforts to lose weight and to maintain weight loss for prolonged periods.

Diet therapy often is referred to as the cornerstone of treatment. For the patient to benefit maximally from this aspect of patient management, a team

approach, which includes the services of a skilled registered dietitian, is recommended. Although these skills are not always available in physician's offices, they are offered in local community hospitals and by some dietitians in private practice.

Exercise plays an important role in diabetes management. For patients with type 1 diabetes, exercise should not be thought of as the major way of improving glucose control but rather as part of the overall approach to maintaining a healthy lifestyle. Physical activity can benefit the patient by lowering the blood glucose level if overall control is good. However, care must be taken to instruct the patient on the possibility of physical exercise provoking hypoglycemic reactions or worsening control when undertaken in the presence of higher blood glucose levels and ketonuria. Furthermore, patients with the complications of retinopathy and neuropathy can place themselves in jeopardy with excessive exercise.

In general, patients who are free of complications can engage in any type of exercise. Certain activities, such as scuba diving, have to be assessed in light of the certification requirements issued by appropriate organizations. Patients often may benefit from a consultation with an exercise physiologist. In patients with type 2 diabetes, an individualized exercise program should be part of the overall treatment plan. Exercise helps promote weight loss, optimize glycemic control, and reduce cardiovascular risk. These patients need to be screened for early neuropathy or peripheral vascular disease before they start an exercise program. Silent ischemia is more common in patients with diabetes than in the general population, and appropriate patients should have a stress test before starting the exercise program. Routine screening of men with type 2 diabetes of longer than 10 years' duration or less if they have more than one cardiovascular risk factor is recommended because of the high prevalence of myocardial ischemia with significant lesions among men with type 2 diabetes . The program should be done three to four times a week to be effective, with appropriate warm-ups, setting target exercise levels with monitoring of pulse rate and cooling-down time.[12, 15, 18,23,40,44]

2-5-Follow-up

A critical part of diabetes management is regular follow-up of patients. This is based on the goals established with the patient in the initial management plan. At each visit thereafter, the patient's progress is reviewed and ongoing problems are addressed. The frequency of visits depends on the individual patient, type of diabetes, goals of control, and other medical conditions. Patients starting insulin therapy need to be seen frequently initially, but once their condition has stabilized, they can be seen three to four times a year. In addition, patients are encouraged to maintain telephone contact with the other team members. Some patients with type 2 diabetes need to be seen only every 6 months.

As part of this follow-up process, an interim history is obtained, results of glucose monitoring are reviewed, and new problems or illnesses that affect diabetes control are addressed.

A comprehensive physical examination is done annually. At interim visits, previously abnormal findings are reevaluated and height, weight, and blood pressure are determined. For younger patients, an assessment of sexual maturation should be done. A complete, dilated eye examination by an ophthalmologist should be performed annually in all patients older than 30 years and in patients 12 to 30 years old who have had diabetes for more than 5 years.

A test for glycosylated hemoglobin should be done at least quarterly in patients with type 1 diabetes and semiannually in those with type 2 diabetes. The patient with adult-onset diabetes also may benefit from having either a fasting or postprandial glucose level checked as a means of judging overall glycemic control. A determination of fasting levels of triglycerides, cholesterol, and high-density lipoprotein (HDL) cholesterol should be performed annually and more often in patients with dyslipidemia. Urinalysis done at least yearly is useful. After 5 years of diabetes, patients should be tested for microalbuminuria yearly. If proteinuria is present, the patient's creatinine and blood urea nitrogen levels should be closely monitored; in addition, aggressive antihypertensive therapy and protein restriction should be considered.

At each visit the overall management plan, including the nutritional program and the exercise plan, is reviewed and modified as required. In addition, the overall emotional status of the patient is reviewed. This type of comprehensive care is extremely important for patients with a chronic, life-long disease such as diabetes. Many studies demonstrating the value not only of glucose control but also of risk factor reduction and cardiovascular disease have been published and incorporated into the routine approach to diabetes management. In addition, therapeutic choices have increased greatly, and therapy can now be based on the underlying pathophysiologic mechanisms of disease. The primary goal in treating patients with diabetes is to help them avoid short-term problems and long-term complications. A recent study of adults with type 1 or type 2 diabetes investigated cognitive representations of illness, self-regulation of diabetes, quality-of-life, and behavioral factors. The authors found that individuals' understanding of diabetes and their perceptions of control over the disease were the most important predictors of outcome . This reinforces the need to continue to provide ongoing self-education for patients and to provide them with the evidence, now available, that control of diabetes is possible and that complications can be avoided [16,27,42.,49].

2-6- Nutrition Therapy

Patients have identified “diet” as one of the most challenging aspects of their diabetes regimen. However, countless events have resulted in positive changes in nutrition science as it relates to diabetes. From the rigidly controlled, semistarvation diets in ancient times to the present “all-foods-can-fit,” we have arrived at nutrition science as we know it today—medical nutrition therapy.

One of the earliest references called diabetic diet was noted in a medical writing as far back as 1550 B.C., although for the first 3,500 years of diabetes history, no clear distinction was made between type 1 and type 2 diabetes. The writings recommended a diet high in carbohydrates, which included fruit, wheat grain, and sweet beer to stop the passing of too much urine. Aretaeus, a follower of Hippocrates, first used the name *diabetes* in the first century A.D. to describe the “melting down of flesh and limbs into the urine”. He concluded that diabetes was a disease of the stomach and should be treated with milk, gruel, cereals,

fruits, and sweet wines. Milk, water, wine, and beer were used as the main fluids to relieve excessive thirst until the second century A.D., when diabetes was thought to be a disease of the kidneys. At this time, restriction of fluids was recommended. By the sixth century, diabetes was thought to be directly caused by overeating and thought to be a disease of “sweet urine”. [1.2.6, 35, 41]

2-6-1-Goals of Nutrition Therapy

Attain and maintain optimal metabolic outcomes, including .Blood glucose levels as near normal as possible to safely prevent or reduce the risk for complications of diabetes .Optimal serum lipid profile to reduce the risk for macrovascular disease .Blood pressure levels that decrease the risk for macrovascular disease.

Prevent and treat chronic complications of diabetes by modification of nutrient intake and lifestyle for prevention and treatment of obesity, dyslipidemia, cardiovascular disease, hypertension, and nephropathy .Improve health through healthy food choices and physical activity.Address individual needs, such as personal and cultural preferences and lifestyle while respecting the individual's wishes and willingness to change.[1.6]

2-6-2-Goals in Type 1 Diabetes

The primary goals of therapy for persons with type 1 diabetes are as follows: Provision of an individualized meal plan based on usual food intake and lifestyle. This plan is used as the basis for integrating insulin therapy into the usual eating and exercise patterns. Consistency of carbohydrate intake to allow the synchronization of mealtimes with times of insulin action for persons receiving fixed insulin regimens. Determination of premeal insulin dose and postprandial blood glucose response by monitoring of blood glucose levels and adjusting insulin doses for the amount of total carbohydrate consumed for persons receiving intensive insulin therapy. Prevention of weight gain is desirable, with attention therefore paid to total caloric intake from carbohydrate, protein, and fat, for persons with improved glycemic control.

Adjustment of rapid- or short-acting insulin for deviations from usual eating and exercise habits is the preferred choice for prevention of

hypoglycemia. Additional carbohydrate may be needed for unplanned exercise.[6,35.]

2-6-3-Goals in Type 2 Diabetes

The primary goals of therapy for persons with type 2 diabetes depend on body weight and level of glucose control. Emphasis on lifestyle changes that result in reduced caloric intake and increased energy expenditure through physical activity for those who are overweight and insulin resistant .Achievement and maintenance of glucose, lipid, and blood pressure goals by reduction in dietary intake of carbohydrate, saturated fat, cholesterol, and sodium when necessary .Maintenance of moderate caloric restriction and a nutritionally adequate meal plan with a reduction of carbohydrate and total fat—especially saturated fat—together with an increase in exercise for those with excessive weight .Increase of activity and exercise to improve glycemia, decrease insulin resistance, and reduce cardiovascular risk factors.

Current medical nutrition therapy recommendations for overall health of persons with diabetes are the same as those for all. These guidelines include the following: Aim for a healthy weight, Choose a variety of grains daily, especially whole grains, Choose a variety of fruits and vegetables daily, Choose a diet that is low in saturated fat and cholesterol and moderate in total fat ,Choose beverages and foods to moderate your intake of sugars ,Choose and prepare food with less salt,If you drink alcoholic beverages, do so in moderation.

The dietary management of type 2 diabetes is now recognized to be quite different from that of type 1 diabetes. Our knowledge about the treatment of obesity in diabetes also has increased. In addition, attention is being given to the special considerations required among different subgroups of people with diabetes, specifically the needs of ethnic minority groups, pregnant women, growing children and adolescents, and the elderly. Emphasis is placed on providing individualized, flexible meal plans that people are willing and able to follow. Dramatic changes in our methods of diabetes education have also been instituted in recent years. New strategies, knowledge, and techniques for teaching and improving the overall management of diabetes, as well as dietary

management, were clearly demonstrated by different studies which recognized the importance of a coordinated team approach to the achievement of nutrition goals. The diabetes team used in the DCCT consisted of the patient and family as the primary participants, a diabetes nurse educator, a registered dietitian, a behaviorist, and the diabetologist. Today, exercise physiologists also have been included as important members of the diabetes team. The DCCT also provided specific information about important nutrition intervention strategies, based firmly on scientific evidence.

2-7-Carbohydrates

No more than 40% of total daily calorie intake should come from carbohydrates, which should be mainly low-glycemic-index foods such as vegetables, fruits, and whole and minimally processed grains. Refined carbohydrates or processed grains and starchy food such as pasta, bread, cereal, and white potatoes should be avoided or consumed in limited quantities.[1, 2]

2-8-Protein

To maintain muscle mass and energy expenditure, 30% of total daily calorie intake should come from protein. Preferable protein sources include fish, particularly cold water fish such as salmon, tuna, or sardines, and chicken, turkey, and other poultry and soy, rather than red or processed meat. Furthermore, data suggest that protein aids in the sensation of fullness and that low-protein meal plans are associated with increased hunger. Thus, protein may serve to reduce appetite and assist one in achieving and maintaining the desired lower calorie level.[1, 2, 6]

2-9-Fat

Of total daily calorie intake 30% should come from fat, which should be mainly derived from monounsaturated and polyunsaturated fat (e.g., nuts, olive oil, canola oil) and fish, particularly those high in omega-3 fatty acids. Meats high in saturated fat, including beef, pork, lamb, and high-fat dairy products, should be consumed only in small amounts. Similarly, foods high in trans-fatty acids should be avoided.

The above distribution of nutrients for overweight and obese people with type 2 diabetes will Promote long-term weight loss in those with type 2 diabetes.

The combination of restricting calories while increasing the intake of protein and low-glycemic-index foods may diminish the sensation of hunger.Improve blood glucose control because of the relatively lower carbohydrate content and the lower glycemic index of those carbohydrates that are consumed.Improve the body's response to insulin (insulin sensitivity), whether or not weight loss is achieved.Improve blood lipid profile, particularly triglycerides and high-density lipoprotein (HDL) cholesterol, whether or not weight loss is achieved.Reduce the stress on the insulin-producing cells in the pancreas by reducing the need for as much insulin.

It is also important to recognize that a meal plan prescription alone is not sufficient to maximize significant and sustained weight loss. Physical activity, behavior modification, and good support systems are extremely important adjuncts to the dietary prescription described above.

Several studies have demonstrated that diets particularly high in fiber (especially soluble fiber) are associated with lower blood glucose and serum lipid levels. Water-soluble fibers, such as the pectins, gums, storage polysaccharides, and a few hemicelluloses found in fruits, legumes, lentils, roots, tubers, oats, and oat bran, have little influence on fecal bulk but may reduce serum levels of glucose and insulin. Wolever reported that the amount of soluble fiber in whole foods is not closely related to glucose response but discerned a weak, but significant, correlation between the total dietary fiber and the glycemic response to a food. He postulated that the cell walls of foods that elicited a low glycemic response were sturdy and high in cellulose and hemicellulose. However, the differences in fiber components of foods did not explain all the variation in glycemic response. Water-insoluble fibers, such as cellulose, lignin, and most hemicelluloses found in whole-grain breads, cereals, and wheat bran, affect gastrointestinal transit time and fecal bulk but have little impact on plasma glucose, insulin, or cholesterol levels.

New evidence that high dietary fiber intake is beneficial in type 2 diabetes confirms previously published research . In a recent crossover study, demonstrated that intake of dietary fiber, particularly soluble fiber, above the amounts recommended by the American Diabetes Association improves glycemic

control and decreases hyperinsulinemia in patients with type 2 diabetes, in addition to the expected decrease in plasma lipid concentrations. Thirteen patients with type 2 diabetes followed two diets, each for 6 weeks. Both diets consisted of unfortified fiber foods, 15% protein, 55% carbohydrate, and 30% fat. The high-fiber study diet provided 50 g of total fiber daily, with soluble and insoluble fiber providing 25 g each. The American Diabetes Association study diet contained 24 g of total fiber per day, with soluble fiber contributing 8 g and insoluble fiber contributing 16 g. Daily plasma glucose levels were 10% lower with the high-fiber diet than with the American Diabetes Association diet. Rendell stated that this study clearly pointed out the importance of dietary intervention in patients with diabetes and that the “decrease in the degree of hyperglycemia achieved in the study by Chandalia et al. by increasing patients' fiber intake is similar to that typically obtained by the addition of another oral hypoglycemic drug to the therapeutic regimen.” As expected, the high-fiber diet resulted in lower fasting plasma total cholesterol, triglyceride, and very-low-density lipopolysaccharide (VLDL) concentrations than did the American Diabetes Association diet.[18, 23]

2-9-1-Educating Patients about Fat Intake

A primary strategy for patients with hypercholesterolemia, before they use cholesterol-lowering medications, is nutrition education. Key education points for patients with diabetes should include the following: Understanding the difference between dietary and blood lipids and how to change and decrease the dietary fats to lower blood lipid levels.Reducing total fat intake to 25% to 35% of calories based on nutrition assessment, with fewer than 7% of calories from saturated fat while meeting needs for essential fatty acids (seafood).Shifting the emphasis from animal to vegetable sources of fat.Encouraging the use of liquid, unsaturated oils, plant stanols, and tub or liquid margarines and reducing the use of foods with partially hydrogenated oils.

Emphasizing an increase in fiber by the inclusion of more whole grains, vegetables, and fruits. Recognizing that fat provides a concentrated source of calories in the diet and in body stores for those who want to lose weight loss or

are obese. Reducing or eliminating alcohol intake for those with dyslipidemia, especially those with elevated triglyceride levels.[26,27]

2-10-Exercise in Patients with Diabetes Mellitus

Exercise has long been recognized as an important factor in the treatment of diabetes mellitus. Before the discovery of insulin, patients with diabetes, particular those with type 1 diabetes, were very limited in their ability to exercise, because it was almost impossible for them to avoid ketosis and dehydration. After insulin therapy was established as a mainstay treatment, exercise was no longer an elusive activity. With their ability to exercise, it became evident that hypoglycemia frequently developed both in the immediate postexercise period and during the 24 hours after exercise. It also was recognized that ketosis could be induced by exercise in patients with poor glucose control and that even patients with excellent control would sometimes develop hyperglycemia after vigorous exercise. As our understanding of exercise in the patient with type 1 diabetes has increased, the goal has been to manage glucose homeostasis and fuel metabolism so that patients can participate fully in all forms of exercise.

Exercise also plays a critical role in patients with type 2 diabetes. It can help improve insulin sensitivity and assist with reduction and maintenance of body weight in obese patients. Exercise, together with diet and pharmacologic therapies, is important as part of the overall approach to improving glycemic control and reducing cardiovascular risk factors. Indeed, exercise often is “prescribed” as a therapy for type 2 diabetes. The many benefits of exercise in these patients include improved long-term glycemic control as a result of the decrease in insulin resistance and of the cumulative blood glucose-lowering effects of individual bouts of exercise. In addition, regular exercise has been shown to improve lipid abnormalities and lower blood pressure . Finally, exercise also may be an important component of weight-loss regimens for these patients. When used in combination with dietary changes (especially calorie restriction), exercise promotes loss of adipose tissue with preservation of lean body mass . In addition, exercise may promote a beneficial redistribution of body

fat. Abdominal adiposity appears to have a greater impact on insulin resistance than does fat deposition at other sites, and exercise has recently been shown to decrease abdominal fat in postmenopausal women . Unfortunately, there are some significant risks of exercise in the patient with type 2 diabetes, including symptomatic hypoglycemia, which can occur up to 24 hours after exercise; exacerbation of known or previously unknown cardiac disease; worsening of symptoms secondary to degenerative joint disease; and possible damage to joints in the setting of neuropathy. It is particularly important to screen patients with type 2 diabetes for existing cardiovascular disease before prescribing an exercise regimen.

There are several universal risks of exercise in patients with type 1 or type 2 diabetes. Most important, vigorous exercise can cause retinal hemorrhage or vitreous bleeding in patients with proliferative retinopathy. Maneuvers such as the Valsalva maneuver that increase intraabdominal pressure should be avoided, as should jarring head motions that might induce retinal detachment. In addition, patients with sensory neuropathy should refrain from high-impact exercise to reduce the risk of soft tissue and joint injury. The presence of autonomic neuropathy often makes performance of high-intensity exercise difficult because of decreased aerobic capacity and postural hypotension. Proteinuria tends to increase with exercise in patients with nephropathy. However, this is thought to merely be a result of a transient change in renal blood flow, as opposed to worsening of renal disease. Angiotensin-converting enzyme inhibitors have been shown to decrease this effect .[1, 2, 14],

2-10-1Exersice and glucose metabolism in patients with type 1 diabetes

Physical exercise increases insulin sensitivity in individuals with diabetes.

This increased insulin sensitivity is thought to be caused by the increase in glucose uptake via GLUT4 resulting from the effect of exercise on the expression and translocation of the transporter to the skeletal muscle plasma membrane.

This state of altered sensitivity can last for several hours. Highly trained athletes have better glucose tolerance, β-cell efficiency, and glucose utilization than do untrained individuals. In addition, athletes may exhibit a greater glycemic response to oral glucose secondary to adaptations in glucose

absorption. The adaptations associated with training reverse rapidly once athletes stop their exercise programs.

In individuals with type 1 diabetes, unlike those without diabetes, regulatory events in the pancreatic islets induced by exercise cannot decrease insulin secretion, because insulin is derived by injection. Because insulin levels are sustained, the suppressive effect of insulin on the liver continues and hepatic production of glucose remains low at the same time that utilization of glucose by muscle rises. This results in a substantial risk of hypoglycemia. The risk of hypoglycemia in patients with diabetes is even greater if they have injected insulin into a subcutaneous site in an exercising limb, because increased blood flow can accelerate insulin absorption . This can be particularly problematic when very-short-acting insulin, such as lispro or aspart, is used . Because of the increased risk of hypoglycemia secondary to rapid absorption of recently administered insulin, it is recommended that vigorous exercise be avoided for 1 to 1.5 hours after injection. The site of insulin administration is also important and should be chosen with regard to the particular activity so as to avoid injecting insulin into an actively exercising area.

As described above, insulin levels do not decline in response to activity in patients with type 1 diabetes, the normal upregulation of glycogenolysis and gluconeogenesis does not occur, the rate of muscle glucose uptake may not be matched, and hypoglycemia is likely to develop. This can cause problems particularly in patients who have tight glucose control, because they may have greater hypoglycemia unawareness and reduced counterregulatory responses . The presence of autonomic neuropathy may further contribute to a decreased counterregulatory response, as well as to a diminished ability to sense hypoglycemia.

As an approach to decreasing the risk of hypoglycemia during exercise, patients with type 1 diabetes often benefit from lowering their dose of short-acting insulin before exercise and ingesting carbohydrates before or during exercise. It often is effective to decrease the insulin dose by 25% to 50% before exercise and to avoid exercise for at least an hour after taking insulin. Patients should check their blood glucose levels before they exercise and consider a

supplementary carbohydrate snack when their blood glucose level is below 100 mg/dL. The response of blood glucose to exercise may vary significantly among patients with diabetes, and thus precise adjustments in insulin and carbohydrate intake need to be individualized.

In some patients with type 1 diabetes, improved insulin sensitivity may persist for several hours after they stop exercising, and these effects can last for up to 24 hours. The mechanism is not fully understood, but the increased sensitivity is thought to be due to a relatively high rate of glucose uptake by the exercised muscles and lower hepatic production of glucose as the glycogen stores are repleted . This may result in the development of hypoglycemia several hours after exercise. Therefore, it is often advisable to decrease doses of short- and intermediate-acting insulin before exercise (as noted above), and carbohydrate intake should be increased after exercise. As stated earlier, the treatment regimen needs to be tailored to each patient on the basis of his or her response to exercise.

It is important to recognize that different types of exercise can have distinct effects on blood glucose levels. Whereas moderate, sustained activity may lower plasma glucose concentrations and result in hypoglycemia in patients with type 1 diabetes, short bursts of high-intensity exertion can actually increase glucose levels and cause hyperglycemia . The glucose level in individuals without diabetes tends to rise modestly during brief intensive exercise, with a peak level occurring up to 15 minutes after cessation of activity. The glucose level then gradually drops during the next hour. The rise in glucose concentration is attributed to an increase in hepatic production of glucose that exceeds the rate of glucose uptake by exercising muscle. This likely reflects the dramatic stimulation of the counterregulatory hormone secretion during intense exercise, which suppresses insulin release. Once exercise is completed, there is a compensatory increase in insulin secretion.

The rise in blood glucose with intensive exercise may last longer in individuals with type 1 diabetes than in those without diabetes. One study found that the postexercise hyperglycemia reached higher levels and lasted for a full 2-hour observation period in patients with type 1 diabetes after they exercised at

80% $VO_{2\ max}$. The higher glucose levels and prolonged hyperglycemia in patients with type 1 diabetes are likely due to increased hepatic production of glucose in the setting of counterregulatory hormone release. This is followed by an inability to increase insulin release after completion of exercise in response to the elevated blood glucose levels. Of note, the catecholamine response in patients with diabetes appears to be normal.

Although hyperglycemia can occur after intense exercise in diabetic patients with excellent glycemic control, patients with poor control who exercise often experience an even more marked increase in blood glucose levels, which can be accompanied by ketosis .In the setting of insulin deficiency, fatty acid oxidation and glucose production by the liver are stimulated, contributing to increased ketogenesis and hyperglycemia . There also appears to be decreased clearance of ketones in patients with poorly controlled diabetes, because this is an insulin-stimulated response . It is recommended that patients with type 1 diabetes check both their blood glucose level and their urine or serum for ketones before exercising. If their serum glucose concentration is 250 mg/dL or higher and ketones are present, they should postpone exercise and administer insulin. If no ketones are present, it is generally safe for them to exercise. Indeed, moderate exercise may be helpful in improving the serum glucose level.

Recommendations for patients with type 1 diabetes should always be individualized, but there are some universal principles .First, patients should always check blood glucose levels before exercise. If their glucose level is less than 100 mg/dL, they should take supplemental carbohydrate before initiating exercise. They also should exercise about 1 to 3 hours after a meal. If they take short-acting insulin with meals, they should plan to lower their dose of insulin at the meal before initiating activity. A general rule is to lower the short-acting insulin by at least 50%. If they take only intermediate-acting insulin, they may wish to lower the dose by 30% to 35% on the morning of the planned exercise. If patients are involved in high-intensity exercise with a $VO_{2\ max}$ greater than 80%, they may need supplemental insulin after exercise to counter postexercise hyperglycemia. For patients on an insulin pump, the basal rate should be lowered and the premeal bolus decreased to avoid hypoglycemia. In addition, patients

may need to take supplemental carbohydrates before exercising and at intervals during and after exercise. It is important to consider each patient's personal experience when developing an appropriate regimen and making adjustments.[40, 42, 43, 49]

2-11-Principles of Insulin Therapy

2-11-1Types of insulin

The laboratory production of human insulin in the early 1980s has gradually resulted in the replacement of animal insulins as a viable therapeutic choice for patients with diabetes. Human insulins and newer insulin analogues produced by recombinant DNA technology are becoming the main insulins used in the current treatment of diabetes in most countries. Insulins for clinical use can be characterized according to their pharmacokinetic profiles. They are available in rapid-acting, short-acting, intermediate-acting, and long-acting preparations . Table 39.1 shows the onset, peak, and duration of action after subcutaneous injections of the insulins used commonly in therapy. The different time-action profiles make it feasible to pursue the goal of simulating physiologic insulin secretion, however, this goal remains difficult to achieve with the current formulations. Insulin replacement should be thought of in terms of mealtime (bolus) and basal insulins. The mealtime insulins are the rapid-acting analogues or short-acting regular human insulin. These insulins have been used to attempt to simulate the high levels of insulin seen in individuals without diabetes after ingestion of a meal. The basal insulins are the intermediate- and long-acting human insulins and analogue. They simulate the basal level of insulin occurring between meals, through the night, and with fasting. Insulin is commercially available in concentrations of 100 or 500 units/mL, designated U-100 or U-500. The U-500 concentration, which is available only in short-acting formulations, is used only in rare cases of insulin resistance when the patient requires extremely large doses of insulin.[1, 2,6,35]

TABLE 1. Approximate Pharmacokinetic Characteristics of Human Insulin and Insulin Analogues Following Subcutaneous Injection

Blood glucose targets	Duration of action	Peak of action	Onset of action	Insulin
Mealtime insulins				
Postprandial	4–5 h	1–1.5 h	10–15 min	Lispro
Postprandial	4–6 h	1–2 h	10–15 min	Aspart[a]
Postprandial	5–8 h	2–4 h	15–60 min	Regular
Prior to next meal				
Basal insulins				

Midafternoon (for morning NPH)	13–16 h	5–7 h	2.5–3 h	NPH
Fasting glucose next morning (for bedtime NPH)				
Similar to NPH	Up to 18 h	7–12 h	2.5–3 h	Lente
Similar to NPH	Up to 30 h	No peak	2–3 h	Glargine[b]
Similar to NPH	Up to 20 h	8–10 h	3–4 h	Ultralente
Similar to NPH	Up to 24 h	No peak	2–3 h	Detemir[c]

2-11-2-Treatment Strategies

The appropriate insulin regimen for an individual patient should take into account the patient's lifestyle, age, motivation, general health, self-management skills, and goals of treatment . Prior to initiating insulin therapy, the patient should receive appropriate education and support regarding the care and use of insulin, the recognition and treatment of hypoglycemia, and the management of sick days

Type 1 Diabetes As prescribed by diabetologists and endocrinologists, the commonly used insulin protocols for individuals with type 1 diabetes are MDI and CSII. The DCCT clearly shows that intensive therapy with MDI or CSII coupled with the appropriate education and frequent self-monitoring of blood glucose (SMBG) achieves a significant lowering of HbA_{1c} levels and reduction in the risk of microvascular complications compared with that achieved with less frequent injections .Unfortunately, even in the intensively treated cohort of the DCCT, after the completion of the clinical trial, glycemic control deteriorated, pointing out the necessity of continuing education and close clinical surveillance . Therefore, MDI or CSII, along with appropriate education, counseling, and support, is the preferred therapy for patients with type 1 diabetes.

2-11-3-Multiple dally injections

It is best to think about insulin therapy according to the pharmacokinetics of the available insulin preparations and the physiologic secretion of insulin in individuals without diabetes. Thus, we tend to think of basal insulin administration for the overnight and postabsorptive states and bolus insulin administration for mealtimes as an attempt to reproduce acute β-cell insulin release. This mealtime-basal routine usually requires at least four injections per day. A rapid-acting mealtime insulin analogue (lispro or insulin aspart) is the preferred insulin before each meal. As described earlier, the rapid onset of action of lispro or insulin aspart produces less postprandial hypoglycemia and less nocturnal hypoglycemia compared with regular insulin, which makes them ideal for an MDI regimen. NPH, ultralente,

or glargine can be used as the basal insulin, classically at bedtime; however, different regimens are being used [32,37,43]. It is likely that glargine (and perhaps detemir) will become the basal insulin of choice for MDI therapy because of their pharmacokinetic properties.

Glargine, as the basal insulin in a MDI regimen, has been associated with improved fasting blood glucose levels and less hypoglycemia . The administration of a rapid-acting insulin analogue (lispro or insulin aspart) prior to each meal controls postprandial serum glucose concentrations, and the intermediate- or long-acting insulin controls fasting serum glucose concentrations. As shown in the DCCT, the risk of hypoglycemia is greater with MDI than with less frequent injections, primarily because of the tighter glycemic targets and improved control achieved . Therefore, patient education, self-monitoring, and a self-directed management approach are fundamental to achieving success with this therapy. Both clinician and patient have to be prepared to make adjustments to the regimen as necessary, including adjustment of glycemic targets to avoid severe hypoglycemia. Since lispro and insulin aspart are such rapidly acting insulins, a second injection of NPH or ultralente before breakfast may be required to provide basal insulin over the day and better control of predinner serum glucose concentrations. However, a controlled clinical trial demonstrated that most patients (75%) required only one injection of intermediate-acting insulin. The actual doses of insulin used must be adjusted on an individual basis. However, the following is an empirical guide for choosing initial insulin doses for MDI .. The approximate total daily insulin (TDI) requirements for an individual not previously receiving insulin are 0.5 units/kg. If the patient is already receiving insulin, the TDI is the sum of all the current insulin doses.

Approximately 60% should be rapid-acting mealtime insulin (lispro or insulin aspart) given before each meal. The breakfast meal usually requires a disproportionately higher dose of insulin than other meals for the calories consumed. The remaining 40% of the estimated TDI should be given as the basal insulin (NPH, ultralente, or glargine) at bedtime.

Close self-monitoring of blood glucose and frequent adjustments are necessary to optimize glycemic control with the fewest episodes of hypoglycemia.[48, 49]

2-11-4-Twice-daily dosage

Twice-daily (BID) injections are not recommended for patients with type 1 diabetes. Such a regimen provides neither optimal glycemic control nor sufficient flexibility for adjustments of insulin dose. It is important to note that NPH given before dinner increases the risk of hypoglycemia during the night; thus bedtime NPH insulin is more appropriate both to control fasting blood glucose levels and to reduce the risk of nocturnal hypoglycemia .[1, 2, 35]

2-11-5-ADjustments to insulin for exercise

Exercise is encouraged for patients with type 1 diabetes and should be prescribed on the basis of the patient's functional status and presence of complications. Patients receiving insulin may experience hypoglycemia during, immediately after, or many hours after exercise. This can be avoided by adjusting insulin therapy and nutritional intake to accommodate exercise. It is essential for the patient to collect self-monitored blood glucose data to determine his or her response to exercise. The glycemic level at the start of exercise, previously measured response to exercise, and intensity and duration of planned exercise need to be considered to make appropriate changes in insulin dose or to increase food intake as necessary .[43, 44]

2-11-6-Common delivery systems

Several insulin delivery systems are commonly used, and choices should be made on the basis of personal preferences and needs. Particular attention should be paid to individuals who have impaired vision, problems with manual dexterity, or difficulty mixing various formulations of insulin.

Syringe and Needle**:-**The traditional insulin delivery system is the syringe and needle. This delivery system is flexible, allows dosages to be adjusted readily, and allows some of the insulin formulations to be mixed for fewer injections per day. The limitations to this delivery

system are the requirement for good eyesight and fine-motor skills to ensure that appropriate doses of insulin are drawn and administered.

The vial, syringe, and needles need to be available whenever insulin administration might be required, and some individuals may find the apparatus cumbersome.

Pen Devices:-Pen-cartridge devices are becoming more popular than the syringe-and-needle system. Replaceable insulin cartridges containing 150 to 300 units of regular, aspart, lispro, NPH, or premixed insulin are used in the pen devices. The dose is dialed into the device, and needles with a very fine gauge are used to minimize the discomfort of injection. This method of insulin administration is convenient, unobtrusive, easy to carry, and very useful for MDI regimens. However, insulins cannot be mixed, so two injections are necessary when both rapid-acting and intermediate-acting insulins are required unless premixed insulins are used .[2, 6, 48]

Continuous Subcutaneous Insulin Infusion

External insulin infusion pumps first became available in the early 1980s and have evolved rapidly since then. Lispro or regular insulin is stored in a reservoir of the pump and is infused through a catheter into a transcutaneous catheter placed subcutaneously . A preprogrammed basal rate of insulin is delivered continuously. The patient can program the pump to provide more than one basal rate over a 24-hour period to best mimic the needs of the individual. There is complete flexibility in the timing of meals because the basal rate maintains glycemic control and boluses of insulin are delivered before the meal. The amount of mealtime insulin given can also be adjusted according to the preprandial blood value. As in all intensive treatment regimens, careful and frequent self-monitoring of blood glucose levels is essential. Adequate support must be provided for the patient with CSII. Although either lispro, aspart, or regular insulin can be used for CSII, there is evidence that lispro and aspart are superior to regular insulin in terms of glycemic control, postprandial blood glucose levels,

and risk of hypoglycemia. Therefore, lispro or aspart is the preferred insulin for CSII.

There are several advantages of the insulin pump over MDI. Patients are spared the burden of administering MDI. Also, the pump provides great flexibility with respect to meal timing and exercise programs. Insulin-pump therapy currently is the most physiologic way of replacing basal insulin, because rates of basal infusion can be changed to match different physiologic requirements.

CSII carries some patient risks and disadvantages that are not encountered with MDI. Since only short-acting insulins are used, any interruption of insulin delivery by pump malfunction, catheter blockage, or displacement of the subcutaneous catheter can result in a rapid deterioration in control and the development of ketoacidosis. However, the newer pumps with safety alarms indicating interrupted flow have dramatically decreased the incidence of this complication . Some studies have shown that interruption of CSII using lispro is associated with an earlier and greater metabolic deterioration than that with regular insulin . However, other studies have not shown a significant difference . The correction of any metabolic deterioration appears to be faster with lispro than with regular insulin . Special attention to self-care is essential to avoid subcutaneous infections. The subcutaneous catheter should be changed every 2 days. Some patients find the external pump cumbersome. Currently, the main barrier to CSII use is the substantial cost of equipment and supplies. CSII used by a well-trained patient can be an effective method of providing more physiologic insulin replacement.[6, 48]

2-11-7-Practical aspects of insulin use

2-11-7-1-Storage

Insulin preparations are stable at room temperature. Insulin in use may be kept at room temperature for 30 days; however, there may be a slight loss in potency if the same vial is used for more than 30 days. If patients experience unexplained deterioration of their glycemic control, they should be instructed to inspect their insulin and possibly

to change vials in an attempt to improve control. Vials of insulin not in use should be refrigerated. Extreme temperatures and excess agitation should be avoided. The insulin should be visually inspected before each use for changes such as clumping, frosting, precipitation, or a change in clarity or color.

2-11-7-2-Mixing Insulin

Many insulin regimens require a mixture of different insulin formulations administered at the same time. These insulin formulations either can be administered as two separate subcutaneous injections or can be mixed for a single injection. Commercially available premixed insulins may be appropriate for patients with type 2 diabetes if the insulin ratio matches the patient's insulin requirements. Pen devices do not allow for mixing insulins, so two injections are necessary. However, conventional insulin administration with syringe and needle does allow for mixing. NPH and regular insulin when mixed may be used immediately or stored for future use. Similarly, rapid-acting insulin analogues may be mixed with NPH or ultralente insulin and used without fear of significantly changing the pharmacokinetics of each component .Mixing regular insulin with lente or ultralente is not recommended except for patients whose glucose levels are already well controlled with such a mixture . The zinc present in the lente insulins can bind with the regular insulin, thereby delaying its onset of action in an unpredictable fashion . NPH insulin should not be mixed with lente insulins because zinc phosphate may precipitate. Insulin glargine cannot be mixed with other insulins because it is in solution at an acidic pH and will precipitate if mixed with pH-buffered insulin.[1, 6, 27]

2-11-8-Insulin Injection Technique

The following description applies to the conventional syringe-and-needle administration of insulin. The top of the insulin vial should be cleaned with an alcohol swab. If the insulin is in suspension, the vial should be gently rolled between the hands to ensure that the suspension is uniform before the syringe is loaded. Before the insulin is drawn into the syringe, an amount of air equal to the dose of insulin should be

injected into the vial to avoid creating a vacuum. The proper amount of insulin is then drawn into the syringe, and the air bubbles are expelled. If two insulin types are to be mixed, air should be injected into both bottles and the clear rapid- or short-acting insulin should be drawn first.

Insulin should be injected into the subcutaneous tissue. The skin should be gently pinched between the thumb and forefinger and injected at a perpendicular angle. The plunger should be pushed down, the skin released, and the needle then withdrawn. In thin people or children, the needle may need to be inserted at a 45-degree angle to avoid an intramuscular injection. Painful injections may be minimized by injecting the insulin at room temperature, making sure there are no air bubbles in the syringe before injection, keeping muscles in the injection area relaxed, penetrating skin quickly, and not reusing dull needles.

Insulin can be injected into sites with the most subcutaneous fat, which include the abdomen, anterior and lateral thigh, buttocks, and dorsal area of the arm. Within the abdomen, a circle with a 5.08-cm (2 in.) radius around the navel should be avoided. Injection into areas with little subcutaneous fat may result in intramuscular administration, which is painful and may result in faster insulin absorption. Insulin is absorbed more rapidly and consistently from the abdomen than from the arms, thighs, or buttocks and from an extremity that is subsequently exercised, probably by increasing blood flow to the skin and perhaps by local muscle contraction . Massage of a local area that has been injected can increase the rate of insulin absorption, as can increased local skin temperature. Rotation of injection site is important to prevent lipohypertrophy or lipoatrophy . Rotation within one area is recommended as opposed to rotating to different areas within the body .[47, 48,49,42,50]

2-11-9Blood Glucose Monitoring

All insulin-using patients should be encouraged to perform SMBG. With SMBG, patients can evaluate their goals of therapy and

adjust their insulin regimens accordingly. A written or electronic record of the daily blood glucose levels is an invaluable tool for the physician and patient for guiding adjustment of the insulin regimen to accommodate fluctuations in insulin requirements. Many of the currently available glucose meters have memory, which simplifies record keeping. The frequency of monitoring depends on the insulin regimen used. The use of MDI of insulin requires multiple daily glucose monitoring, specifically before every meal and at bedtime. Specific situations, such as pregnancy and illness, may make more frequent monitoring necessary.

2-11-10-Implementation

One of the most critical components for successful implementation of any insulin regimen is education and support. This is especially true for implementing MDI or CSII therapy. All patients must be educated about the basics of insulin therapy, including all the previously discussed practical topics and about the complications and how to manage them. In addition, patients receiving MDI or CSII should learn how to self-manage their insulin therapy. They should learn about meal planning and carbohydrate counting, how to identify blood glucose patterns, potential hypoglycemic situations, and the principles of insulin dose adjustments and how to make appropriate adjustments for exercise, sick days, and travel. They should learn how to develop and adjust their own variable insulin dose scales (VIDS). These steps will empower patients and allow them to actively participate with their diabetes care team in their therapy. Education and support on a continuous basis not only improve overall glycemic control they also can decrease hypoglycemia and other adverse events .

2-11-11-Complications of insulin therapy

2-11-11-1Hypoglycemia

Hypoglycemia is the most frequent and feared complication of insulin treatment, with potentially serious sequelae . Poor timing of meals, exercise, and insulin treatment can lead to hypoglycemia.

Previous episodes of repeated severe hypoglycemia requiring assistance or hypoglycemic unawareness are risk factors for severe hypoglycemia. In the DCCT, the frequency of severe hypoglycemia was increased threefold in the intensive-therapy group . The risk of severe hypoglycemia was inversely related to HbA_{1c} levels . When severe hypoglycemia occurs, one should investigate the specific circumstances of that episode, potentially raise glycemic targets, and improve education to avoid future episodes . Also, a period of meticulous prevention of hypoglycemia may reverse some hypoglycemia unawareness . The rates of hypoglycemia in type 2 diabetes are much lower than those in type 1 diabetes . In the united kingdom prospective study UKPDS, the frequency of major hypoglycemic episodes was 1.8% per year in the insulin-treated group. Some study mentioned that ,no major hypoglycemic episodes occurred with insulin-mediated intensive control over 7 years of follow-up. However, the same general principle applies in type 2 diabetes; namely, the risk of hypoglycemia is inversely related to the HbA_{1c} . Most patients experience symptoms when their plasma glucose levels decrease to 60 mg/dL (3.3 mmol/L). As plasma glucose levels decline further, more severe symptoms, specifically neurologic symptoms, appear. [2, 35]

2-11-11-2-Weight Gain

Weight gain is another potential adverse effect of insulin use. In the DCCT, the incidence of becoming overweight during the median 6.5 years of follow-up was 41.5% in the intensive-therapy groups compared with only 26.9% in the conventional-therapy group ($p < 0.001$) . The risk of weight gain with insulin use in type 2 diabetes also has been well documented . In the UKPDS, the insulin group gained 4.0 kg (8.89 lb) more than the conventional-therapy group ($p < 0.001$).

Several mechanisms have been proposed to explain the weight gain associated with insulin use. Improved glycemic control decreases glycosuria, thereby decreasing the loss of calories through the urine . The direct lipogenic effects of insulin on adipose tissue contribute to weight gain . Also, increasing insulin doses may cause recurrent mild

hypoglycemia that only manifests itself as hunger. This may result in intake of excess calories. Therefore, diet therapy and weight-loss programs in conjunction with appropriate glycemic targets are extremely important in the management of diabetes.

The result of weight gain in insulin-treated patients is further insulin resistance, leading to the need for more insulin and a potentially greater weight gain. Obesity is associated with decreased responsiveness to insulin in muscle, liver, and fat.

2-11-11-3-Lipoatrophy/Lipohypertrophy

Injection of less-purified insulin into subcutaneous fat can sometimes lead to localized loss of the fat. With the current more-purified insulins, this problem is uncommon. If insulin is injected into the area surrounding the affected sites, the subcutaneous fat will be restored over several months to years.

The opposite of lipoatrophy, lipohypertrophy, may occur at sites of insulin injection. Localized areas of increased swelling of subcutaneous fat can develop with repeated injection. The sensitivity to pain may decrease in these areas, and masses of fibrous tissue may develop. Insulin absorption from sites of lipohypertrophy may be erratic and unreliable. Rotating injection sites can prevent the development of lipohypertrophy. The excess tissue will regress gradually with time.

2-11-11-4-Atherosclerosis

For a number of years, there has been a concern that insulin promotes and accelerates atherosclerosis. Some studies have shown an association between high insulin levels and macrovascular disease . Others have shown that hyperinsulinemia is not an independent risk factor for macrovascular disease . It has been suggested that hyperinsulinemia merely reflects insulin resistance, which is closely associated with other risk factors for macrovascular disease. Therefore, insulin probably does not directly promote atherosclerosis. There is clearly no evidence that exogenous insulin use is associated with macrovascular disease, and its appropriate administration should not be

discouraged . UKPDS showed no increase in cardiovascular events or death in either the insulin or sulfonylurea group than in the conventionally treated patients, despite higher plasma insulin levels . As a consequence, one can safely conclude that exogenous insulin is not a risk factor for atherosclerosis.

2—11-12-Alternative Routes of Insulin Delivery

The benefits of achieving tight glycemic control are well established, and the insulin analogues play an important role in meeting appropriate bolus and basal insulin requirements. However, for this goal to be achieved, MDI of insulin or CSII are required. Despite the widespread use of insulin pen devices that are less painful and use smaller gauge needles, injection-related anxiety remains a common problem . Since the 1920s, there have been many attempts to find alternative routes of insulin delivery, including oral, rectal, transdermal, nasal, and pulmonary routes.

Attempts to develop an effective oral insulin began in 1923 . To date, these attempts have been largely unsuccessful because of the extensive enzymatic and chemical degradation that occurs in the gastrointestinal tract and the variable transit time of the gastrointestinal tract . Researchers have tried enclosing insulin within microspheres and concurrent administration of proteolytic enzyme inhibitors, with minimal success . Rectal insulin has been investigated but its variable poor bioavailability and lack of patient acceptance make this route of delivery impractical .

Transdermal delivery of insulin is an attractive option given the easy accessibility of skin; however, success has been limited because of the relative impermeability of the skin. Methods used to try to improve the permeability of skin include iontophoresis, low-frequency ultrasound, coupling with transferomes, and the application of photomechanical waves.

The initial observations in animals and humans have been encouraging; however, further clinical studies are required.

Intranasal administration of aerosolized insulin seemed like another attractive option. However, the disadvantages are that the surface area of the nasal mucosa is relatively small, at approximately 150 cm^2, and absorption must occur quickly or the drug will be removed to the back of the nasopharynx by the mucociliary clearance mechanisms and swallowed . Clinical studies demonstrate poor bioavailability and a rapid but short-lived hypoglycemic effect . Large doses are required, despite the addition of enhancers, and patients experience irritation to the nose and nasal congestion for these reasons, intranasal administration does not appear to be a viable route for delivering aerosolized insulin.

Beginning as early as 1925, investigators have tried to develop an effective means of intrapulmonary delivery of insulin . The surface area of the alveolar region of the lung is very large (75 to 100 m^2) and is highly permeable (0.1 µm) (103,108). It is well vascularized and has minimal mucociliary clearance. All these features favor the lung as an effective and efficient means of delivering insulin. However, effective delivery of aerosolized insulin to the alveolar region of the lung requires appropriate aerosol particle size, aerosol velocity, and inspiratory flow rate . Current delivery systems include dry-powder inhalation systems and aqueous insulin aerosol devices.

The dry-powder insulin inhalation system uses a holding chamber to capture the insulin cloud and allow for slow deep inhalations. Comparison with subcutaneous regular human insulin demonstrated faster onset of action and time to peak effect. The duration of action was between that of lispro and regular insulin . An open-label, proof-of-concept study in 73 patients with type 1 diabetes, comparing preprandial inhaled insulin plus bedtime subcutaneous ultralente insulin and usual MDI of subcutaneous insulin, demonstrated no difference in HbA_{1c}, fasting or postprandial blood glucose levels, and frequency or severity of hypoglycemia after 3 months . An open-label, noncontrolled study of 26 patients with type 2 diabetes using preprandial inhaled insulin plus bedtime ultralente insulin demonstrated decreased HbA_{1c}

after 3 months. Inhaled insulin was well tolerated in both studies, and there was no change in pulmonary function.

The aqueous insulin aerosol device is breath-activated and releases insulin when inspiratory flow rate and volume are optimal. A clear dose-response curve and a rapid onset of action as compared with that of subcutaneous regular human insulin have also been demonstrated . Both insulin formulations have relatively poor bioavailability as compared with that of subcutaneous insulin. Enhancers have been incorporated to try to improve bioavailability, and early results have been promising.

Improved aerosol and delivery technology, ease of use, and patient satisfaction make intrapulmonary insulin the most promising alternative route of insulin delivery at this time. Adequate patient education to ensure proper technique is critical to the success of inhaled insulin. It is important to note that clinical studies to date have been performed in patients with normal pulmonary function tests. Data are unavailable for patients with abnormal pulmonary function. In addition, smokers are known to have more rapid absorption of intrapulmonary substances, and this may affect its clinical use in this population. There is also concern about the potential of high concentrations of insulin in the lungs to cause pulmonary vascular disease or other effects. No major adverse effects have been demonstrated to date, but long-term safety and efficacy studies are required before inhaled insulin delivery systems can be routinely incorporated into clinical practice.

2-11-12-The Diabetic Foot Strategies for Treatment and Prevention of Ulcerations

Diabetic foot disease affects nearly 2 million patients with diabetes in the United States annually . This places an inordinate social and economic burden not only on the United States healthcare system but also on the families of these patients. It is estimated that almost $200 million is spent annually strictly for the care of the diabetic foot . This represents only the direct costs of hospitalization, medications,

and surgery. Indirect costs such as lost employment, disability, and stress on the family unit cannot even be estimated. More amputations are performed in patients with diabetes than any other group of patients.

The management of diabetic foot disease is focused primarily on avoiding amputation of lower extremities. This goal is carried out through three main strategies: identification of the “at-risk” foot, treatment of the acutely diseased foot, and prevention of further problems. Vital to the success of any program is education of the patient and family members. A comprehensive program of diabetic foot management must include each of these aspects for successful salvage of limbs.

These goals are best met by the establishment of a dedicated limb-salvage team. The members of this team must be dedicated to meeting the challenge of the patient with diabetes whose fears of limb loss are rivaled by fears of blindness and kidney failure . Members of this team most commonly include a podiatrist, an endocrinologist, a vascular surgeon, and a pedorthist. The team also may include plastic surgeons, infectious disease specialists, orthopedic surgeons, and diabetes teaching nurses. All players must know their role and be available in a timely fashion for consultation.

Several systems exist for grading the at-risk foot . The main purpose of any classification system is to standardize descriptions of lesions and to formulate algorithms for treatment. While each system claims to be complete, all have pitfalls. Identifying the patient with diabetes at risk for ulceration requires examination of the feet, including the vascular and neurologic systems, skin condition, and foot structure.[22, 24, 24, 26]

2-11-12-1-Identification of risk factors

While certain clinical features are known to increase the risk for lower-extremity amputation, peripheral sensory neuropathy has been identified as the major risk for diabetic foot ulceration . The inability of a patient with diabetes to feel pain places him or her at significant

risk for future foot problems. Knowledge of this condition and education on preventive measures are critical to the patient's ability to avoid ulcerations. However, even with appropriate preventive measures, ulcerations will develop. Unperceived or unintentional trauma occurs that results in breaks in the skin and inoculation by bacteria.

Clinically significant peripheral sensory neuropathy can be detected by using a 128-millihertz (mHz) tuning fork and a 5.07 Semmes–Weinstein monofilament wire as screening tools to identify at-risk patients . While loss of vibratory sensation is the initial step in the development of clinically significant neuropathy, grading with a tuning fork is often a subjective exercise without scientifically established norms. A biothesiometer provides more objective documentation of a patient's ability to perceive vibratory sensation. Clinical studies have determined a vibratory perception threshold of 25 mHz as identifying patients at risk for ulceration . This instrument, however, is not readily available to the practicing clinician. It is used primarily in clinical trials where documentation of the degree of sensory neuropathy is important in stratifying groups.[5, 17]

The 5.07 (10 g) Semmes-Weinstein monofilament wire is an effective and inexpensive device to identify the patient at risk for foot ulceration. Several clinical trials have demonstrated that patients with diabetes who are unable to perceive this gauge of monofilament wire are at a statistically significant higher risk for development of ulceration than are patients who are able to detect the wire . Proper use of the wire requires application of the wire against the foot with enough force to gently bend the wire. Inability to feel the wire implies lack of adequate protective sensation. By testing different sites on the foot, areas of insensitivity can be mapped and identified to the patient. These patients then must be educated on the significance of sensory neuropathy and the steps to preventing foot ulcerations. Regular evaluation by a foot care specialist is recommended for these individuals.

Formal nerve conduction studies in patients with diabetes have not been shown to alter treatment planning. Nerve conduction studies are rarely helpful or necessary for the evaluation of neuropathy. Many patients with type 2 diabetes have clinically significant neuropathy at the time of diagnosis, and nerve conduction studies will be abnormal in the majority of these patients.

Motor neuropathy can produce foot deformities that put the foot at risk for ulceration .Loss of innervation of the intrinsic musculature of the foot can lead to common foot deformities such as hammer toes, claw toes, and plantar-flexed metatarsals. Plantarly prominent metatarsal heads result in areas of high focal pressures that have been shown to increase risk for foot ulceration. Digital deformities can be irritated dorsally by shoe gear, resulting in corns or even ulcerations.

Autonomic neuropathy, although less common than peripheral sensory neuropathy, can also affect the feet. Most commonly, autonomic neuropathy affects local temperature regulation and the function of sweat glands. Loss of sweat production can lead to dry skin . Untreated this can lead to cracking and fissuring, especially in the heel, creating a portal of entry for bacteria.

Peripheral vascular disease by itself is responsible for only a small percentage of diabetic foot ulcerations. Only 15% of all diabetic foot ulcers are purely ischemic . However, arterial insufficiency can lead to nonhealing of ulcerations once they have developed. The single most important indicator of adequate perfusion is the presence of palpable pedal pulses. Additional clinical maneuvers to assess vascular status should include measurement of the venous filling time and evaluation for dependent rubor and pallor on elevation. The presence of a slowly or nonhealing ulceration in the face of absent pulses warrants further evaluation. This may be in the form of noninvasive arterial studies. Pulse volume recordings and the character of the distal pulses on Doppler evaluation (monophasic vs. triphasic) can provide valuable information on the patient's ability to heal the ulceration. Although ankle-brachial indices (ABIs) are measured, they are of limited

usefulness in the patient with diabetes. The ABIs often are artifactually elevated due to medial calcinosis of pedal vessels. Assessment of a patient's ability to heal should not be based solely on this measurement.

The presence of a nonhealing ulceration with clinical or objective evidence of arterial insufficiency warrants a prompt referral to a vascular surgeon .[17, 19]

The areas under the metatarsal heads are the most vulnerable areas for plantar ulcerations. These areas have been identified as having high focal pressures in patients with diabetes . A symptom of these high pressures is the presence of callus tissue under a metatarsal head. This most commonly results from plantarly prominent metatarsal heads, as occurs in the intrinsic minus foot and when the plantar fat pad atrophies . More recently, an association between limited joint mobility and high plantar foot pressures has been discussed as a risk factor for foot ulcerations . Other causes of high foot pressures include developmental foot deformities such as bunions, hammer toes, or rocker-bottom deformities from Charcot joint disease.

Quantitation of plantar foot pressures in the form of vertical load is possible with various computerized pressure-sensing equipment . These devices are expensive for most private practitioners and are most useful as a research tool. A Harris mat (ink-impregnated foil that demonstrates pressure points in static stance), however, is a simple, inexpensive tool that can be helpful in identifying areas of high plantar foot pressures.

2-11-12-2-Classification of ulceration

As previously noted, several classification systems for grading ulcerations exist . Classification systems have two primary purposes: (a) to provide healthcare professionals with a common language to describe and understand common conditions, in this case diabetic ulcerations; and (b) to help direct the management and treatment of these conditions. While these are noble and useful purposes, there are also notable deficiencies in each of these grading systems. Some neglect the importance of ischemia, others are too complex to

remember, and others are not completely applicable to diabetic ulcers but are more appropriate to pressure or decubitus ulcers. Nevertheless, for the purposes of this book, the Wagner classification has been selected for the discussion of ulcerations and their management, as it is the simplest, best known, and most widely used system. One should, however, by aware of its shortcomings. The Wagner classification system is based strictly on ulcer description and depth. It ignores the importance of ischemia and infection in determining the severity of the ulceration. In other words, although a Wagner grade 1 or 2 ulceration in a patient with adequate blood flow can often be managed with little to no complications, a similar condition in patients with poor perfusion can be a limb-threatening condition.[19]

Grade 0 Foot the Wagner grade 0 foot is the diabetic foot without ulceration but with one or more risk factors. Clinically significant sensory neuropathy as described above is one such risk factor. Other risk factors include bony deformities, atrophic fat pad, plantarflexed metatarsals, peripheral vascular disease, and Charcot joint disease.

Dermatologic conditions also may pose risks to the grade 0 foot. Such conditions include dry, scaly skin with fissures, or thickened, discolored nail plates as seen in chronic onychomycosis. Although peripheral sensory neuropathy is the primary component cause for ulceration, the predictive index for ulceration increases significantly with each additional component cause identified . This constellation or grouping of risk factors is referred to as sufficient causes for ulceration (i.e., two or more component causes equal a sufficient cause for ulceration).

Appropriate evaluation of this foot should include a careful neurologic examination using the 5.07 Semmes-Weinstein monofilament wire. Mapping of insensate areas helps the patient and the physician identify vulnerable areas. The foot should be closely inspected for corns or calluses, because these areas will identify focal pressures or irritation that may lead to ulceration. The vascular examination should include palpation of pedal pulses and observation

for pallor with elevation or rubor on dependency. The physician should inspect for fissures either on the heels or in the interdigital spaces.

Management of the grade 0 foot centers on a program of education and prevention. Patients should be educated about the risks associated with the neuropathic foot and instructed on the early signs of inflammation, irritation, and infection and the initial treatment of these conditions. They should also be educated on the importance of good glycemic control in the management of foot disease.

Disease prevention in this patient population may include shoe-gear modification to decrease plantar foot pressures and to accommodate foot deformities and the use of orthotic devices and padded hosiery to further decrease plantar foot pressures . The simple habit of changing shoes every 4 hours can also help modify plantar foot pressures. This simple technique has several advantages in ulcer prevention: (a) it prevents the accumulation of pressure over any one area of the foot for extended periods; (b) it reduces loss of shock absorption and support functions of the outer soles and leather uppers, which occur the longer a shoe is worn; (c) it provides the patient with the opportunity to inspect his or feet frequently, allowing earlier detection of potential foot lesions .

Regular visits to the foot specialist are recommended as part of a program of education and prevention. Depending on the patient's risk category, these visits should be scheduled annually, semiannually, or more frequently. Pulses should be palpated and any lesion should be noted at each visit. Corns and calluses should be debrided . The patient should be instructed on the proper care of the nails and skin. Moisturizing creams should be prescribed for application to the bottom of the foot for dry, scaly skin to avoid fissures. The interdigital spaces should also be inspected for fissures or evidence of tinea pedis.

The single most important aspect of preventive self-care is for the patient to inspect his or her feet daily. In those situations in which patients are unable to perform this function themselves, a family member should receive instruction on how to do this properly. Proper

inspection involves inspecting the bottom of the foot visually and feeling it for lesions such as blisters, loose skin, or open sores. Patients also should note any areas of unexplained swelling or redness. The interdigital spaces are particularly problematic areas. They should be inspected and kept dry to prevent maceration, which may lead to athlete's foot and secondary bacterial infection.

Grade 1 Foot The grade 1 ulceration implies the presence of two or more risk factors: peripheral sensory neuropathy and at least one other risk factor, such as bony deformities, plantarly prominent metatarsal heads with distally displaced fat pad, limited joint mobility, or ill-fitting shoes. The grade 1 ulceration extends to the dermis but not beyond . The evaluation of ulcerations should include a search for risk factors and an underlying cause. Ulcerations themselves should be evaluated for size, depth, and location. Knowledge of the anatomic structures involved, as well as the presence of any infection, will help direct treatment. The presence and type of drainage should also be noted. Cultures are of limited usefulness at this stage as the ulceration likely will be colonized with multiple organisms representing primarily skin flora.

Treatment most commonly requires soft-tissue debridement and elimination of all pressure from the site of ulcerations . Ulcerations most commonly will have some degree of hyperkeratosis surrounding the ulcer bed. In many cases, this callus tissue will overhang the margins of the ulcer, thus preventing ulcer healing from the “inside out.” Therefore, all exuberant hyperkeratotic tissue must be debrided to a healthy granular bed that will support further granulation. Debridement has the added advantage of promoting dependent drainage and perhaps stimulating growth factors. Studies have suggested that ulcers that have undergone aggressive debridement may heal faster .[22, 24]

The second important concept of wound healing is off-loading, the technique by which pressure at the site of the ulceration is eliminated or reduced. There are various means of accomplishing this. The most

effective is total non-weight-bearing on the affected extremity by means of crutches or a walker. This is often impractical for most patients, making compliance a serious issue. Therefore, techniques such as the total-contact cast and felted foam dressings have been devised as a compromise to relieve pressure, increase compliance, and improve the chances for healing.

Dressings are changed daily to provide a moist wound environment, which has been shown to be conducive to wound healing. Normal saline, hydrogels, and growth factors are acceptable choices for superficial ulcerations without active drainage or infection. Harsh, undiluted chemicals should be avoided, as they can be toxic to granulation tissue . Topical antibiotics have limited usefulness in this setting . If an infection is suspected, it is best treated with systemic antibiotics. Oral antibiotics are recommended only when clinical signs of infection are present (i.e., erythema, purulent drainage). Overuse of oral antibiotics may lead to superinfection or development of resistant strains. Exceptions to this rule include patients with severe peripheral vascular disease, in whom development of infection may be limb-threatening, or in patients receiving immunosuppressive medications, as in kidney or kidney/pancreas transplant recipients.

Repeated ulcerations may warrant consideration of surgical correction of any underlying structural deformity. Metatarsal osteotomies, digital arthroplasties, and metatarsal-head resections have all proven useful in the prevention of recurrent ulcerations .

Grade 2 Foot Failure to adequately off-load grade 1 lesions likely will lead to deepening ulcerations beyond the level of the dermis . Deeper structures such as tendons or joint capsule may often be involved (grade 2). Appropriate management of these ulcerations depends on the accurate assessment of ulcer depth and the structures involved.

The most accurate and cost-effective method for assessing ulcer depth is to probe the ulcer base gently with a stainless-steel blunt probe. This technique can detect undermining of the ulceration,

presence of any penetrating sinus tract, and involvement of deeper structures . The ability to probe bone with this simple technique has an 89% specificity for the diagnosis of osteomyelitis. This compares favorably with more expensive and invasive tests such as labeled white blood cell (WBC) scans and magnetic resonance imaging (MRI) . Bone, joint, or tendon involvement should alert the clinician to the possible need for hospitalization, complete bed rest, surgical debridement, and broad-spectrum intravenous antibiotics.

Areas of undrained infection should be opened and drained dependently. Although most of these debridements can be performed at the bedside in severely neuropathic patients, if the infection is expected to be extensive, the patient should be brought to the operating room for a thorough debridement.

The wound is then packed open .All nonviable, necrotic tissue should be sharply debrided. This may often require the removal of infected tendon and/or bone. Antibiotics are adjusted to cover the offending organisms. The choice of antibiotics should be based on deep cultures taken at the time of surgery.

The clinician often may delay or avoid the aggressive debridement of the infected foot in patients with ischemia. Such delay may actually lead to further tissue loss and potential limb loss. The infection should be controlled first by debridement. Once this is accomplished, an arteriogram and lower extremity revascularization should be performed in the patient with an ischemic limb to prevent further tissue loss and to salvage the limb . Recent advances in vascular surgery and anesthesia have made this option safe and successful in patients with diabetes .

Although radiographs are not always sensitive enough to make the diagnosis of osteomyelitis, they should be performed on all long-standing, full-thickness ulcerations to evaluate for osteomyelitis. Bone scans, labeled WBC scans, MRIs, and bone biopsies have been recommended as more sensitive studies for diagnosing osteomyelitis . However, any of these modalities can result in false-positive and false-negative diagnoses. Once again, the ability to probe bone with a blunt,

sterile probe is both reliable and cost-effective in diagnosing osteomyelitis .

Not all patients with grade 2 ulcerations require hospitalization . Outpatient treatment of these lesions must follow the same principles as those applied to treating grade 1 ulcerations, namely strict adherence to non-weight-bearing if healing is expected to occur. Although rare, ulcerations over exposed tendon and capsule have the ability to granulate. The same strategies to off-load grade 1 ulcerations (e.g., felted foam dressings, total-contact cast) should be applied to grade 2 ulcerations. Dressings typically are changed twice daily because of the increased drainage that commonly occurs with these ulcerations. It is best if dressings are changed by a healthcare professional, such as a visiting nurse, trained in recognition of early signs of infection. Oral antibiotics, while often not necessary in grade 1 ulcerations, are more commonly prescribed in grade 2 ulcerations because of the depth of the ulcerations, the vital structures involved, and the presence of drainage, creating an ideal environment for bacterial growth. First-generation cephalosporins are often a good initial choice as they provide broad-spectrum coverage and good coverage of staphylococci . Any changes in antibiotics should be based on deep wound cultures and sensitivity as well as the clinical response of the wound.

The care of the foot following complete healing is just as important as the care provided to rid the foot of infection. Regular patient follow-up is essential to ensure proper wound healing and assess the effectiveness of any orthotic device and shoe-gear modification. This is especially important in cases in which metatarsal heads have been resected, either single or multiple. One can expect that additional pressure will be transferred to adjacent metatarsal heads . It is therefore important for the foot to be protected with an appropriate orthotic device. These patients will also require education on selection of appropriate shoe gear. Conventional jogging shoes fitted with an orthotic device are appropriate for most patients with diabetes. However, patients with more severe foot deformities need specialized

shoe gear. Extra-depth shoes that have a deep toe box may be required . In some cases custom-molded shoes may be necessary. Patients also need to be educated on the care of the foot. Daily care should consist of daily inspection, especially between the toes, and the daily use of an appropriate moisturizing cream on the heel and the sole of the foot to avoid fissures. Both the inside and the outside of the shoes should also be inspected every day. The patient should understand the need for regular visits to a foot specialist for continued monitoring.

Grade 3 ulcerations typically result from grade 2 ulcerations that have not responded to local care or have been neglected. Less common causes include particularly aggressive bacteria that result in early and rapid tissue necrosis and puncture wounds that lead to direct inoculation of underlying bony structures. Invariably, these ulcerations involve bone. Therefore, hospitalization and surgical debridement often is necessary.

The key to managing grade 3 ulcerations is to perform an adequate incision and drainage procedure of any underlying infection . Any sinus tract discovered must be explored. Any abscess must be drained, and all devitalized tissue must be debrided. In some cases, open amputations may be required to control the spread of infection and achieve limb salvage. This should be performed initially without regard to the vascular status of the limb.

After the infection has been cleared and healthy granulation tissue is seen, thought can be given to surgical reconstruction of the wound and foot. This may involve simple delayed primary closure or more complicated reconstructive surgery, including additional bone resections, tissue flaps, or skin grafts. No single technique can be applied to all wounds. A flexible approach to wound closure will maximize limb salvage. These lesions will make maximum use of all members of the diabetic foot team .

Because ablative surgery is common in the grade 3 foot, pressure is often transferred to adjacent areas of the foot, increasing the risk of chronic ulcerations. The long-term management of the grade 3 foot

must emphasize prevention of transfer ulcerations. Prevention of recurrent ulcerations requires knowledge of orthoses and footwear.

These at-risk patients should be encouraged to schedule regular visits to their podiatrist for the purpose of preventive diabetic foot care, education, and evaluation of orthoses and footwear. When orthoses and shoe gear are worn out, they should be replaced immediately. The goal of these interventions is to distribute plantar foot pressure evenly and avoid concentrating pressure in any one area.

Grade 4 Foot Diabetic patients with grade 4 lesions may pose several challenges, including a variety of underlying risk factors. The cooperation and involvement of a dedicated limb-salvage team will often be required to help manage the various issues encountered in this particular group of patients. The team may include vascular surgeons, podiatrists, plastic and reconstructive surgeons, and orthopedic surgeons. The primary goal is to limit the amount of tissue loss and maintain a functional extremity.

Gangrenous changes in the lower extremity can commonly occur in one of two ways. Minor injury to the foot can result in gangrenous changes of the skin when severe arterial insufficiency is present . Injuries such as puncture wounds, superficial abrasions, or heel fissures may appear minor. Yet, they can have devastating consequences in the patient with arterial insufficiency.

The arteries below the level of the popliteal artery are most commonly affected. This results in lack of adequate perfusion and oxygenation. Initially, there may be a focal area of necrosis. If not corrected, tissue loss will increase, leading to dry gangrene. The second potential cause of gangrene is overwhelming infection. In this case, occlusion of digital arteries can occur as a result of marked edema of the local tissue or an infective vasculitis . The clinical findings described as “wet gangrene” result from infective vasculitis. It is therefore imperative to identify the underlying cause in the hope of minimizing further tissue loss. When gangrene results from arterial insufficiency, an immediate vascular assessment should be instituted

and lower-extremity revascularization performed where possible. If infection is the primary cause, selection of an appropriate antibiotic and aggressive debridement with adequate incision and drainage is the treatment of choice.

The vessels most commonly affected by diabetic vascular disease are the anterior and posterior tibial arteries. A significant clinical feature of the diabetic foot is that the foot vessels (i.e., dorsalis pedis) are often spared . This is significant because it makes distal arterial bypass procedures possible and effective. This contradicts the concept of “small-vessel disease,” which has been associated with the diabetic foot since the late 1950s. It previously was believed that lack of healing of diabetic foot ulcers was due to occlusive disease of the digital arteries. Several investigators have shown that this does not occur. Most vascular surgeons and individuals who deal with the diabetic foot on a regular basis believe that small-vessel disease is not a major issue in the diabetic foot.

Adequate preoperative evaluation for arterial insufficiency requires visualization of the pedal arteries. The current standard of care dictates the use of digital subtraction angiography (DSA) to assess the level of revascularization accurately . Once revascularization has been performed, an amputation at the most distal level that will support healing should be performed with consideration to preserving as much of the weight-bearing surface of the foot as possible. This will allow more efficient ambulation, better distribution of plantar pressures, and easier shoeing of the foot.

When gangrene results from extensive or overwhelming infection, immediate incision and drainage must be performed, because any delay in treatment may lead to systemic toxicity, including a substantial risk of mortality. This may necessitate open amputation and should be performed even in the face of arterial insufficiency. Once control of the infection has been established and the patient is stable, thought should turn to foot salvage. This may require revascularization or reconstructive surgery of the foot and ankle.[22, 24, 26]

Grade 5 foot

The only treatment for extensive necrosis of the foot is primary amputation. Arterial occlusion and lack of arterial inflow are the main causes of gangrene. Even in these advanced cases, patients should undergo vascular assessment in the form of DSA and, if possible, revascularization so that the most distal level of amputation that will support healing is performed. It should be remembered that oxygen consumption increases dramatically with more-proximal amputations, increasing work and energy expenditure by the patient during ambulation. Because many of these patients already have some compromise of cardiac function, this becomes an important factor in their postoperative recuperation and in their ability to function independently .[19, 22]

2-11-13-Care of the amputated foot

One of the risk factors for recurrent ulcerations is prior foot surgery, either reconstructive or ablative. The partially amputated foot poses special problems due to the loss of the weight-bearing surface . In basic terms, the same weight-bearing forces that acted before the amputation are at work after the amputation. However, those forces are now distributed over a smaller area. Consequently, the pressure over any one area is increased. In addition, certain types of amputations may lead to muscle imbalances and contractures. This can lead to an abnormal gait and further changes in plantar pressures.

Proper protection of these feet requires the use of orthotic devices and, very often, specially designed therapeutic shoes. Custom-molded orthoses should be made of a soft, closed-celled material that will allow for good shock absorption and accommodation of any lesions or deformities. These must be inspected regularly, because they do fatigue and collapse, thus losing their accommodative properties. Shoe-gear modification is almost always necessary for these at-risk feet. Basic recommendations for shoe gear should include a soft upper with a deep or rounded toe box to accommodate deformities such as bunions or hammer toes. The outer sole should be made of a soft shock-absorbing

material such as EVA (ethylvinylacetate), crepe, or Vibram. These typically wear well and are the best shock absorbers. Patients should also be encouraged to wear shoes with laces as opposed to loafers, because a better, more supportive fit is provided by a laced shoe. Finally, patients should be encouraged to change their shoes every 3 to 4 hours to avoid pressure points, to maintain the support and stability of the shoe, and to allow patients the opportunity to inspect their feet during the course of the day .When the patient has severe foot deformities, as those seen with Charcot joint disease, a custom-molded shoe may be the patient's best alternative.

Regular examination by a podiatrist is an important part of preventive care. The role of the podiatrist is to detect early warning signs of impending trouble. The presence of corns or calluses is a sign of focal pressure, from either weight-bearing forces or shoe irritation. The myth that calluses are protective and should not be trimmed has proven to be false . Any corn or callus should be trimmed by a podiatrist. Nails should be inspected for proper growth and care. Patients with diabetes should be instructed on the importance of avoiding “bathroom surgery” for the self-care of ingrown nails. While cutting nails straight across may be desired, few patients' nails allow this. Current convention dictates that nails should be trimmed according to the contour of the nail. Diabetic patients with profound sensory neuropathy or evidence of peripheral vascular disease should not be allowed to trim their own nails and should seek professional care. Diabetic patients should have their orthoses and shoes evaluated regularly for increased wear and loss of support. When this occurs they should be replaced immediately.[2, 6, 17]

2-11-14-Foot surgery for the diabetic patients

Not so long ago, patients with diabetes were advised to avoid foot surgery at all cost. Small-vessel disease and the risk of infections were cited as factors that impaired healing. This misinformation and misconception prevented many patients with diabetes from undergoing potentially limb-sparing foot procedures. Today, a more aggressive

approach to the diabetic foot, including earlier surgical intervention, to prevent major amputations has been advocated by various centers. cal surgical intervention may be advised where bony deformities exist, which are known to pose risk for ulceration, or where chronically recurrent ulcerations have failed to heal. Hammer toes and plantar-flexed metatarsals are known risks for ulceration, as they are often areas of high focal pressures. Arthroplasties and metatarsal osteotomies have been shown to be effective surgical treatments to allow primary healing of the ulcer and to decrease the risk of recurrence . Local surgical procedures such as metatarsal head resections can be performed to resect localized osteomyelitic bone . Multiple metatarsal head resections can be performed as an alternative to distal amputation and still leave a functional foot capable of efficient ambulation.

Furthermore, maintaining as much of the plantar weight-bearing surface as possible allows better weight distribution.In recent years, there has been increased discussion on the role of prophylactic surgery in the diabetic patient. Some groups define prophylactic surgery as surgery performed to correct an underlying deformity even in the absence of a history of ulceration . Other groups subscribe to a narrower definition of prophylactic surgery: surgery performed on those deformities that have a history of ulceration to prevent further ulceration and possible amputation.

When surgery is being considered, proper patient selection and preoperative evaluation are tantamount to success. A thorough history and physical examination should be performed, with special emphasis on the cardiac and vascular examination. Whenever possible, surgery should be performed with the patient under local anesthesia with mild sedation to minimize stress on the heart. Many of these surgical procedures are amenable to this type of anesthesia because of the patients' sensory neuropathy .[1, 20, 35]

2-11-14-1-Charcot joint diseases

It is estimated that one in 680 patients with diabetes have Charcot joint disease. However, this may be an underestimate, as many

cases go undetected until the late stages. Classically, Charcot joint disease presents as unexplained swelling and erythema of the foot.

Although there is often a history of trauma prior to the development of the Charcot joint, the trauma may be so insignificant that patients are unable to recall a specific injury. It is often believed that profound sensory neuropathy makes this a painless process. In fact, patients may complain of mild to moderate discomfort. The pain, however, is not in proportion to the degree of bone and joint destruction seen on radiographs . Charcot joint disease is one of the most misdiagnosed entities involving the diabetic foot. Common misdiagnoses include osteomyelitis, tendinitis, gout, or acute sprain. It is important to maintain a high index of suspicion when encountering diabetic patients with unexplained painless swelling. In these patients, in the absence of a portal of entry, a diagnosis of Charcot joint disease should be considered until proven otherwise.

Initial evaluation of a suspected Charcot joint should begin with plain radiographs. In most circumstances, no further diagnostic studies are necessary, as the bone destruction is often quite obvious. Computed tomography (CT) scans and MRIs are rarely necessary to make the diagnosis of Charcot joint. CT scans may be useful for preoperative planning if surgical correction of the deformity is being contemplated. Although any joint of the foot can be affected, the most common location is the tarsometatarsal articulations (Lisfranc joint) . Charcot joint disease is characterized by three clinical phases: acute, coalescence, and reconstruction or remodeling. The acute phase is characterized by edema, localized warmth, erythema, and joint crepitus with range-of-motion examination. Radiographically, this phase is characterized by osseous debris, fragmentation, and possible subluxations of joints. The degree of fragmentation is variable and most often is related to the particular joints involved and continued ambulation on the fractures.

Once appropriate treatment is instituted, edema and erythema reduce rapidly. As the Charcot joint progresses to the next phase of

coalescence, skin temperature begins to equilibrate and joint crepitus diminishes. Plain radiographs will show resorption of osseous fragments and the laying down of new bone. The reconstructive or remodeling phase occurs over a period of months and years. During this phase, the joints further stabilize and remodel by way of increased trabeculations and new bone growth. This can eventually lead to a stable foot devoid of significant motion. Unfortunately, in many cases, the foot can be severely deformed, with obvious bony prominences susceptible to ulceration (e.g., the rocker-bottom foot) .

Treatment for the acute Charcot foot is directed at eliminating weight-bearing forces that may lead to further destruction and deformity. This is best achieved by the use of crutches, a walker, or in the event of bilateral involvement, a wheelchair. A walking cast in acute Charcot joint disease is not appropriate treatment. Noncompliance with non-weight-bearing in the early stages of this disease will cause further fragmentation of bone, resulting eventually in greater deformity . Casts, splints, or braces may be used for immobilization and to provide stability to the involved joints but not for weight-bearing initially . Our preference is the use of a removable bivalved cast brace that will allow regular inspection of the insensate skin . Adjunctive therapies, such as biphosphonates or electrical bone stimulation, have been discussed as means to enhance healing . While isolated reports appear to favor these modalities, further clinical trials are needed for objective documentation of their effectiveness.

No weight-bearing is allowed as long as crepitus across joints and elevated skin temperature persist. Lack of attention to these clinical parameters will result in reexacerbation of the disease. Protected weight-bearing can be instituted when the clinical examination and serial radiographs show gradual resolution of the inflammatory process and healing of the involved joints. When appropriate, weight-bearing is instituted in a gradual manner and with protection. Weight-bearing is begun with a protective brace and with 15 to 20 lb of pressure. This can be increased in 10-lb increments per week

as long as there are no signs of reactivation. Should reactivation occur, the patient should be returned to non-weight-bearing until resolution of these symptoms. As weight-bearing progresses, the patient is eventually allowed to ambulate short distances without assistive devices.

Long-term management of chronic Charcot joint often involves accommodation of any resultant foot deformity to avoid ulceration. Whenever possible, conventional shoe gear is preferred over custom-molded shoes. All shoes should be fitted with a well-molded Plastizote orthotic device that will support and cushion the foot. If severe foot deformity develops, there may be no alternative to a custom-molded shoe that matches the shape of the foot.

There has been much recent discussion in the surgical literature of surgical reconstruction foot rendered deformed or unstable by Charcot joint disease . Severe deformity and instability is not uncommon when destruction involves the midtarsal, subtalar, or ankle joints. This can lead to a high likelihood for ulceration or difficulty with ambulation. Arthrodesis of the involved joints can provide a stable platform for ambulation and resistance to further ulcerations. Patients who elect to undergo these procedures must be advised as to the need for prolonged immobilization and non-weight-bearing—in some cases as long as 6 months. Strict adherence to the principles of internal fixation is required if success and limb salvage is expected.[7, 26]

2-11-15-Future of diabetic foot management

The amount of interest in the diabetic foot has increased tremendously over the past 5 years. One only has to look at the numbers of wound-care centers that have sprouted up nationwide as evidence . The major impetus for this interest is the financial burden of caring for the diabetic foot. In 1980, more than $200 million was spent in direct hospital costs alone for the treatment of diabetic-foot complications and amputations . While current cost estimates for the United States are not available, one can only assume that they are significantly higher and will only get higher as the population continues to age and the incidence of diabetes continues to increase.

Most research has centered on treatment of foot ulcers and identification of those factors important in wound healing. Such research has increased our knowledge of the mechanism of wound healing and the identification of various growth factors and their roles in wound healing From this research, autologous platelet-derived wound healing factor was introduced as a topical dressing to help promote wound healing. State-of-the-art research has recently made platelet-derived growth factor available as a topical gel for use on diabetic foot ulcerations . Recombinant DNA technology is used to produce this factor in the laboratory. Early experience with this product has been favorable. Other factors potentially conducive to wound healing are currently being developed in the laboratory using similar technology and should be available for clinical trials within the next 5 years.

The newest area of promise involves the use of bioengineered living-skin equivalents. These products have previously been approved for use in venous stasis ulcerations. Recently, one product, Apligraf, received US Food and Drug Administration approval for use in diabetic foot ulcerations. This product is a dermal/epidermal composite graft grown from neonatal foreskin. It is grown into large sheets on mesh in culture media. It is applied to a properly prepared ulcer bed in the same way that a skin graft is applied. The clinical trials that led to the approval of this product showed a higher percentage of healed ulcerations and a faster healing rate compared with controls .

There continues to be great interest in the treatment and prevention of sensory neuropathy. Earlier studies involving aldose reductase inhibitors had to be suspended before any useful clinical results could be evaluated because of a high incidence of adverse effects. However, the available data suggested that these agents might have some usefulness. Controversy exists concerning the potential role of these agents in the management of diabetic peripheral neuropathy. Recently, there has been renewed interest in these agents, which have been modified to reduce the risk of adverse effects. Tolrestat and γ-linoleic acid have been studied intensively, with promising, but inconclusive, results.

Diabetic neuritis or painful neuropathy remains one of the most frustrating conditions for the patient and for the clinician. The cause of this condition is not well understood. It is often believed that poor glycemic control may be responsible for exacerbations of this condition, although this is not universally accepted. Treatment often consists of trial and error using various agents. Most commonly, the combination of an analgesic with a tricyclic antidepressant has proven most effective, albeit not universally successful . Gabapentin is being used with increasing frequency. While it appears to be relatively safe, there have been conflicting reports on its efficacy .

Diabetic neuroarthropathy (Charcot joint) is another area fertile for investigation. The underlying cause of Charcot joint has not been clearly elucidated. Further, medications that may modulate the Charcot process have been studied on a small scale . Prospective, randomized trials are needed to determine whether these medications have any role in the treatment of Charcot joint disease. Anecdotal reports have claimed a role for the use of electrical bone stimulation to achieve more rapid consolidation . These studies have looked at small numbers of patients and have suffered from being neither randomized nor blinded trials. A large, randomized, double-blinded multicenter trial is needed to determine the efficacy of this modality of treatment.[9, 28, 30]

Study design

This study was semi - Quasi experimental, hospital based research; carried out to evaluate the effectiveness of training program for nurse's regarding education of diabetic patients about self care practice

Study area

The study was carried out at Shendi town which is 176km north to Khartoum and 110 km south to Elddamer, the capital of River Nile State; Shendi town is lies on the eastern bank of the River Nile with a total area of about 14596 Km2. The total population of Shendi 'locality ' is estimated at about 197589 of whom 116713 live in rural areas and 80876 in urban centers, most of them are farmers. Shendi University was established in the early 1990s and stands as a landmark institution in Higher Education

Setting

This study was carried out at Elmeck Nimer University hospital. This hospital was established since 2002. And it's the second university hospital in Sudan. The hospital provides most types of medical services (medicine, surgery, Obs/Gyne, and pediatric). Beside these there are cardiac, renal, and oncology centers). In the hospital there is a big theater complex in which most type general operations can be done (caesarean, GIT surgery and orthopedic surgery …ect). There was two diabetic outpatient clinics in the hospital established science 2009 ,one for adult and other for children , which composed of three rooms ; laboratory ,doctor and nursing follow-up care room which provide care , follow up and teaching for the diabetic patients. In this clinic there are nurses rotate the duty among them , doctors and physician , the clinic work every Thursday from eight o'clock to midday and patient ratio from (25 to 35) patients .

Study population:-

This study includes nurse`s working in Elmak Nimer university hospital during the three shifts. And diabetic patients admitted or visited the outpatient clinic during the time of the study.

Inclusion criteria:

- Adult diabetic patients of both sexes and type I (IDDM) according to the following criteria:-
  - Age: - 18 – 60 years from both sexes
  - Receiving insulin therapy
  - Patient without advanced complications of diabetes

- Nurses :-
  - who have bachelor degree
  - Who have diploma and work for more than two years.
  - Who their experience more than one year.

Exclusion criteria:

- Nurses who work as part timer.
- Newly graduated nurses who work less than one year.

Sampling

A-Nurses

1- Sample techniques

- Nurses were selected randomly by simple random sample technique from frame work sheet developed by the researcher.

2-Sample size

A. (40) nurse was selected by using the following equation to estimate the required sample size from ninety five nurse:-

Sample size (n) = $\frac{Z^2 / Pq}{d^2}$

- (n) = the required sample size
- **Z** = the confidence level = 95 %
- P = the anticipated population proportion = 95 nurse
  - d = absolute precision required on either side of the proportion 5%
  - q = 1-P

B- Patients

- All patient whom admitted to the hospital or visiting the outpatient clinic.

2- Sample size:-

Convenience sample, (200) patient`s were visited the diabetic center clinic during four month, and were met the inclusion and agreed to participate.

Data collection tools

Two programs had been used to assess the nurses and patients during the study for eight moths, and this includes:-

- Structured questionnaire for both nurses and patients.
- Observational Checklist for both nurses and patients.

Part I: - nurses tools

1. **Structured questionnaire for nurses:**

Standard interview closed end questionnaire was developed by the investigator to assess the self – care practice of nurses. It composed of three parts:

Section one

Concerned with Sociodemographic and health profile. It include five structural questions related to nurses sex, educational level , occupation , year of experience, workshops and training courses attended .

Section two

It`s include question about nurses knowledge about diabetes definition, etiology, clinical manifestations, management and source of information.

Section three

It includes structural questions designed to obtain information about nurses knowledge about insulin definition , action , types , dose , site of insulin injection , the route of insulin injection , syringe , the important of rotating insulin site , complication of insulin. Steps of foot care. How patient perform exercise. And diet controlling.

2. Observational skills:

An observational checklist was developed by the researcher guided by reviewing text books. [47, 48, 49]

Scale system:-

The scale system had been described according to the respondents skills and rated for done, not done.

The observational checklist includes:

-Foot care compose of 19 steps

-Exercise program compose of 13 steps

- Diet program compose of 17 steps

- Insulin therapy compose of 14 steps

Part 2: - patients tools

Section one

Concerned with Sociodemographic and health profile. It include five structural questions related to patients sex, educational level , occupation , duration of illness, age.

Section two

It`s include question about patients knowledge about diabetes definition, etiology, clinical manifestations, management and source of information.

Section three

It includes structural questions designed to obtain information about patients knowledge about insulin definition , action , types , dose , site of insulin injection , the route of insulin injection , syringe , the important of rotating insulin site , complication of insulin. Steps of foot care. How they perform exercise. And diet controlling.

3. Observational skills:

An observational checklist was developed by the researcher guided by reviewing text books. [47, 48, 49]

Scale system:-

The scale system had been described according to the respondents skills and rated for done , not done.

The observational checklist includes:

-Foot care compose of 8 steps

-Exercise program compose of 12 steps

- Diet program compose of 10 steps

- Insulin therapy compose of 8 steps

Operational Design

Operational design includes pilot study and data collection technique.

Validity and real ability

The tools have been examined by three expertises' they indicated that some items needed to be modified, and they assured that each tool was achieved the aim of the study.

A pilot study was carried before embarking on the actual study (data collection). To test applicability of the tools of data collection, and to estimate the time required for filling the required forms. It was carried out on ten nurses to evaluate the content of tools in order to determine whether or not the items were understood by the nurses.

The results of pilot were as follows:

- The nurses understand the method used to fulfill each tool. They indicated that some items needed to be modified; rephrasing, omission, whether these items stay as they were or by adding some words.
- Based on pilot results the modification was done and further the researcher refined each tool, each item in the same part, parts to each other and tools to each other, were done. Finally, making assurance that each tool as a whole achieved the aim of the study.
- The pilot study (10nurses) was excluded from the total subject of the research work.

Data collection technique

The data was collected in two phases before implementation of education program (pretest data), in which the questionnaire is distributed for respondents and each one of them is allowed sufficient time to fill it. Then each of responders was observed by checklists for their skills and how patients teach. After collection of pretest data the nurses were received the training program, the training was continued for one month and half, then information's had been taken from patient's after explanation verbally the purpose of the study , written consent was taken , then the researcher filled the interview questionnaire , and then each patients was observed by simplified checklist to perform the skills of foot care , insulin injection ,diet regiment, and exercise schedule .after that the trainee implement this program in the outpatient diabetic clinic at the hospital, four months later the same tools used in pretest was used to collect mid test data and then after another four months post test data was collected from both patients and nurses.

Experimental design model:-

Content	Pre test	Training session	Post test (1)	Ongoing
Knowledge map	O1	X1	O2	O3
Practice map	O1	X1	O2	O3

Note:

(1) X = the experimental treatments
(2) O1 = the pre-test
(3) O2 = the post-test
(4) O3= the ongoing test

Operational procedure

Test	Time	Period	Task
Pre test	4 month	Two weeks	Questionnaire :- filled by nurse (4-7) minutes
		4 weeks	Observational skills :-each nurse was observed alone (10) minutes
		4 weeks	Questionnaire :-filled by patients (5-10) minutes
		6 weeks	Observational skills :-each patients was observed alone (10) minutes
Training (application of the program) for nurses	4 month	4 weeks	Foot care
		4 weeks	Insulin administration
		4 weeks	Diet regiments program
		4 weeks	Exercise scheduling program
Teaching of patient by nurses in small group (10-13) for each group	6 months	6 weeks	Foot care
		6 weeks	Insulin administration
		6 weeks	Diet regiments program
		6 weeks	Exercise scheduling program
Post test one	4 month	Two weeks	Questionnaire :- filled by nurse (3-5) minutes
		4 weeks	Observational skills :-each nurse was observed alone (8) minutes
		4 weeks	Questionnaire :-filled by patients (4-6) minutes
		6 weeks	Observational skills :-each patients was observed alone (10) minutes
Follow up	4 month	Two weeks	Questionnaire :- filled by nurse (3-5) minutes
		4 weeks	Observational skills :-each nurse was observed alone (8) minutes
		4 weeks	Questionnaire :-filled by patients (4-6) minutes
		6 weeks	Observational skills :-each patients was observed alone (10) minutes

Ethical considerations

- The study was approved by ethical committee of the collage and the institute research board of the university.
- Before conducting the study permission was taken from hospital general manager.
- The purpose of study was explained to each one of responders. And the researcher assured them that the data collected from the questionnaire will remain confidential and it's not allowed for any person to identify it. Responders

were informed that they could refuse to participate in the study, and withdraw from it at any time.

- Clarification of the aim of the study to each of the patients had been explained verbally, to be familiar with the importance of their participation, and then written consent has been taken in addition, assuring them that, the obtained information should be only used for the research purpose. And the patients have the choice to participate or stop at any time he\her wish.

Health Education Program:

An intense educational program has been designed by the researcher based on actual assessment of diabetic adult's needs to improve self care practice in the light of the available researches and literature. The intervention has been developed in a simple Arabic language ( ) to cover the relevant theoretical and practical aspects of self care practice of diabetic adult's as physical ,functional, emotional, and social dimensions. Different teaching methods as discussion, demonstration, and re-demonstration, have been used.

The intervention has be implemented to nurses in small groups divided into four main group each group contain ten nurse .The program has been implemented in two sessions a week for four months. Each session had taked about one hour and at the end of each session each nurse has been assessed for his/her understanding of the instructions. The impact of the program had based on the improvement of the nurses quality to train diabetic patients self practice , and to be more compliant to diabetes treatment regimen, decrease in the occurrence of diabetes complications and have acceptance level of blood glucose.

Modules

Real objects (syringes, vial, cotton bottles, regular insulin, modified insulin and left arm module, supplies of foot care, has been used.

The researcher have used different media as charts, animation, colored pictures showing route of administration and rotation of injection site, foot care, and diet schedule.

Data analysis

After the data was collected, it coded and transferred into a specially designed formats so as to be suitable for computer feeding by using the soft ware program SPSS version 16, following data entry, checking and

verification process were carried out to avoid any errors during data entry. Frequency analysis, cross tabulation, and manual revision were all used to detect any errors.

The following statistical measures were used:

1. Descriptive measures include: count, percentage, mean, and standard deviation quantitative data.
2. Statistical test include: Chi square test, T test was used for quantitative variables for research questions.
3. The level of significance selected for this study was **P value** equal to or less than **0.05.**

Results

The results were presented into the following sequences:

1. **Section I:**Frequency and distribution of nurse`s according to their Sociodemographic data.

2. **Section II**: A comparison between study groups (nurses) regarding their practices and knowledge about diabetes self care practice.

Section III: Figure presentation of nurse`s according to their Sociodemographic data..

3. **Section IV :**A comparison between studies groups (diabetic patients`) regarding their self care practice.

4. **Section V**: Figure presentation of the study groups in relation to patient's practices, and Sociodemographic data.

Result Summary

Table No (1) represent that there was highly significant relation between farmer age and educational level, while the relation was significant between employer age and educational level, and the relation was significant between housewife age and educational level.

Table No (2) showed that, nurse's knowledge regarding insulin therapy during the pre test (71.25%), post test one (34.5%), and in post test two was (91.9%).

Table No (3) showed that, nurses knowledge regarding foot care was (53.1%) during the pre test phase, while (76.25%) in post test, and (83.7%) in follow up phase.

Table No (4) showed that, nurse's knowledge regarding diet regiment program in pre test was (50%), while in post test was (83.1%), and in post test two was (93.1%).

Table No (5) showed that, nurse's knowledge regarding exercise program in pre test nurses was (56.9%), post test one was (95%), and in post test two was (96.9%).

Table No (6) showed that, nurse's skills regarding insulin therapy during the pre test (62.5%), post test one (92%), and in post test two (92.3%).

Table No (7) showed that, nurses skills regarding foot care during the pre test was (65.75%), post test one (81.75%), and in post test two (94.75%).

Table No (8) showed that, nurse's skills regarding exercise program during the pre test was (32. 5%), post test one (87. 5%), and in post test two (92. 5%).

Table No(9) showed that, there was improvement in nurse's skills regarding diet regiment program during the pre test was (77.75%), post test one (91.75%), and in post test two (95.25%).

Table No (10) showed that, there was significant relationship between patients educational level, occupation, and age.

Table No (11) showed that, patients knowledge regarding diet regiment program in pre test was (65.65%), while in post test was (85.5%), and in post test two was (94.65%).

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Table No (12) showed that, patients knowledge regarding insulin therapy during the pre test (18.4%), post test one (87%), and in post test two was (89.9%).

Table No (13) showed that, patients knowledge regarding exercise program in pre test nurses was (31.9%), post test one was (77.75%), and in post test two was (97.5%).

Table No (14) showed that, patients knowledge regarding foot care was (37%) during the pre test phase, while (85%) in post test, and (98.5%) in follow up phase.

Table No (15) showed that, patients skills regarding insulin therapy during the pre test (36%), post test one (73.5%), and in post test two (75.65%).

Table No (16) showed that, patients skills regarding foot care during the pre test was (18%), post test one (68. 5%), and in post test two (74. 5%).

Table No (17) showed that, patient's skills regarding exercise program during the pre test was (7. 5%), post test one (60%), and in post test two (72. 5%).

Table No (18) showed that, there was improvement in patients skills regarding diet regiment program during the pre test was (38.65%), post test one (63%), and in post test two (73.6%).

Figure No (1) showed that, 17.5% of nurses their experience less than one year, 70% of nurses their experience from (1-3) years, 7.5% of nurses their experience from (3-6) years, and 5% of nurses their experience less than one years.

Figure No (2) showed that, 27.5% of nurses were never attended any workshop, 37.5% of nurses attended only one workshop, while 22.5% of nurses were attended two session of workshop, and 12.5% of nurses more than three session of workshop.

Figure No (3) showed that, most of the patient were housewife (101), (34) were employer, and (66) were farmer

Section I

Table No (1) Relationship between nurses educational level, years of experience, and workshops attended

N= 40

workshops	Education level	Experience				total	P value
		<one year	(1-3) years	(3-6 years	>6 years		
Never	Diploma	0	2	0	0	2	
	Bachelor	0	8	0	0	8	
Once	Diploma	0	2	0	0	2	.000
	Bachelor	0	11	3	0	14	
Twice	Diploma	2	1	0	0	3	
	Bachelor	3	3	0	0	6	
Three or more	Bachelor	2	1	0	2	5	
Total		7	28	3	2	40	

Section 2

Table No (2) the differences between nurse's knowledge pre, post and ongoing test regarding insulin administration

N = 40

Nurses knowledge	Pre test		Post test		Follow up	
	Know	Not know	Know	Not know	Know	Not know
Types , action , duration of insulin	29(72.5%)	11(27.5%)	32(80%)	8(20%)	36(90%)	4(10%)
Technique of injection	28(70%)	12(30%)	35(87.5%)	5(12.5%)	38(95%)	2(5%)
Complications of miss dose or over dose	26(65%)	14(35%)	34(85%)	6(15%)	35(87.5%)	5(12.5%)
Safe disposal of needles	31(77.5%)	9(22.5%)	36(90%)	4(10%)	38(95%)	2(5%)
Mean	28.5(71.25%)	11.5(28.75%)	34.5(86.25%)	5.8(13.75%)	36.75(91.9%)	3.25(8.1%)

Table No (3) the differences between nurses knowledge pre, post and ongoing test regarding foot care

N = 40

Nurses knowledge	Pre test		Post test			
			Post test		Follow up	
	Know	Not know	Know	Not know	Know	Not know
Common types of diabetic foot problems	29(72.5%)	11(27.5%)	33(82.5%)	7(17.5%)	35(87.5%)	5(12.5%)
Foot care: ferequency,cleaning, observation	25(62.5%)	15(37.5%)	32(80%)	8(20%)	36(90%)	4(10%)
Advised patient regarding foot care	16(40%)	24(60%)	28(70%)	12(30%)	32(80%)	8(20%)
About suitable shoes	15(37.5%)	25(62.5%)	29(72.5%)	11(27.5%)	31(77.5%)	9(22.5%)
Mean	21.25(53.1%)	18.75(46.9%)	30.5(76.25%)	9.5(23.75%)	33.5(83.75%)	6.5(16.25%)

Table No (4) the differences between nurses knowledge pre, post and ongoing test that given to patients regarding diet regiment program

N = 40

Nurses knowledge	Pre- test		Post test		Follow up	
	Know	Not know	Know	Not know	Know	Not know
Advised patients about adjustment of meal components	24(60%)	16(40%)	34(85%)	6(15%)	36(90%)	4(10%)
Advised patients about importance of regulater meals time	26(65%)	14(35%)	31(77.5%)	9(22.5%)	35(87.5%)	5(12.5%)
Advised patients avoiding of skipping meals and snacks	15(37.5%)	25(62.5%)	35(87.5%)	5(12.5%)	39(97.5%)	1(2.5%)
Advised patients about hypoglycemia prevention and treatment	15(37.5%)	25(62.5%)	33(82.5%)	7(17.5%)	39(97.5%)	1(2.5%)
Mean	20(50%)	20(50%)	33.25(83.1%)	6.75(16.9%)	37.25(93.1%)	2.75(6.9%)

Table No (5) the differences between nurses knowledge pre, post and ongoing test regarding exercise program

N = 40

Nurses knowledge	Pre - test		Post test			
			Post test		Follow up	
	Know	Not know	Know	Not know	Know	Not know
Pre exercise assessment	26(65%)	14(35%)	38(95%)	2(5%)	38(95%)	2(5%)
Suitable types of exercise	22(55%)	18(45%)	39(97.5%)	1(2.5%)	39(97.5%)	1(2.5%)
Principle of exercise	29(72.5%)	11(27.5%)	37(92.5%)	3(7.5%)	40(100%)	0(0.0%)
Symptoms of exercise intolerance	14(35%)	26(65%)	38(95%)	2(5%)	38(95%)	2(5%)
Mean	22.75(56.9%)	16.25(43.1%)	38(95%)	2(5%)	38.75(96.9%)	1.25(3.1%)

Table No (6) the differences between nurses performance regarding educating patients insulin administration pre, post and ongoing test

N = 40

Teaching points	Pre test		Post test		Follow up	
	Done	Not done	Done	Not done	Done	Not done
Checked order for :Types , dose , time	31(77.5%)	9(22.5%)	39(97.5%)	1(2.5%)	39(97.5%)	1(2.5%)
Follow the six rights	38(95%)	2(5%)	39(97.5%)	1(2.5%)	38(95%)	2(5%)
Preparation of equipments	32(80%)	8(20%)	38(95%)	2(5%)	38(95%)	2(5%)
Selecting site of injection	38(95%)	2(5%)	40(100%)	0(0.0%)	37(92.5%)	3(7.5%)
adjusting of insulin dose	39(97.5%)	1(2,5%)	39(97.5%)	1(2.5%)	40(100%0	0(0.0%)
Technique of injection	26(65%)	14(35%)	35(87.5%)	5(12.5%)	38(95%)	2(5%)
Assessment of injection site	13(33%)	27(67.5%)	35(87.5%)	5(12.5%)	39(97.5%)	1(2.5%)
Observe signs and symptoms of complications	14(35%)	26(65%)	34(85%)	6(15%)	36(90%)	4(10%)
Document patients response	10(25%0	30(75%)	37(92.5%)	3(7.5%)	32(80%)	8(20%)
Follow a septic technique	9(22.5%)	31(77.5%)	32(80%)	8(20%)	34(85%)	6(15%)
Mean	25(62.5%)	15(37.5%)	36.8(92%)	3.2(8%)	37.1(92.3%)	2.9(7.7%)

Table No (7) the differences between nurses performance regarding educating patients tips of foot care pre, post and ongoing test

N = 40

Teaching points	Pre test		Post test		Follow up	
	Done	*Not done*	Done	*Not done*	Done	*Not done*
Taught patient about diabetic food risk	25(62.5%)	15(37.5%)	28(70%)	12930%)	35(87.5%)	5(12.5%)
Advised patient to look at feet every day by mirror	26(65%)	14(35%)	32(80%)	8(20%)	37(92.5%)	3(7.5%)
Instructed patients to wash feet every day three to four time	17(42.5%)	23(57.5%)	30(75%)	10(25%)	38(95%)	2(5%)
Taught patient to dry carefully between toes and avoid lubricant on it	33(82.5%)	7(17.5%)	32(80%)	8(20%)	38(95%)	2(5%)
Instructed patients to apply moisturizing cream to the heel if have dry skin	23(57.5%)	17(42.5%)	28(70%)	12930%)	38(95%)	2(5%)
Instructed patients to wear clean socks	33(82.5%)	7(17.5%)	36(90%)	4(10%)	39(97.5%)	1(2.5%)
Instructed patients to select proper shoes	32(80%)	8(20%)	36(90%)	4(10%)	40(100%0	0(0.0%)
Advised patient to See a podiatrist regularly	13(32.5%)	27(67.5%)	37(92.5%0	3(7.5%)	38(95%)	2(5%)
Taught patient to avoid walk barefoot , walk barefoot, Exposed to heat source	29(72.5%)	11(27.5%)	34(85%)	6(15%)	39(97.5%)	192.5%)
Taught patient not treat foot problems by themselves	32(80%)	8(20%)	34(85%)	6(15%)	37(92.5%)	3(7.5%)
Mean	26.3(65.75%)	13.7(43.25%)	32.7(81.75%)	7.3(18.25%)	37.9(94.75%)	2.1(5.25%)

Table No (8) the differences between nurses performance regarding educating patients exercise regiment pre, post and ongoing test

N = 40

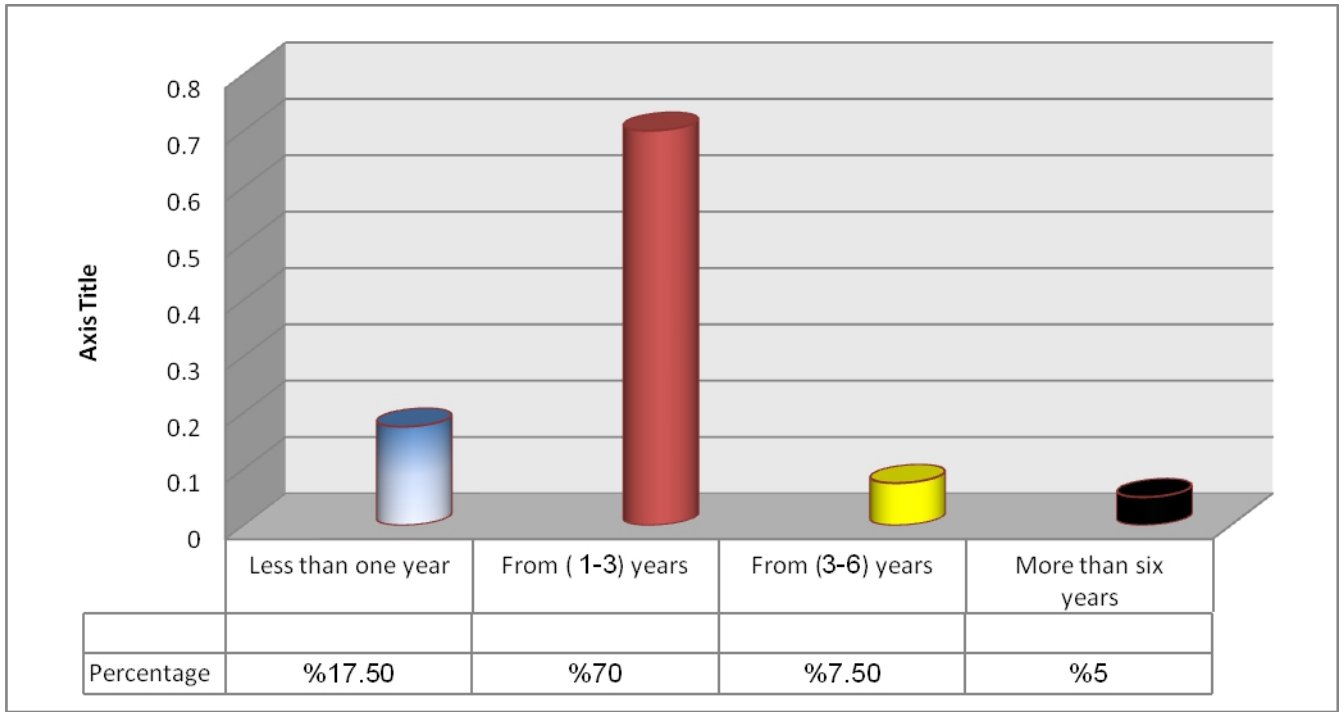
Teaching points	Pre test		Post test		Follow up	
	Done	Not done	Done	Not done	done	Not done
Examined feet for ulcer , plaster before and after exercise	24(60%)	16(40%)	35(87.5%)	5(12.5%)	36(90%)	4(10%)
Selected the suitable socks and shoes and checked for foreign body	30(75%)	10(25%)	36(90%)	4(10%)	39(97.5%)	1(2.5%)
Checked blood glucose level before exercise	8(20%0	32(80%)	32(80%)	8(20%)	39(97.5%)	1(2.5%)
Drunked plenty of water before and during exercise	20(50%)	20(50%0	32(80%)	8(20%)	35(87.5%)	5(12.5%)
Make sure about drug dose is correct	14(35%)	26(65%)	33(82.5%0	7(17.5%)	38(95%)	2(5%)
Always warmed up for at least five minutes before they exercise	11(27.5%)	29(72.5%)	38(95%)	2(5%)	39(97.5%)	1(2.5%)
Cool down for at least five minutes afterwards before you stop moving.	11(27.5%)	29(72.5%)	36(90%)	4(10%)	37(92.5%)	3(7.5%)
Stared t with 10 minutes (or even less) and gradually increase their workout duration as they become more fit.	7(17.5%)	33(82.5%0	29(72.5%)	11(27.5%)	36(90%)	4(10%)
scheduling your exercise at the same time of day can help with blood glucose control	16(40%)	24(60%)	35(87.5%)	5912.5%)	36(90%)	4(10%)

Teaching points	Pre test		Post test		Follow up	
	Done	*Not done*	Done	*Not done*	Done	*Not done*
Taught patients about benefits of achieving and maintaining ideal weight	23(57.5%)	17(42.5%)	27(67.5%)	13(32.5%)	37(92.5%)	3(7.5%)
Advised patients about regulation time of meals	29(72.5%)	11(27.5%)	36(90%)	4(10%)	40(100%)	0(0.0%)
Taught patients number of meal per day	34(85%)	6(15%)	39(97.5%)	1(2.5%)	38(95%)	2(5%)
Advised patients about the suitable diet according to (exercise , medication)	28(70%0	12(30%0	34(85%)	6(15%)	38(95%)	2(5%)
Advised patients about adjustment of meal components	26(65%)	14935%)	39(97.5%)	1(2.5%)	37(92.5%)	3(7.5%)
Advised patients about importance of diet in managing , and preventing of complications	34(85%)	6(15%)	38(95%)	2(5%)	36(90%)	4(10%)
Taught patients when to take medication in relation to meal	35(87.5%)	5(12.5%)	38(95%)	2(5%)	37(92.5%)	3(7.5%)
Taught patients about regular meal pattern and snacks	37(92.5%)	3(7.5%)	38(95%)	2(5%)	39(97.5%)	1(2.5%)
Taught patients about meal based on low glycemic index	33(82.5%)	7(17.5%)	38(95%)	2(5%)	39(97.5%)	1(2.5%)
Taught patients about avoiding of skipping meals and snacks	38(95%)	2(5%)	40(100%)	0(0.0%)	39(97.5%)	1(2.5%)
Taught patients about Keeping of artificial sweeteners	28(70%)	12(30%)	39(97.5%)	1(2.5%)	39(97.5%)	1(2.5%)
Hypoglycemia prevention and treatment	25(62.5%)	15(37.5%)	33(82.5%)	7(17.5%)	37(92.5%)	3(7.5%)
Decrease simple sugar, fat, salt intake	34(85%)	6(15%)	38(95%)	2(5%)	39(97.5%)	1(2.5%)
Mean	31.1(77.75%)	8.9(32.25%)	36.7(91.75%)	3.3(8.25%)	38.1(95.25%)	1.9(4.75%)

Table No (9) the differences between nurses performance regarding educating patient's diet program pre, post and ongoing test N = 40

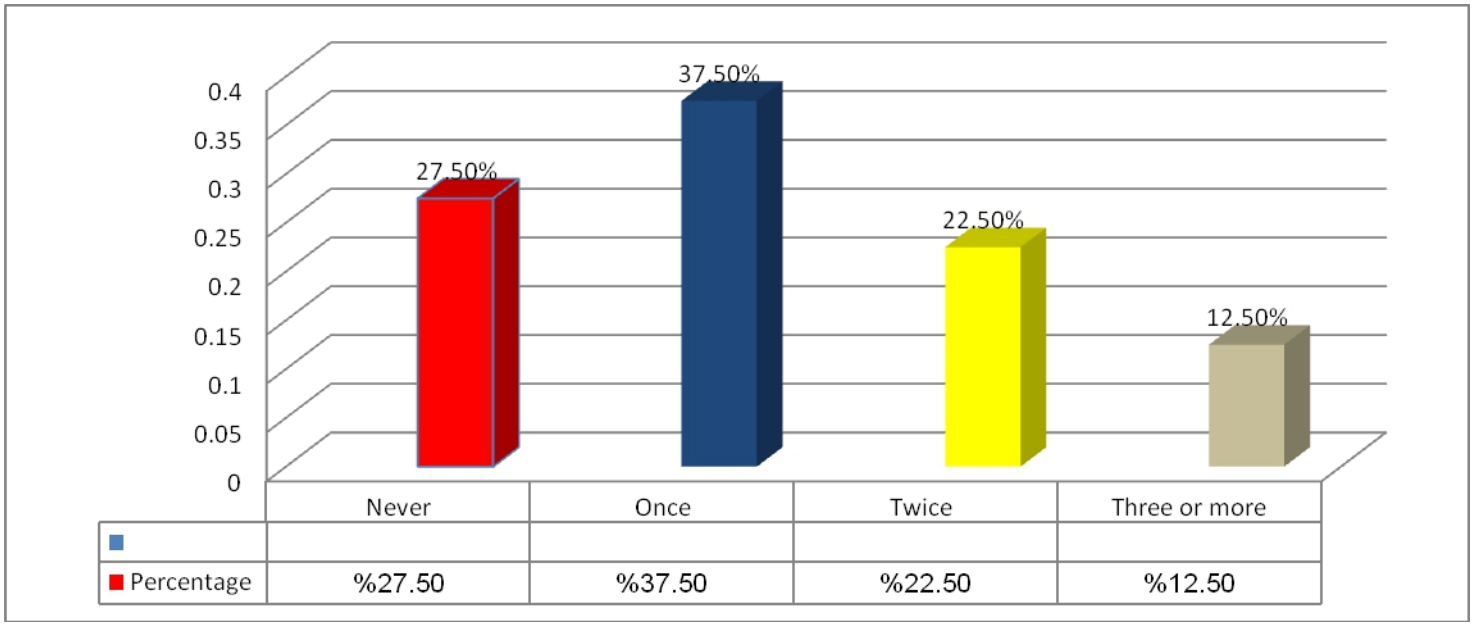
Section 3

Figure No(1)



Distribution of nurses according to their years of experience

Figure No (2)



Distribution of the nurses according to workshops attended

Section 4

Table No(10) Relation between patients occupation, age, and educational level

Occupation	Age	Educational level				total	P value
		Illiterate	Basic school	High secondary	Graduate		
Farmer	Age less than 20 years	24	0	0	0	24	
	From (20-40) years	14	2	0	0	16	.000
	From (41-60) years	2	18	6	0	26	
Employer	Age From (20-40) years	12	10	0	0	22	
	From (41-60) years	5	0	0	0	5	0.21
	more than 60 years	7	0	0	0	7	
House wife	Age less than 20 years	4	0	0	0	4	
	From (20-40) years	8	0	2	5	15	
	From (41-60) years	17	25	10	0	52	.000
	more than 60 years	12	11	5	1	29	
Total		105	66	23	6	200	

Table No (11) the differences between patients knowledge pre, post and ongoing test regarding diet regiment program

N = 200

Patients knowledge	Pre- test		Post test			
			Post test		Follow up	
	Know	Not know	Know	Not know	Know	Not know
adjustment of meal components	110(55%)	90(45%)	157(78.5 %)	43(21.5%)	180(90%)	20(10%)
regulation time of meals	65(32.5%)	135(67.5%)	179(89.5 %)	21(10.5%)	193(96.5%)	7(3.5%)
Avoiding of skipping meals and snacks	180(90%)	20(10%)	168(84%)	32(16%)	194(97%)	6(3%)
Hypoglycemia prevention and treatment	170(85%)	30(15%)	180(90%)	20(10%)	190(95%)	10(5%0
Mean	131.3(65.65%)	68.7(43.35%)	171(85.5%)	29(14.5%)	189.3(94.65%)	10.7(5.35%)

Table No (12) the differences between patient's knowledge pre, post and ongoing test regarding insulin therapy

N = 200

Patients knowledge	Pre- test		Post test			
			Post test		Follow up	
	Know	Not know	Know	Not know	Know	Not know
Information about insulin storage ,types, dose time,	100(50%)	100(50%)	150(75%)	50(25%)	166(83%)	34(17%)
Selecting injection site and Technique of administeration	55(27.5%)	145(72.5%)	181(90.5%)	19(9.5%)	180(95%)	10(5%)
Signs and symptoms of complication and their action	40(20%)	160(80%)	177(88.5%)	23(11.5%)	183(91.5%)	17(8.5%)
Signs and symptoms of hypoglycemia and hyperglycemia	7(3.5%)	193(96.5%)	188(94%)	12(6%)	190(95%)	10(5%0
Mean	36.8(18.4%)	163.2(81.6%)	174(87%)	26(13%)	179.8(89.9%)	20.2(10.1%)

Table No (13) the differences between patients knowledge pre, post and ongoing test regarding exercise program

N = 200

Patients knowledge	Pre- test		Post test			
			Post test		Follow up	
	Know	Not know	Know	Not know	Know	Not know
Action done before exercise	66(33%)	134(67%)	116(58%)	84(42%)	191(95.5%)	9(4.5 %)
Common types of exercise they perform	67(34%)	132(66%)	180(90%)	20(10%)	199(99.5%)	1(0.5%)
Steps of perform exercise	90(45%)	110(55%)	160(80%)	40920%)	195(97.5%)	5(2.5%)
Symptoms of discontinuing exercise	32(16%)	168(84%)	166(83%)	34(17%)	195(97.5%)	592.5%)
Mean	63.8(31.9%)	136.2(68.1%)	155.5(77.75%)	44.5(32.25%)	195(97.5%)	5(2.5%)

Table No (14) the differences between patient's knowledge pre, post and ongoing test regarding foot care

N = 200

Patients knowledge	Pre- test		Post test			
			Post test (1)		Post test (2)	
	Know	Not know	Know	Not know	Know	Not know
Abnormal foot signs	64(32%)	136(68%)	170(85%)	30(15%)	193(96.5%)	7(3.5%)
Information about dialy cleaning , frequency and way of observation	90(45%)	110(55%)	178(89%)	22(11%)	199(99.5%)	1(0.5%)
Information about hazards	86(43%)	114(57%)	154(77%)	46(23%)	198(99%)	2(1%)
Measures used to avoid problems	56(28%)	144(72%)	180(90%)	20(10%)	198(99%)	2(1%)
Mean	74(37%)	126(63%)	170.5(85%)	29.5(15%)	197(98.5%)	3(1.5%)

Table No (15) the differences between patients practice pre, post and ongoing test regarding insulin administration

N = 200

patients practice	Pre test		Post test		Follow up	
	Done	*Not done*	Done	*Not done*	Done	*Not done*
Identified order : Types , dose ,time of insulin	113(56.5%)	87(43.5%)	132(66%)	68(34%)	124(63%)	76(37%)
Checked insulin for validity	97(48.5%)	103(51.5%)	137(68.5%)	63(31.5%)	137(68.5%)	63(31.5%)
Adjusted insulin dose	108(54%)	92(46%)	140(70%)	60(30%)	140(70%)	60(30%)
Selected site of injection	122(61%)	78(39%)	160(80%)	40(20%)	158(79%)	42(21%)
Administered dose correctly	60(30%)	140(70%)	155(77.5%)	45(22.5%)	151(75.5%)	49(24.5%)
Assessed site of injection	46(23%)	154(77%)	176(88%)	24(12%)	174(87%)	26(13%)
Reported of their response	25(12.5%)	175(87.5%)	146(73%)	54(27%)	171(85.5%)	29(14.5%)
Followed a septic technique	5(2.5%)	195(97.5%)	130(65%)	70(35%)	155(77.5%)	45(22.5%)
Mean	72(36%)	128(64%)	147(73.5%)	53(26.5%)	151.3(75.65%)	48.7(14.35%)

Table No (16) the differences between patients practice pre, post and ongoing test regarding foot care

N = 200

patients practice	Pre test		Post test		Follow up	
	Done	*Not done*	Done	*Not done*	Done	*Not done*
Commented on diabetic food risk	84(42%)	116(58%)	149(74.5%)	51(25.5%0	140(70%)	60(30%)
looked at feet	74(37%)	126(63%)	120(60%)	80(40%)	118(59%)	82(41%)
Washed feet correctly	56(26%)	154(74%)	139(87%)	26(13%)	119(59.5%)	81(40.5%)
Dried carefully between toes and avoid lubricant on it	78(39%)	122(61%)	117(58.5%)	83(41.5%)	124(62%)	76(38%)
Applied moisturizing cream to the heel	56(28%)	144(72%)	150(75%)	50(25%)	133(66.5%)	67(33.5%)
Checked shoes for pebbles before putting them on	39(19.5%)	161(80.5%)	169(74.5%)	31(15.5%)	118(59%)	82(41%)
Commented on avoid walk barefoot , walk barefoot, Exposed to heat source	46(23%)	154(77%)	123(61.5%)	77(38.5%)	139(69.5%)	61(30.5%)
Stated that not treat foot problems by themselves	36(18%)	164(82%)	137(68.5%)	63(31.5%)	149(74.5%)	51(25.5%)
Mean	58.6(29.3%)	141.4(70.7%)	138(69%)	62(31%)	130(65%)	70(35%)

Table No (17) the differences between patients practice pre, post and ongoing test regarding exercise regiment

N = 200

Patients practice	Pre test		Post test		Follow up	
	Done	*Not done*	Done	*Not done*	Done	*Not done*
Examined feet for ulcer , plaster before	96(48%)	104(52%)	150(75%)	50(25%)	128(64%)	72(36%)
Selected the suitable socks and shoes and checked for foreign body	100(50%)	100(50%)	154(77%)	46(23%)	148(74%)	52(26%)
Checked blood glucose level before exercise	8(4%)	192(96%)	124(62%)	76(38%)	136(68%)	64(32%)
Drunked plenty of water before and during exercise	60(30%)	140(70%)	146(73%)	54(27%)	148(74%)	52(26%)
Make sure about drug dose is correct	14(7%)	186(93%)	143(72.5%)	57(27.5%)	145(72.5%)	55(27.5%)
Always warmed up for at least five minutes before they exercise	9(4.5%)	191(95.5%)	126(63%)	74(37%)	160(80%)	40(20%)
Cool down for at least five minutes afterwards before I am stop moving.	13(6.5%)	187(93.5%)	132(66%)	68(34%)	138(69%0	62(31%)
Stared t with 10 minutes (or even less) and gradually increase my workout duration as I become more fit.	11(5.5%)	189(94.5%)	123(62.5%)	77(37.5%)	148(74%)	52(26%)
Stopped exercise if I feel :- palpitation , sweating , hunger , chills	15(7.5%)	185(92.5%)	120(60%)	80(40%)	138(69%0	62(31%)
Encouraged to engage in some form of aerobic activity for about 30 minutes a day at least five days a week.	15(7.5%)	185(92.5%)	120(60%)	80(40%)	145(72.5%)	55(27.5%)
Mean	34.1(17.05%)	165.9(82.95%)	133.8(66.9%)	66.2(33.1%)	143.4(71.7%)	56.6(28.3%)

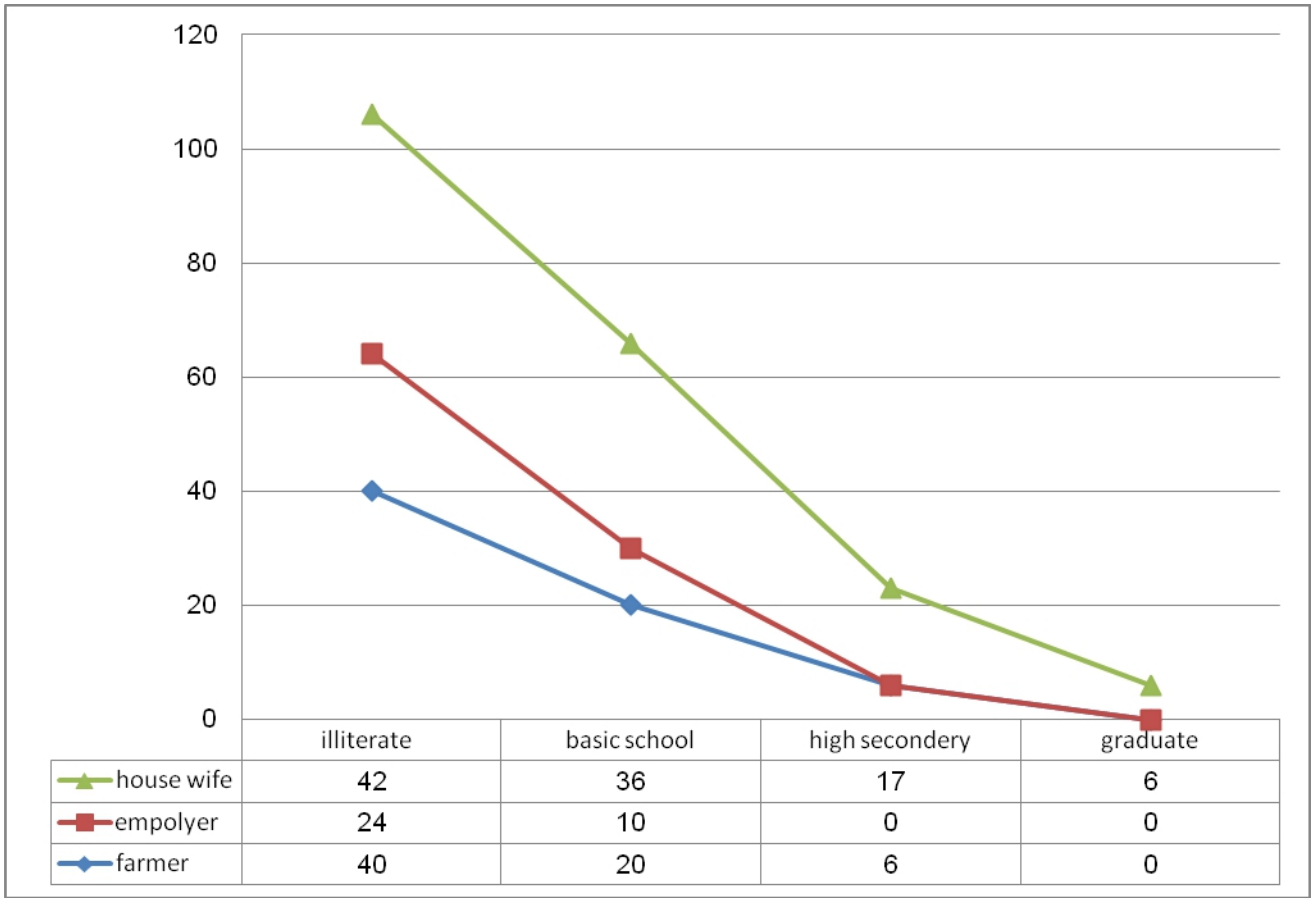
Table No (18) the differences between patients practice pre, post and ongoing test regarding diet program

N = 200

patients attitude	Pre test		Post test		Follow up	
	Done	*Not done*	Done	*Not done*	Done	*Not done*
Commented on benefits of achieving and maintaining ideal weight	60(30%)	140(70%0	130(65%)	70(35%)	150(75%)	50(25%)
stated number of meal per day	60(30%)	140(70%0	120(60%)	80(40%)	158(79%)	42(21%)
Commented on choosing suitable diet according to (exercise , medication)	60(30%)	140(70%0	105(52.5%)	95(47.5%)	110(55%)	90(45%)
Adjusted ideal meal components	82(41%)	118(59%)	99(44.5%)	101(50.5%)	130(65%)	70(35%)
Commented on when to take medication in relation to meal	71(35.5%)	129(64.5%)	144(72%)	56(28%)	147(73.5%)	53(26.5%)
Know Regular meal pattern and snacks	114(57%)	86(43%)	129(64.5%)	71(35.5%)	158(79%)	42(21%)
Meal based on low glycemic index	83(41.5%)	117(58.5%)	130(65%)	70(35%)	166(83%)	34(17%)
Avoiding of skipping meals and snacks	100(50%)	100(50%)	120(60%)	80(40%)	165(82.5%)	35(17.5%)
Keeping of artificial sweeteners	40(20%)	160(80%)	117(57.5%)	83(42.5%)	152(76%)	48(24%)
Hypoglycemia prevention and treatment	110(55%)	90(45%)	145(72.5%)	55(77.5%)	146(73%)	54(27%)
Decrease simple sugar, fat intake, salt intake	120(60%)	80(40%)	147(73.5%)	53(26.5%)	137(68.5%)	63(31.5%)
Mean	77.3(38.65%)	122.7(61.35%)	126(63%)	74(37%)	147.2(73.6%)	52.8(26.4%)

Section 5

Figure No (4)



	illiterate	basic school	high secondery	graduate
house wife	42	36	17	6
empolyer	24	10	0	0
farmer	40	20	6	0

Discussion

Diabetes education is effective in enhancing knowledge, skills and behavioral change. It has been shown to improve self-care and clinical outcomes. It should be interactive, solution focused and based on the experiences of the learner, as well as staged and tailored to meet individual needs and abilities. Group education and sustained, long term follow-up have both been shown to enhance knowledge and produce positive outcomes.

Self-management support programs assume a complex sequence of effects. Developers expect these programs to change patients' behavior by increasing the patients' self-efficacy and knowledge. Improved behavior is expected to lead to better disease control which should, in turn, lead to better patient outcomes and reduced utilization of health care services, particularly preventable emergency room visits and hospitalizations, and ultimately to reduced costs. This sequence of assumptions gives self-management support programs multiple objectives and multiple end points for evaluation. So this study conducted to apply self care practice training program among nurses in order to assess the impact of program on nurses knowledge, and practice regarding education of diabetic patients.

The present study showed that , nurse's knowledge pre test evaluation represented that , 72.5% of the nurses know insulin type, action, duration, the knowledge has been improved gradually during the post test one to include more than two third and represented by 80% while this point of knowledge upgraded in follow up phase after awhile of time to be 90% , these finding reflect the hazard of missed selection of the exact type of insulin , and monitoring the frequency of dose in order to assess the patient response, so , the study can justify that nurses have background about the key point of insulin use but they have to be 100% to avoid any complication or side effects. More over nurses had good knowledge about technique of injection because 70% understand the right steps of insulin injection in pre test, these finding has been changed in post test one with luckiness there was increase in nurses knowledge and this due to supervision during the time of the study. In addition to that, the study reveal that nurses also had unsatisfactory background about signs and symptoms of complications of

miss dose or over dose only 65% just differentiate between these side effect in pre test phase ,also these evidence had been changed in phase two of data collection and represented by 80 %, but fortunately increased in follow up phase to be 95%,so the following finding indicate that nurses responded to the program and indicated that patient should not been at great risk to developed complication and they may been controlled well.

The following findings had been compared with nurse's practice during training patients about insulin administration by using real objects and material with availability of all required material needed for the procedure, the study showed that, there was great variation between nurse knowledge and practice regarding insulin administration, because more than two third of the nurse (77.5%) checked doctor order, select the desired type of insulin, identify the exact time of dose for patient in pre test observation , these finding had been changed and increase markedly in post test one and two 97.5% of nurse taught patients how to check doctor order, so actually this skills will reflect on patient behavior and they reduce the occurrence of incorrect selection of the insulin but nurses knowledge should be 100% in order to be in save way.

In addition to that, the collected evidenced from the obtained result suggested that, nurses skills in selecting site of injection, preparation of required equipments, and adjusting insulin dose represented by 95 % in pre test phase and had been the same grade in post test two, while their skills were weak regarding technique of injection 65% ,assessment of injection site 33% , documentation of the findings including patient response 25% during the pre test phase, it's interesting to note that these skills had been increased markedly in the post test one and during follow up phase with high evidence which support the effectiveness of the educational program and importance of follow up for nurses .

These evidenced of good outcome already reflect in patient knowledge regarding insulin therapy as the study reveal that patients knowledge in pre test presented by 25% , these result had been changed gradually in post test one and tow and showed excellent changes in patients knowledge.

These results already correlated and supported by other studies which had been conducted in USA to assess Patient Understanding of Diabetes Self-

Management: the study showed that, Patient participation in decision-making is associated with better understanding of care. Participation in decision-making plays a key role in patient understanding of diabetes self-management and subsequent self-care practices.

The most striking differences was found between nurses knowledge and skills regarding foot care , nurses knowledge were about identification of common types of diabetic foot problems during pre test 75% know foot risk , but in post test one their knowledge had been developed to the best steps 82% with good information and upgraded to 82.5% during follow up phase , these result had been reflected positively on patient outcome both knowledge and attitude thus lead to decreased number of foot injury and problems among patients.

moreover ,the result consistently demonstrated the presences of poor development and changing on nurses knowledge during pre test phase only 62.5% know the frequency of foot observation , method of cleaning , these points had not changed during the program , in addition to that few of nurses just 37.5% advised patients regarding foot care and how to choose the suitable shoes, these finding had poor out come on patients behavior and may lead to development of foot problems among them .the mentioned results in fact, contrast the practical result finding of nurses because they had good skills while teaching patients items of foot care and demonstrated it correctly ,because more than half of the nurses 62.5% taught patients about diabetic foot risk, advised patient to look at their feet every day by using mirror ,advised patient to dry between toes and not lubricate it ,also instructed patient to wear socks and to select the proper shoes during the pre test phase and had been developed widely among nurses during the post test one because by more than 75.5% and more than 87.5% on going assessment phase ,in spite of that nurse had adequate knowledge about certain items of foot care because only 42.5% instructed patients to wash their feet three to four times per day by using the suitable solution ,57.5% instructed patient to apply moisturizing cream to the heel if they dry ,32.5% advised them to see podiatrist regularly for follow-up, but 72.5% taught patient to avoid walking bare foot or exposed to heat source or to treat their injuries by themselves. The collected evidenced from the obtained result suggest that nurses skills

had been improved widely and clearly regarding teaching or advising patient about foot care and observation.

Furthermore, the present study indicate that, nurses knowledge had been improved about preparation the special diet program for diabetic patients because in pre test phase 60% of them advised patients about adjustment of meal components while in post test one increased to be 80% and in ongoing follow up shown by 90%,in addition to that, 65% advised patients about regulation of meal time in pre test phase and 77.5% during post test one , and had been improved to be 87.5% on follow up phase, while only 37.5% taught patient to avoid skipping meals or miss snacks in pre test , 87.5% in post test and 97.5% on follow up , moreover 37.5% advised patient about hypoglycemia prevention and management pre intervention and had been increased to involve 82.5% of nurses ongoing study.

The study show that only half of the nurses (52.5%) taught patients about benefits of achieving and maintain ideal weight during the pre test, while increased in post test one to be 67.5%, and in post test two to be more than two third 92%, also more than two third of the nurses 72.5% advised patients about reregulation of meal time , number of meal per day , importance of diet in managing and preventing of complication , decrease simple sugar , fat , salt intake, when to take medication in relation to meal time ,meal based on low glycemic index these findings had been improved gradually on nurses behavior during posttest one to include more than two third of nurses (85%) , and 92.5% of nurses during the ongoing evaluation of nurses.

In addition to that, less than half of nurses (45%) were advised and taught the patient about pre exercise assessment during the pre test phase, this result improved clearly on post test one as shown by 75%, and 80% on ongoing evaluation phase, while they were have poor knowledge regarding selection of the suitable types of exercise 12.5%, principle of exercise 25%, and how to identify symptoms of intolerance 7.5% , these finding had been changed and improved during post test one and two to be include more than two third of nurses 82.5%. so the study reveals that patient may be at risk for heart disease , un controlling of blood sugar because exercise is important and have a role in management of diabetes and it's a key corner as mentioned by PETER [26] he mentioned that 'The benefits of exercise in these

patients include improved long-term glycemic control as a result of the decrease in insulin resistance and of the cumulative blood glucose-lowering effects of individual bouts of exercise. In addition, regular exercise has been shown to improve lipid abnormalities and lower blood pressure. Finally, exercise also may be an important component of weight-loss regimens for these patients.

Concerning the practical issues of nurses regarding teaching patients about exercise regiment, the study showed that 60% of nurses taught patient`s to examine their feet for ulcer, pilaster before and after exercise to avoid developing foot problems, theses evidenced had been changed to positive demonstration of this skills during the post test one to include 87.5% from the total sample but unfortunately there still few of nurses represented by 12.5% did not include this point on their teaching , these finding also has been improved to be 90% during the ongoing evaluation phase. Moreover, more than half of nurses represented by 70% taught the patients to select the suitable socks and shoes and check it for foreign body during the pre test assessment, this result improved in post test one to be 90% and during ongoing test to be 97.5%. While the study represent that nurses had poor background regarding teaching patients to take plenty of water pre and during exercise to replace the loss and represented by 50% during the pre test observation , this has been changed to involved more nurses during the post test to be 80% and in ongoing evaluation to be 87.5%. Also few of nurses less than 15% only advised and trained patients to check blood glucose before and post exercise, make sure that they used the correct dose of insulin, and they have to warm up at least five minutes before starting the exercise and to cool down for at least five minutes afterwards before stop move, and benefits of scheduling exercise as the same time of day help in controlling blood glucose , theses finding had been improved to be more clear to patients after the intensive program , because during the first observation the study showed that 75% of nurses trained the patients theses important steps and to be more than 90% during ongoing assessment , but still there was few of nurses did not include these points during teaching and this may be harmful for patient and they may developed complications or exercise may not beneficial for them.

The result of the present study provide evidence that, diet makes a difference whether patients are at risk for diabetes or have diabetes because following a healthy diet and exercise plan are key to treat or prevent diabetes. Because there was great difference between participant behaviors and attitude pre and post intervention; less than half of them have no meal plan or selective food items 45% pre intervention , while during first post test evaluation the study shown improve on patient behavior to include 87.5% of patients and in post test two 90% of them adjust their meal and select it according to their need , while few of them eat as they like without precautions 10% during the pre test evaluation ,and this may be due to their low educational level or lake of support from family member or ignorance of complications, these evidenced correlate with nurses knowledge pre intervention because most of nurses did not teach patients or given them the needed information regarding diet regiment befits and represented by less than 60% have good knowledge , these findings improved gradually in nurses behaviors post interventional program and reflect positively on patient knowledge which support the importance of continuous follow up and teaching in changing patients life style care. In addition to that more than half of the patients avoiding skipping meals or snacks as represented by 90% pre test and by 84% during first evaluation, and haven't improved during the follow up phase to include 79% of patient during ongoing assessment.

The study represent that there was statistically significant relation between patient`s knowledge and practice about diet, because patient attitude towards meal plan was poor, because

Furthermore the study show that patients knowledge regarding insulin administration was very poor because 50% of them have no information about insulin storage, types or dose time, these has been improved post intervention to be 25% of patients, while their knowledge up grated to reach 60% of patients with good knowledge, also the study reveal that more than two third of patient 80% did not know how to select the injection site or administration technique , differentiate between sign and symptoms of complication or insulin reaction.

So, this study represent that there was statistically significant relation between patient`s knowledge and practice about diabetes care , because

patient skills regarding insulin preparation , storage, technique of injection and post injection, foot care, exercise regiment , and diet control was very poor pre intervention but the study reveal that educational program which conducted among nurses had very excellent impact on changing both patients knowledge and skills and in reducing the problem associated among patient.

With reference to the previous studies which had been conducted in other countries to assess the relationship of Depression and Diabetes Self-Care, Medication Adherence, and Preventive Care [38], there was a great difference and variation between patients knowledge and attitudes regarding insulin therapy and this may be due to lake of specialized diabetic center, patient educational level or published information's, so there was highly significant relation between patient behavior and knowledge pre and post intervention (P = 0.000).because most of the patients were unable to differentiate syringe type , adjust insulin dose , inject them self or where insulin can be stored , while the two observational follow-up indicated that there was clearly improvement in patient skills and knowledge.

Also ,the result from the study which conducted in Elmek Nimer university hospital 2010 Sudan to Assess knowledge and practice of diabetic patients regarding insulin use[35] indicate that good quality of diabetes care has not yet been achieved, and the study found that more than two thirds of the patients were not optimally controlled, regardless of whether they were attending private or public health clinics because they have poor knowledge and skills regarding insulin storage 8%, technique of injection 8% , selection site of injection 2%, and the angle of injection 62%, habit of discard needle 6%.

It`s justifiable to assume that, patients had poor knowledge regarding exercise program because 67% did not know which action should be done before exercise , 66% did not know what types of exercise they have to practice , and 55% they did not follow the ideal steps of exercise , or differentia symptoms of discounting exercise. This evidence has been changed and improved during the post test one and two.

Finally, compression of the present results with those previously published by Margaret M Collins1 (e t a l) to assess Self-care coping strategies in people with diabetes: a qualitative exploratory study, University of California 53, reveals, supported and interpreted that, diabetes educators are instrumental in providing information for diabetes knowledge and supporting self-care behaviors that may affect subsequent health behavior change. In a primary office setting, educators can educate, motivate, manage, and assist their patients in meeting standards of care. And , D J Toobert .S E Hampson and .R E Glasgow 54 (The summary of diabetes self-care activities measure: results from 7 studies and a revised scale).confirmed that There are numerous benefits from standardization of measures across studies. The SDSCA questionnaire is a brief yet reliable and valid self-report measure of diabetes self-management that is useful both for research and practice. The revised version and its scoring are presented, and the inclusion of this measure in studies of diabetes self-management is recommended when appropriate

Conclusion

The research conclude the followings

1. A majority of patients lacked sufficient knowledge about their disease before implementation of the program and this have contributed to their inability to perform appropriate self-care practices as presented by (38.2%),during the pre test phase , but in post test one the mean of their knowledge was 83.8%, while in follow up phase 82.5%.
2. Patients skills have been very weak before implementation of the program, but they response to the program smoothly and the post test indicate wide variation in patients outcome insipid of their low educational level.
3. Concerning the practical issues of nurses regarding teaching patient, the study showed that, nurses' teach patients about exercise, food control, and insulin injection only during the pre intervention phase , but this improved in post test one and follow up phase to include all teaching items needed.

Recommendations

Based on the finding of the present study, the following is recommended

1. Regular conferences between nurse's staff with diabetic patients to discuss their problems, exchange knowledge, and find ways to improve services provide to them.
2. More special centers have to be establish particularly in primary health centers to promote appropriate health care in diabetes and education of diabetic patients and those involved in their care and also essential for researches and training .
3. In view of the prevalence of diabetes, it is essential to apply this program in Naher EL Neel state and to be generalized by federal ministry of health throughout the country.

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بعنوان :-

تطبيق برنامج تدريبي للممرضين عن كيفية تعليم مرضي الداء السكري العناية الشخصية

الباحث : حجازي محمد احمد عبد الله

استمارة رقم ( )

الجزء الأول:

أ. بينات شخصية:

1- المستوى التعليمي:

أ- دبلوم ☐ ب- بكلاريوس ☐ ج جامعي ☐ د-فوق جامعي ☐

2- عدد سنين العمل :- أ-اقل من سنة ☐ ب-من (1-3) ☐

ج- من (4-6) ☐ د- اكثر من 6 سنوات ☐

3- هل تلقيت دورات تدريبية أ-لا ☐ ب- مرة ☐ ج- مرتين ☐

د-ثلاثة مرات او اكثر ☐

الحزء الثاني:

خاص بتقيم المعلومات:

4- هل تعرف الأنوع المختلفة للأنسولين؟

1/ انسولين عادة ☐ 2/ لا ☐ 3\ انسولين زنك ☐ 4\ انسولين مخلوط ☐

5- على أي أساس يتم تحديد كمية جرعة الأنسولين المأخوذة يومياً؟

1/ كما وصف الطبيب ☐

2/ حسب نتيجة تحليل البول ☐

3/ حسب شعورالمريض بأعراض السكر ☐

4\ حسب نوع الوجبه الطعام ☐

6- هل تعرف ما هي الحقنة المستخدمة في حقن الأنسولين؟

1/ حقنة 1 مل ☐ 2/ حقنة 2 مل ☐

3/ تحدد نوع حقنة حسب الوحدات. ☐ 4\ اي حقنة ☐

7- كم عدد مرات استخدامك للحقنة؟

1/ مرة واحدة ☐ 2/مرتين ☐ ث مرات ☐ عند الحوجة ☐

8- ما هي الأسباب التي تمنعك من استخدام الحقنة البلاستيك لمرات أخرى؟

1/ سن الإبرة غير حامي ☐ 2/ الكتابة بدأت تمحى ☐

3/ صعوبة استخدام المكبس ☐ 4/ لانه ملوث ☐

9- أين تحفظ زجاجة الأنسولين التي يتم فيها السحب للحقن:

1/ فريزر ☐ 2/ رف الثلاجة ☐

3/ في درجةحرارةالحجرة ☐ 4\ في ماء مثلج ☐

10- ما هي الأماكن التي يحقن بها الأنسولين في الجسم؟

1/ العضد ☐ 2/ الفخذ ☐

3/ الظهر (اسفل لوحة الكتف) ☐ 4/ جدار البطن (اسفل السره) ☐

11- هل تعرف في أي طبقة من الجلد يحقن الأنسولين؟

1/ تحت الجلد ☐ 2/ في العضل ☐ 3/ في الوريد ☐ 4\ في الجلد ☐

12- هل تنصح المريض بتغيير مكان الحقن بصورة دورية؟

أ- لا ☐ ب- نعم ☐

13- إذا كانت الإجابة بنعم فلماذا؟

1/ لتجنب حدوث تشوهات بالجلد. ☐ 2/ لمنع الورم بمكان الحقن ☐

3/ لزيادة إمتصاص الأنسولين ☐ 4/ لتوزيع الشعور بالألم ☐

14- هل تنظف مكان الحقن؟

1/ لا ☐ 2/ بماء ☐ 3\ كحول ☐ 4\ ملح طعام ☐

15- ما هي أهمية ممارسة الرياضة لمريض السكري؟

1/ التحكم في الوزن ☐

2/ الوقاية من أمراض القلب ☐

3/ التحكم في نسبة السكر ☐

4/ المحافظة علي النشاط ☐

16- ما هي أنواع الرياضة التي تنصحه بان يمارسها مريض السكري؟

1/ الجري ☐ 2/ المشى من 20 -30 دقيقة ☐ 3/ تمارين خفيفة ☐ السباحة ☐

17- ما هي الاحتياطات التي يجب انتتخذها المريض عند ممارساته للرياضة؟

1/ تجنب ممارسة الرياضة في الجو الحار ☐

2/ يقلل جرعة الأنسولين ☐

3/ يقوم بالتحليل لمعرفة نسبة اسكر في الدم قبل ممارسة الرياضة ☐

4/ لا يقوم بآي احتياطات ☐

18- هل تنصحه بتغير نظام تغذيته أو خطته لممارسة الرياضة أو جرعة الأنسولين؟

1/ لا ☐ 2\ حسب التحليل ☐ 3/ حسب شعوره بأعراض المرض ☐
4/ باستشارة الطبيب ☐

19- هل تقوم بتعليم المريض كيفية تحليل السكر في الدم و البول ؟

1/ بعض المرضي ☐ 2/ لا ☐ 3\ الا اذا طلب المريض ☐ 4\ كل المرضي ☐

20- ما سبب غيبوبة السكر؟

1/ عندما تكون جرعة الأنسولين أكبر من اللازم. ☐
2/ حقن الأنسلين عن طريق خطأ ☐
3/ قمت بإلغاء وجبة أو تأخير وجبة عن موعدها ☐
4/ إذا زاد النشاط البدني عن معدله ☐

21- ما هي أعراض غيبوبة نقص السكر؟

1/ زغللة في العين و زيادة شديدة في العرق ☐
2/ رعشة, و شعور بالإعياء ☐
3/ إحساس بالجوع الشديد ☐
4/ فقدان الوعي ☐

22- ما هي عدد الوجبات التي تنصحه بان يتناولها يومياً؟

1/ وجبتان ☐ 2/ ثلاث وجبات ☐ 3/ اربعة وجبات ☐
4\ ثلاث وجبات اضافة الي سندات ☐

23- هل تعرف المكونات الأساسية التي يجب أن يحتويها غذاء المريض؟

1/ زيادة المواد البروتينية . ☐
2\ تقليل المواد الكربوهيدراتية , و تقليل المواد الدهنية ☐
3/ تقليل المواد السكرية. ☐
4\ زيادة طعام يحتوي على ألياف (خضروات و فواكه) ☐

24- كيف تنصحه بأخذ الدواء بالنسبة لمواعيد الطعام؟

1/ ياكل بعد الحقنة مباشرة ☐
2/ ينتظر من ثلث ساعة الي نصف ساعة بعد الحقن ☐
3/ يأكل بعد الحقنة بساعة ☐
4\ ياكل ثم ياخذ الجرعة ☐

بسم الله الرحمن الرحيم

***No* ( )**

Educational checklist of foot care for diabetic patients

The nurse taught patients that	Done	Not done
checked feet every day :-		
- by looking carefully between toes , soles , tops of feet , and heels for:- redness , cracks on the heels or between the toes , hard skin , sores or ulcer , swelling , color change of nail , toes , or part of foot.		
- if they spot any of these they have to visit their r doctor for advice		
look at feet every day by mirror		
Wash feet every day three to four time		
Dry carefully between toes and avoid lubricant on it		
Apply moisturizing cream to the heel if have dry skin		
Wear clean socks		
Check shoes for pebbles before putting them on		
Measure feet before buying new shoes		
See a podiatrist regularly		
Taught patient to avoid the following :-		
walk barefoot		
Using tight and open shoes		
use hot water (test it with your elbow first		
Exposed to heat source (e.g. hot bottle, sun light …..)		
use corn plaster , razor or knife for trimming		
cut their nails if they have vision problem		
cross their leg		
treat foot problems by themselves		

بسم الله الرحمن الرحيم

No ( )

Educational checklist of insulin therapy for diabetic patients

The nurse taught the patients about	Done	Not done
Types , action , duration of insulin		
Insulin regime and techniques		
Monitoring and equipment's		
adjusting of insulin dose		
Sites of injection		
Technique of injection		
Drawing up of dose		
Rotation of injection sites		
Storage of insulin		
Timing of injection		
Assessment of injection site		
Complications of miss dose or over dose		
Safe disposal of needles		
Importance of documentation		

بسم الله الرحمن الرحيم

Educational checklist of diet for diabetic patients

Serial No ( )

The nurse give the following information	**Done**	**Not done**
Taught patients about benefits of achieving and maintaining ideal weight		
Advised patients about regulation time of meals		
Taught patients number of meal per day		
Advised patients about the suitable diet according to (exercise , medication)		
Advised patients about adjustment of meal components		
Advised patients about importance of diet in managing , and preventing of complications		
Taught patients when to take medication in relation to meal		
Taught patients about:-		
Regular meal pattern and snacks		
Decrease simple sugar		
Decrease fat intake		
Increase fiber intake		
Decrease salt intake		
Five portions fruits and vegetables per day		
Meal based on low glycemic index		
Hypoglycemia prevention and treatment		
To avoid alcoholic drinks		
Keeping of artificial sweeteners		
Avoiding of skipping meals and snacks		

No ( )

Educational checklist of exercise for diabetic patients

The nurse taught the patient to	Done	Not done
Examined feet for ulcer , plaster before and after exercise		
Selected the suitable socks and shoes and checked for foreign body		
Checked blood glucose level before exercise		
Drunked plenty of water before and during exercise		
Make sure about drug dose is correct		
Always warmed up for at least five minutes before they exercise		
Cool down for at least five minutes afterwards before you stop moving.		
Stared t with 10 minutes (or even less) and gradually increase their workout duration as they become more fit.		
scheduling their exercise at the same time of day can help with blood glucose control		
Stopped exercise if they feel :- palpitation , sweating , hunger , chills		
Encouraged to engage in some form of aerobic activity for about 30 minutes a day at least five days a week. These may include		
1- Aerobic exercises (exercises that improve oxygen circulation) include Walking وrunning, Swimming, Bicycling.		
2- Strength training exercises (resistance exercises that rely on the use of free weights, elastic bands or weight machines).		
3- Stretching exercises. They should performed stretching exercises for five to 10 minutes before and after all physical activities to increase flexibility reduce stress and prevent muscle damage and soreness.		

بسم الله الرحمن الرحيم
جامعة شندي
كلية الدراسات العليا
بحث لنيل درجةدكتوراة الفلسفة في التمريض

إستمارة المقابلة الخاصة باحتياجات مرضى السكر بالنسبة(للرياضة-العلاج بالانسولين –تنظيم الغذاء – العناية بالقدم)

الجزء الأول:

أ. بينات شخصية:

1) السن :

أ/ اقل من 20 سنة ☐ ب\ من 20 إلى 40 ☐ ج/ 40 وأقل من 50 ☐

د/ 50 أو أكثر ☐

2) الجنس: أ- ذكر ☐ ب أنثى ☐

3) المستوى التعليمي:

أ- أمي ☐ ب/ إبتدائي ☐ ج- ثانوي ☐ د- جامعي ☐

4) الوظيفة:

أ- مزارع ☐ ب- موظف ☐ ب- ربة منزل ☐ د- طالب ☐

5) مدة الاصابةبالمرض:

أ- سنة أو أقل ☐ ب- من 1 – 5 سنوات ☐

ج- من 5 -10 سنوات ☐ د- أكثر من 10 سنوات ☐

الحزء الثاني:

خاص بتقيم المعلومات:

6) ما هو مرض السكر؟

أ- إرتفاع في نسبة السكر في الدم عن المعدل الطبيعي. ☐

ب- نقص الأنسولين في الجسم. ☐

ج- مرض وراثي. ☐

د- مرض مزمن. ☐

7) ما هي أعراض مرض السكر؟

أ كثرة التبول ☐ ب- العطش الشديد ☐

ج- الجوع الشديد ☐ د- نقص الوزن ☐

8) ما هي طرق علاج مرض السكر؟

أ- تنظيم الغذاء ☐

ب- أدوية للتحكم في نسبة السكر في الدم ☐

ج- تنظيم الغذاء والرياضة. ☐

د- أنسولين.

9) 22- كيف حصلت على المعلومات الخاصة به؟

أ- وسائل الإعلام

ب- من طبيب أو ممرض

ج- من مريض آخر

د- صديق / قريب

10) ما هو الأنسولين؟

أ- هرمون ب- إنزيم

11) هل تعرف الأنوع المختلفة للأنسولين؟

أ- عاده ب-/ مخلوط ج- زنك د- لا اعرف

12) على أي أساس تحدد كمية الأنسولين المأخوذة يومياً؟

أ- كما وصف الطبيب

ب- حسب نتيجة تحليل البول

ج- حسب شعوري بأعراض السكر

د- حسب نوع الوجبه الطعام

13) هل تعرف ما هي الحقنة المستخدمة في حقن الأنسولين؟

أ- حقنة 1 مل ب- حقنة 2 مل

ج- تحدد نوع حقنة حسب الوحدات د- اي حفنة

14) كم عدد مرات استخدامك للحقنة؟

أ- مرة واحدة ب- مرتان ج- ثلاث مرات

د- حسب الحوجه

15) ما هي الأسباب التي تمنعك من استخدام الحقنة البلاستيك لمرات أخرى؟

أ- سن الإبرة غير حامي ب- الكتابة بدأت تمحى

ج- صعوبة استخدام المكبس د- لانه ملوث

16) كيف تعقم الحقنة قبل الاستخدام إذا كانت مستخدمة من قبل؟

أ- لا ب- بالغلي ج- مسح الإبرة بالكحول

د- توضع في الثلاجة

17) اين تحفظ زجاجة الأنسولين التي يتم فيها السحب للحقن:

أ-فريزر ب- ثلاجة ج- في درجةحرارةالحجرة د- في ماء مثلج

18) ما هي الأماكن التي يحقن بها الأنسولين في الجسم؟

1/ العضد 2/ الفخذ
3/ الظهر 4/ جدار البطن

19) هل تعرف في أي طبقة من الجلد يحقن الأنسولين؟
أ- تحت الجلد ب- في العضل ج- في الوريد د- في الجلد

20) هل تغير مكان الحقن؟
1/ نعم 2/لا

21) إذا كانت الإجابة بنعم فلماذا؟
أ- لتجنب حدوث تشوهات بالجلد. ب- لمنع الورم بمكان الحقن
ج- لزيادة إمتصاص الأنسولين د- لتوزيع الشعور بالألم

22) هل حدث في مكان الحقن أي مضاعفات؟
أ- ورم ب-إحمرار ج- زرقة د- لون أسود

23) هل تنظف مكان الحقن؟
أ- لا ب- ماء و صابون ج- كحول د- ملح طعام

24) ما هي أهمية ممارسة الرياضة لك؟
أ- التحكم في الوزن
ب- الوقاية من أمراض القلب
ج- التحكم في نسبة السكر
د- تقليل شهية الطعام

25) ما هي أنواع الرياضة التي تمارسها؟
أ- الجري ب- المشى من 20 -30 دقيقة
ج- رياضة خفيفة في المنزل د- السباحة

26) ما هي الاحتياطات التي تتخذها عند ممارساتك للرياضة؟
أ- أحتفظ معي أثناء ممارسة الرياضة بطعام يحتوي على سكريات أو كربوهيدرات أو سوائل
ب- أتجنب ممارسة الرياضة في الجو الحار
ج- أقوم بالتحليل لمعرفة نسبة اسكر في الدم قبل ممارسة الرياضة
د- لا أقوم بآي احتياطات

27) هل تغير نظام تغذيتك أو خطتك لممارسة الرياضة أو جرعة الأنسولين؟
أ- لا 1/ حسب التحيل 2/ حسب شعوري بأعراض المرض
3/ باستشارة الطبيب

28) هل تقوم بتحليل السكر في الدم و البول ؟
أ- لا ب- في العيادة المحولة - عند الشعور بتغيير في الحالة الصحية

29) ما سبب غيبوبة السكر؟
أ- عندما تكون جرعة الأنسولين أكبر من اللازم.
ب- حقن الأنسلين عن طريق خطأ
ج- قمت بإلغاء وجبة أو تأخير وجبة عن موعها

د- إذا زاد النشاط البدني عن معدله مما أدى إلى هبوط نسبة السكر في الدم

30) ما هي أعراض نقص السكر؟

أ- زغللة في العين

ب- زيادة شديدة في العرق

ج- رعشة

د- إحساس بالجوع الشديد

31) ما هي عدد الوجبات التي تتناولها يومياً؟

أ- وجبتان ب- ثلاث وجبات ج- اربـــع وجبـــات د- ثـــلاث وجبات و سندتين

32) هل تعرف المكونات الأساسية التي يجب أن يحتويها غذائك؟

أ- زيادة المواد البروتينية

ب- تقليل المواد الدهنية

ج- تقليل المواد السكرية

د- زيادة طعام يحتوي على ألياف

33) ماهي قائمة طعامك التي تتناولها عادة ؟

أ- قائمة الطعام كما هو متبع في الخطة التعليمية.

ب- قائمة الطعام مخالفة للخطة التعليمية

34) متى تأخذ الدواء بالنسبة لمواعيد الطعام؟

أ- آكل بعد الحقنة مباشرة

ب- أنتظر اقل من 10دقائق

ج- انتظر من ثلث ساعة – نصف ساعة

د- لا أكل بعد الحقنة

35) ما تفعل إذا نسيت جرعة معينة من الأنسولين؟

أ- لا أنسي جرعة الأنسولين أبدا

ب- اقلل من محتوي الوجبة

ج- أخذ الجرعة قبل الوجبة التالية

د- أحلل السكر في الدم وأقرر أخذ الجرعة حسب التحليل

سم الله الرحمن الرحيم

Education checklist of diet for diabetic patients

No ( )

Patients have to state the	Done	Not done
Commented on benefits of achieving and maintaining their ideal weight		
Stated number of meal per day		
Commented on choosing suitable diet according to (exercise , medication)		
Adjusted meal components		
Commented on when to take medication in relation to meal		
Know regular of meal pattern and snacks		
Meal based on low glycemic index		
Hypoglycemia prevention and treatment		
Keeping of artificial sweeteners		
Decrease simple sugar , fat intake , salt intake		

بسم الله الرحمن الرحيم

Education checklist of exercise for diabetic patients

No ( )

Patient have to state that	Done	Not done
Examined feet for ulcer , plaster before and after exercise		
Selected the suitable socks and shoes and checked for foreign body		
Checked my blood glucose level before exercise		
Drunken plenty of water before and during exercise because dehydration can affect glucose levels		
Marked sure about my drug dose is correct		
Always warmed up for at least five minutes before i exercise		
Cool down for at least five minutes afterwards before i stop moving.		
Started with 10 minutes (or even less) and gradually increase my workout duration as i become more fit.		
scheduling my exercise at the same time of day can help with blood glucose control		
Stop exercise if i feel :- palpitation , sweating , hunger , chills		
Exercise reduce weight and regulate serum sugar level		
Encourage to engage in some forms of aerobic activity for about 30 minutes a day at least five days a week.		

بسم الله الرحمن الرحيم

No ( )

Education checklist of foot care for diabetic patients

Patients should state that	**Done**	**Not done**
Commented on diabetic foot risk		
Checked feet every day by mirror		
Looked carefully between toes , soles , tops of feet , and heels for:-		
dried carefully between toes and avoid lubricant on it		
applied moisturizing cream to the heel if i have dry skin		
checked shoes for pebbles before putting them on		
Commented on avoid walk barefoot , or exposed to heat sources		
Sated that not treat foot problems by themselves		

بسم الله الرحمن الرحيم

No ( )

Education checklist of insulin therapy for diabetic patients

Patients have to state the	**Done**	**Not done**
Identified order : types , dose , time of insulin		
Checked insulin for validity		
Adjusted insulin dose		
Selected site of injection		
Administered dose correctly		
Assessed site of injection		
Reported of their response		
Followed a septic technique		

بسم الله الرحمن الرحيم

جامعة شندي

كلية الدراسات العليا

استمارة الموافقة علي المشاركة في البحث

عنوان البحث :- تطبيق برنامج تدريبي للممرضين عن كيفية تدريب مرضى السكري الرعاية الشخصية

Designing and application of training program for nurses to teach diabetic patients about self-care practice

اسم الباحث :- حجازي محمد أحمد عبد الله

إسم المشارك :-.....**العمر**.....
الوظيفة :-.....**السكن :-**.....

طبيعة و اهداف البحث :-

1. للتأكد من مدي معرفة مريض الداء السكري عن انواع الانسولين , كيفية التخزين , كيفية الحقن , تحضير الجرعة ,اماكن الحقن و الآثار الجانبية.
2. للتأكد من مدي معرفة المريض عن التنظيم الغذائي , النظام الرياضي و العناية بالقدم .
3. للتحقق من مدى ممارسة المريض عن تحضير جرعة الانسولين و كيفية الحقن , العناية بالقدم , و النظام الغذائي و الرياضي المتبع.
4. لتطبيق برنامج تعليمي و تدريبى لمرضى السكري عن العناية الشخصية.

- **المدة التي يشارك فيها المريض :-** سيشارك المريض لمدة لا تقل عن ست أشهر من خلاله يتعرض لبرنامج تعليمي و متابعة من قبل الباحث .
- **إحتمالات الخطورة :-** لا يتعرض المشارك لأي تدخلات من شانها التاثير في العلاج او حدوث مضاعفات , بينما يحدث العكس حيث يكون المشارك تحت رعاية طبية متكاملة و دقيقة .
- **الفوائد للمريض و المجتمع :-**
- سيستفيد المشارك من تعلم كل المهارات الخاصة بالعناية الشخصية المتعلقة بالمرض و مضاعفاته , اضافة الي امكانية المساعدة في تعليم افراد اخرين مصابين بالمرض و لذا يقلل من حدوث المضاعفات و يساعد في التحكم بالمرض .
- **حق المشارك في التوقف عن المشاركة بدون فقدان فوائد** :- للمشارك الحق في رفض المشاركة في البحث متي ما رائ ذلك
- سيتم تمليك المشارك بأيّ معلومات جديدة عن البحث مع توضيح الحقائق

أنا ..... البالغ من العمر
..... بكامل وعيي و قواي العقلية و بعد التعرف علي البحث و طبيعه المشاركة و كل الموجهات الخاصة بمشاركتي سالفة الذكر أوافق علي المشاركة في هذا البحث مع الاحتفاظ بحقي في التوقف في اي وقت اشاء .

امضاء المشارك ..... التلفون .....
امضاء الباحث ..... التاريخ :- .... \ ..... \2009

Diabetes Patient Self Management Skills

Nursing Competency-Based Training Form

Purpose: To provide the nurse trainer with the skills and educational tools necessary to provide basic skills education to patients with diabetes.

Objectives: To

1. Identify and contrast the type I diabetes
2. State the diagnostic criteria for diabetes
3. Describe the acute complications and treatment interventions
4. Explain actions and indications of insulin
5. Explain purpose of self-monitoring of blood glucose
6. Explain importance of meal regularity
7. Describe sick day management
8. Explain purpose , role , of exercise
9. Explain purpose and importance of diet control and understand the meal plan.

Modules:-

- Real objects (syringes, vial, cotton bottles, regular insulin, modified insulin and left arm module will be used.
- The researcher will use different media as charts, colored pictures showing route of administration and rotation of injection site, meal plan sheet, steps and method of foot care, and exercise schedule.

Duration of the program:-

- The program should be done in three weeks insomuch of four hours per week

Component of the program

❖ Guidelines for assigning practice presentations

- Practice presentations should be from thirty minutes to two hours, depending on the size of the group.
- When assigning practice presentations, the researcher try to ensure that each candidate has the opportunity to practice, delivering a range of content and formats—lecture, discussion, activity.

❖ Steps of conducting the program

1) pretest:- This include an observational checklist and standard closed structured questionnaire will be developed by the researcher, to evaluate nurses knowledge ,skills and practice about insulin , foot care , exercise , and diet control.

2) Information (Education Program):

This section includes pictures of the slides, talking points, activity instructions, worksheets and other guidelines to help them deliver the program.

An intense educational program will be designed by the researcher based on actual assessment of diabetic needs to improve self care practice in the light of the available researches and literature. The intervention will be developed in a simple Arabic language to cover the relevant theoretical and practical aspects of self-care practice of diabetic patients as physical functional, emotional, and social dimensions. Different teaching methodology as discussion, demonstration, and redemonstration, will be used.

The intervention will be implemented to in small groups (10-13).The program will be implemented in two sessions once a week for four months. Each session will take about one hour and at the end of each session each nurse will be assessed for his/her understanding of the instructions. The impact of the program will be based on the improvement of the quality of self practice , they will be more compliant to diabetes treatment regimen, decrease in the occurrence of diabetes complications and acceptance level of blood glucose.

3\Diabetes education skills for nurse trainer:-

- Lists professional resources available as reference for own teaching needs
- Describes how to obtain educational resource materials for patients
- Describes differences between major types of diabetes
- States diagnostic criteria for diabetes
- Describes actions and side effects of insulin
- Describes how to draw up insulin, rotation of sites, and storage
- Describes onset, peak, and duration of insulin
- Explains purpose of self-monitoring of glucose
- Demonstrates use of glucometer and self blood glucose monitoring
- Explains the importance of meal regularity
- Describes sick day management
- Explain purpose , role , of exercise
- Meal planning, carbohydrate counting, weight control
- Activity and exercise planning
- Stress management, risk reduction and problem solving

- Updates on new injection equipment, monitoring devices, medication
- Foot examination and care
- Intensive insulin management and insulin pumps
- New to diabetes care
- Diabetes self-management series

6.2.5- Map of Shendi locality (study area):