DIABETIC NURSE PRACTITIONER INTERVENTIONS

by

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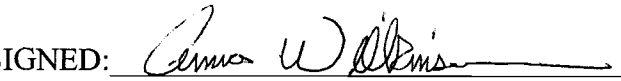
SIGNED: 

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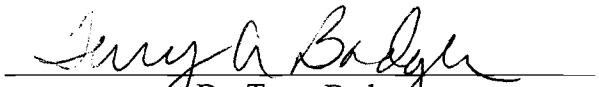

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Date

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The writing and editing process was possible due to the input of Dr. Terry Badger and committee member Kathy Watson who made the experience pleasurable.

I am forever grateful for the support and encouragement of my mother throughout my thesis development and career. I can only hope to emulate the example that she has demonstrated both in nursing and as a parent.

A special thanks to my wife Honey for her love, support, and patience.

DEDICATION

I dedicate this thesis to my mother. May God bless you in your life as you have blessed mine for so many years. I thank you for your example, guidance, support, patience, hope, faith, and love over all of these years.

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ABSTRACT

The purpose of this study was to conduct a metaanalysis of diabetic intervention data found in current nursing and medical literature using Neuman's Systems Model as a framework to create a theory based review of current Adult/Family Nurse Practitioner (A/FNP) diabetic interventions. Data analysis involved several steps. First was the determination of intervention recommendations for A/FNPs for diabetes mellitus (DM). Second was the comparison of the intervention recommendations for A/FNPs to the theory literature to determine if those interventions were supported theoretically. Third was the comparison of the interventions used by A/FNPs to the empirical literature to determine if those interventions were supported empirically.

A total of ten intervention categories with 22 subcategories were formulated on the levels of primary, secondary, and tertiary prevention. Primary prevention categories included screening, education, and community collaboration, with education subcategories of diet modification and exercise. Secondary prevention categories included screening, assessment, education, health care intervention, counseling, and documentation. Screening subcategories included glycemic, hypertension, dyslipidemia, nephropathy, retinopathy, neuropathy, coronary artery disease, immunization, and alcohol and tobacco screening. Education subcategories included diet modification and exercise. Health care intervention subcategories included oral antidiabetic agents; insulins; combination therapies; and hypertension, dyslipidemia, nephropathy, retinopathy, neuropathy, and coronary artery disease treatment. Tertiary prevention categories included routine follow up and referral. All categories and subcategories were found to be supported both theoretically and empirically.

CHAPTER I

INTRODUCTION

The purpose of this study was to conduct a metaanalysis of diabetic intervention data found in current nursing and medical literature using Neuman's Systems Model as a framework to create a theory based review of current (A/FNP) diabetic interventions.

An alarming number of people in the world are affected by diabetes. There are roughly about 17 million people or about six percent of the population in the United States who have diabetes (University of Maryland Medicine, 2001). Greater than half of this number of people have diabetes and are unaware of it. Approximately 2,200 people are diagnosed with diabetes each day and about one million people will be diagnosed this year (American Diabetes Association, 2002a). It is a chronic disease that has no cure. It is the leading cause of new cases of blindness, end stage renal disease, and non-traumatic lower limb amputations (Cameron, 2002). Peridontal disease occurs among 30 percent of people 19 years or older with type 1 diabetes (University of Maryland Medicine, 2001). About two thirds of all diabetics have mild to severe forms of nerve damage and all diabetics are two to four times more likely to have heart disease and stroke than the rest of the population (American Diabetes Association, 2002a). Health care cost related to disease treatment and the cost of loss of productivity is estimated at $98 billion dollars annually (University of Maryland Medicine, 2001).

Diabetes is a metabolic disease in which the body is unable to correctly use or produce the hormone insulin for the absorption and utilization of glucose into living cells. Insulin produced in the pancreas normally maintains blood glucose levels at 70 mg/dL to 140 mg/dL (Cameron, 2002). When target tissues are resistant to insulin or not enough is

produced the cells of the target tissues are starved of glucose and must turn to other sources of energy. Gluconeogenesis begins to break down stores of glycogen, protein, and fat in an effort to obtain fuel. This raises blood glucose levels and releases glycerol and fatty acids into the blood stream causing hyperglycemia, dyslipidemia, ketosis, and increased oxidants. These body states are associated with the long-term complications of diabetes such as retinopathy, nephropathy, neuropathy, and cardiovascular disease (Cameron, 2002).

Environmental factors such as obesity and lack of exercise appear to influence the development of the disease, as does genetics (Caughron & Smith, 2002). The two major types of diabetes are type 1 and type 2. Gestational diabetes occurs in women during pregnancy and other types of diabetes can occur as the result of specific illnesses, drugs, malnutrition, surgery, and infection (American Diabetes Association, 2002b).

Type 1 diabetes is an autoimmune disease in which the body does not produce any insulin (University of Maryland Medicine, 2001). It accounts for less than ten percent of all diabetics and three quarters of all newly diagnosed cases occur in individuals younger than 18 years. People with type I diabetes must take daily insulin injections to live. The disorder runs in families and those related to a type I diabetic therefore have an increased risk of development of the disease (American Diabetes Association, 2002a).

Type 2 diabetes is a result of the body's inability to make enough or to properly use insulin (University of Maryland Medicine, 2001). Over 90 percent of diabetics have type 2 diabetes. The incidence is increasing due to an increased number of older obese Americans with sedentary lifestyles (American Diabetes Association, 2002a). Gestational

diabetes is similar to type 2 diabetes pathologically but, unlike type 2, has an onset during pregnancy and disappears when the pregnancy is over. It occurs in 2-5 percent of all pregnancies and increases risk for developing type 2 diabetes later in life. Environmental factors such as poor diet, decreased exercise, and obesity increase diabetic progression in type 2 DM (Bell, 2002). Ketoacidosis seldom occurs spontaneously, and insulin treatment is often not needed for survival. Genetic factors such as inherited and expressed genes can cause a decrease in insulin secretion and an increase in insulin resistance making individuals of certain family types and cultures more likely to develop type 2 diabetes (Dokken, 2001).

Gestational diabetes mellitus (GDM) diagnosis and treatment interventions and or diabetic treatment interventions in pregnant women with diabetes will not be discussed in this work for six reasons. First, the incidence of GDM and/or pregnant women with diabetes makes up only a small percentage of the diabetic population. Pregnant women make up approximately 1.48% of the population as a whole and of those women approximately 3-6% of them have DM or will develop GDM (Olds, London, & Ladewig, 2000). Second, the diagnosis and treatment of diabetes in pregnant women is very different from treatment in the rest of the DM population (Caughron & Smith, 2002). Third, the period requiring specialized treatment interventions during the pregnancy is usually only within the third trimester, a very brief period with very different concerns and complications than those found in DM in the rest of the population (Nobles, 2001). Fourth, diabetes in pregnancy and associated complications are a specialty usually referred to an OB/GYN and diabetologist in addition to other health care workers (diabetes educator, dietitian, social worker) rather than sole care coordination by the

A/FNP trained in areas of more general primary care (American Diabetic Association, 2002b). Fifth, none of the interventions of the sample reviewed in this study included interventions on pregnant women with diabetes. And finally, the depth of information on both DM and on DM in pregnancy is very large and detailed. Focuses are also therefore narrowed to DM in the nonpregnant population for the sake of length.

Diabetes mellitus of all types is widespread affecting both genders, all ages, all races, and all socioeconomic classes. Type 1 diabetes is more common in Caucasians (Dokken, 2001). Type 2 diabetes is more common in African Americans (10.8% incidence), Mexican Americans (10.6% incidence), and Native Americans (12.2% incidence), when compared to the 5.2% incidence of the general population (American Diabetes Association, 2002a). In some Native American tribes, over half of the population has diabetes. 60% of the Pima Indians of Arizona aged 30-64 have type 2 diabetes. The incidence of type 2 diabetes is expected to rise from 7.4% in 1995 to approximately 9% in adults by 2025 (Dokken, 2001).

Research Questions

1. What interventions are recommended for A/FNPs to treat DM?
2. Are the interventions recommended for A/FNPs to treat DM theoretically supported?
3. Are the interventions for A/FNPs empirically supported?

Significance of the Study

Diabetes mellitus is a chronic and often harshly debilitating disease of epidemic proportions. As the numbers of DM cases continue to increase there is an increasing need for effective interventions to control the disease and prevent multiple complications. Interventions used by nurse practitioners are most defendable when based on research rather than experience or routine and should therefore be evaluated for both theoretical and empirical support and effectiveness. This study will confirm whether the interventions recommended for A/FNPs are supported theoretically and/or empirically.

The study is significant to nurse practitioner practice, future research, patient care, and the cost effectiveness of health care. Effective health care interventions can improve patient and NP outcomes. Any theoretically based intervention not yet supported empirically creates the opportunity for future research in determining if the intervention is supported empirically, and vice versa. Effective interventions can enhance the quality of life for the patient by decreasing disease complications. Effective low-cost interventions can reduce the cost of health care spent on diabetes by decreasing the incidence of DM and/or by decreasing allocations spent on the care of associated DM complications (Cameron, 2002).

Summary

DM is a major health concern in the United States that effects a large and diverse population across the country and throughout the world. The treatment of the disease and its multitude of complications places a strain on today's cost containment focused health care system. Nurse practitioners and other health care workers are placed in the position

to be able to identify and assist the patient with multiple therapeutic interventions. Primary healthcare providers such as NPs are also in the position to diagnose, treat, and coordinate diabetes care with the support of patient families and other members of the healthcare team. Effective interventions used by healthcare providers have the potential to decrease the incidence of diabetes and/or complications, which in turn decreases the high costs spent on diabetes each year. This study will determine if the interventions recommended for A/FNPs are research and/or theoretically based.

CHAPTER II

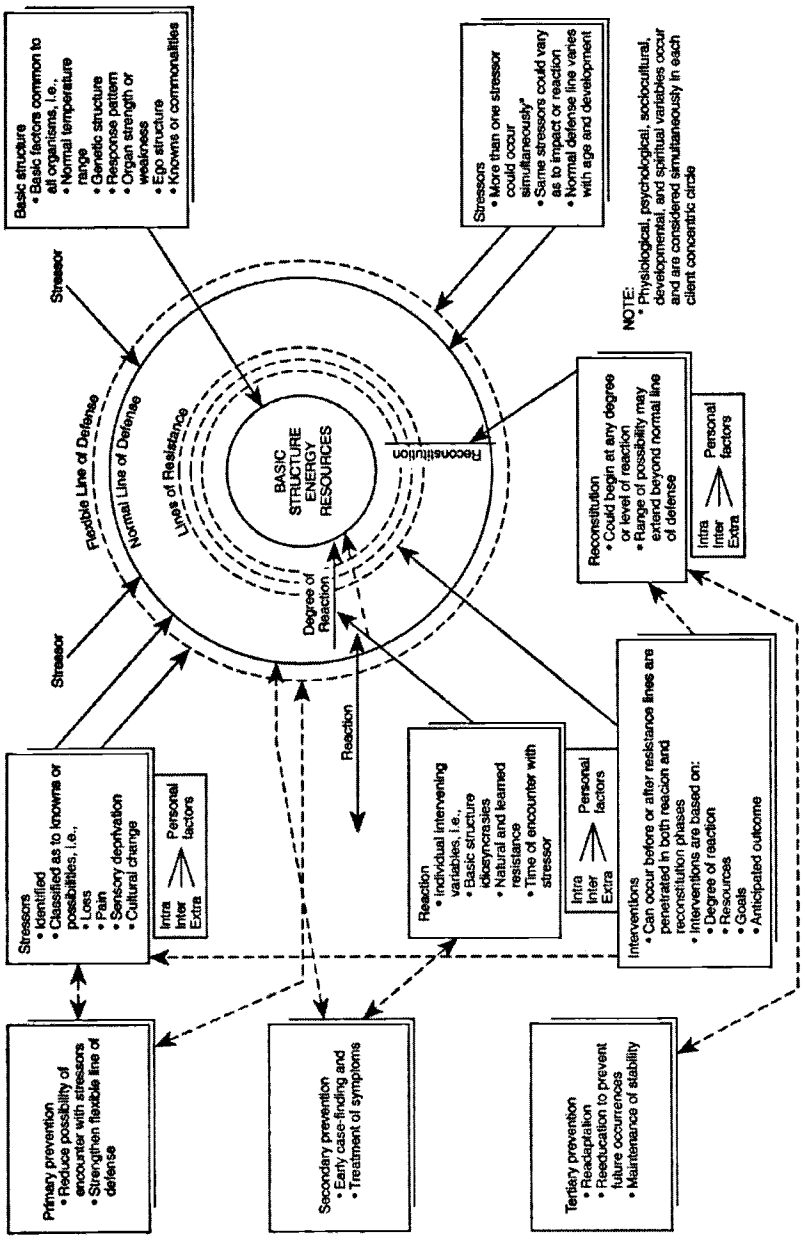
THEORETICAL ORIENTATION AND REVIEW OF LITERATURE

In chapter II the theoretical orientation used to divide the literature review into different groups of interventions is discussed. The literature review focuses on diabetic interventions used by nurse practitioners grouped into primary, secondary, and tertiary interventions.

Theoretical Orientation

Betty Neuman's Systems Model has been one of the most widely used nurse theories in many clinical areas of institutional and community nursing practice around the world (George, 1995). The model has been used in physical therapy programs and in nurse anesthesia. The model has been used at all levels of nursing education from diploma to doctorate. The model has been applied in quantitative, qualitative, correlational, quasi-experimental, and experimental research. In practice the model has been applied to patients in a variety of units such as psychiatric, medical and surgical, critical care, rehabilitation, orthopedics, emergency, and hospice (Neuman, 1996). Examples of the use of the model in administration include the use of the model as a framework for community health administration and as a framework for the reorganization of structure and function of the nursing department at Jefferson Davis Memorial Hospital (Meleis, 1997). The Neuman Systems Model (1995) is the framework selected for this study of A/FNP interventions for patients with diabetes mellitus (see Figure 1).

Figure 1. Diagram of the Neuman Systems Model (1995).



In order for the model to be used effectively a number of concepts must first be understood. These include person, stressors, environments, variables, lines of defense, core energy resources, health, prevention, reconstitution, and stability.

Neuman (1995) describes person, or client/client system, as a system of interrelationships between physiological, psychological, sociocultural, developmental, and spiritual variables. She emphasizes her focus on the whole person, which can not be broken down to selected parts.

Neuman (1995) describes stressors as tension producing stimuli occurring within the internal or external environment of the client. The stressors are classified as intrapersonal, interpersonal, and extrapersonal in terms of the environment in which they occur. The internal environment contains intrapersonal stressors and is composed of internal forces within the defined client system boundaries. The external environment contains interpersonal and extrapersonal stressors and is composed of the forces existing outside the defined client system boundaries. Examples of intrapersonal stressors include emotions, feelings, and the immune response. In the case of type 1 diabetes mellitus (DM), the immune response attacks beta cells of the pancreas, rendering them ineffective and creating the intrapersonal stressor of DM. Examples of interpersonal stressors include gender, familial, and relationship roles and expectations. The expectation of a diabetic family member to eat foods of family tradition can be an interpersonal stressor if the foods are not in agreement with diet recommendations. Examples of extrapersonal stressors include job, financial, and governmental responsibilities and laws. A diabetic who has no job or a job with very little income and no health insurance can be a great extrapersonal stressor when considering treatment expenses.

The created environment is an environment identified by Neuman (1995) that connects the internal and external environments and acts to unconsciously stimulate health. It is created by client both consciously and unconsciously and acts to protect the client system. The created environment includes values, beliefs, and self-esteem. It is be explored by the caregiver during assessment. Examples of the created environment for each of the five variables of the client system discussed below include body build, rationalization, social variety, life cycle survival patterns, and hope. A diabetic with poor self-esteem, social support, and motivation to try and gain control of the disease has a poor created environment for attaining treatment goals.

The five variables of a client system include physiologic, psychological, sociocultural, developmental, and spiritual. Ideally these variables are all in balance with each other. The physiologic variable involves body mechanics and processes such as recommended exercise programs in the case the of DM patient. The psychological variable deals with our relationships and how we think about our health and how DM can effect it. The sociocultural variable has to do with social and cultural activities that can be both beneficial and disruptive to DM dependant upon activity. The developmental variable involves our growth and maturation over the lifespan and how age can effect DM treatment recommendations. The spiritual variable deals with our spiritual belief system. The spiritual variable was an addition that Neuman added to her third edition of the model in 1995. The variable is described as being on a continuum from complete unawareness of the presence of the variable to a fully developed spiritual understanding. If well developed, the spiritual variable may be used as a coping mechanism for disease, negative outcomes, and/or death.

Stressors attempt to penetrate flexible and normal lines of defense. Stressors effect all five of the variables and first attempt to attack the flexible line of defense. The flexible line of defense is represented in Neuman's diagram as the outermost circle (see Figure 1). It is represented as broken to signify its flexible nature. It is a buffer to the client's normal line of defense and is described by Neuman (1995) as being accordion-like in function. As it expands from the normal line of defense greater protection is provided.

The normal line of defense is what protects the core structure and stability of the system (Neuman, 1995). It is represented as a solid circle surrounding the next layer of the client system, which is the line of resistance (Figure 1). The normal line of defense represents the normal level of stability or wellness and can be used as a baseline for determining deviation. The normal line of defense also has some ability to expand or contract over time. Stressors attempt to penetrate the normal line of defense after the flexible line of defense has been passed. Stressors then work toward the central core or basic structure.

In the case of diabetes, when a person's normal line of defense is upset by abnormal blood sugar, the individual's flexible line of defense would attempt to ease the stressor so that the normal line of defense is not surpassed. The flexible line of defense in this case would be the person's ability to internally release insulin. Each person has internal lines of resistance that try to stabilize the person after a reaction to a stressor. Such reactions occur when the flexible line of defense is unsuccessful in protecting or supporting the normal line or usual state of stability. The goal of the lines of defense and resistance are to protect the basic core structure of the person.

The core is made up of basic survival factors of the system (Neuman, 1995). Physical strength, cognitive ability, and value systems are some example survival factors of the core for humans. When stressors penetrate the core, reactions to stress to occur. Reactions elicit a stress response. As stressors penetrate the core and reactions occur, energy is depleted. The degree of energy depletion can vary from minimal to instability to death. When more energy is expended than generated, the client moves toward illness or what Neuman (1995) calls entropy. Entropy is what leads to complications in the case of diabetes.

Health is the degree of client stability viewed on a continuum from wellness to illness (Neuman, 1995). Stability occurs when all of the parts of the system are in balance so that the whole system is in balance. When system needs are met there is no shortage of energy and wellness exists. An unstable or out of balance system requires energy expenditure to attain wellness. Illness occurs when there is a lack of energy available and the client is unstable. Illness can progress to the point of death.

Nurses determine client stability levels, internal and external environmental stressors, and the effect of the stressors on stability level (Neuman, 1995). Levels of stability are determined through the assessment of lines of defense, lines of resistance, basic structure energy resources, and the five interacting variables. An assessment of the data collected on a person includes the perception and meaning of the total experience to the client, the client's overall coping patterns, and the client's life-style habits. The client, then, is viewed as being engaged in varying amounts of activity with regard to stressors and in need of help in certain instances. When stressors occur, the individual may need more information or other assistance to overcome stressors. The nurse serves

as an active participant in supporting the person's defenses by assisting the person to respond appropriately to the stressor.

The goal of the nurse or caregiver is to maintain or to bring about the system's stability through reconstitution (Neuman, 1995). Reconstitution consists of bringing the system to a higher state of stability or wellness by increasing the amount of energy generated and or decreasing the amount of energy being expended. Nursing actions or interventions such as diabetic education, medication, and referral, are instituted in order to bring about reconstitution by helping the system restore and maintain some degree of stability between variables with a focus on conserving energy. Nursing interventions are classified as primary, secondary, and tertiary preventions.

Primary prevention identifies potential stressors and augments positive coping and function (George, 1995). The goal of primary prevention is to retain optimal functioning by reducing the possibility of encountering a stressor and strengthening the flexible line of defense. It is an appropriate intervention when a reaction to a stressor has not yet occurred (Neuman, 1974). This would include interventions made before DM diagnosis in high-risk patients. There are eight interventions under primary prevention (Table 1). Specific examples include health screening, exercise, and life style changes.

TABLE 1

Neuman's Interventions for Primary Prevention (George, 1995)

1.	Classifying stressors that threaten stability of the client/client system and preventing stressor invasion.
2.	Providing information to retain or strengthen existing client system strengths.
3.	Support positive coping and functioning.
4.	Desensitize existing or possible noxious stressors.
5.	Motivate toward wellness.
6.	Coordinate and integrate interdisciplinary theories and epidemiological input.
7.	Educate or reeducate.
8.	Use stress as a positive intervention strategy.

Secondary prevention mobilizes and supports internal and external responses when stressors attack to decrease energy use (George, 1995). The goal of secondary prevention is to increase stability. Secondary prevention is attaining optimal functioning after a reaction has occurred and symptoms are present. It mobilizes the patient's internal and external resources to stabilize or strengthen the lines of resistance. Neuman lists nine secondary interventions (Table 2). Specific examples include treating abnormal blood sugars in the case of diabetes and treating abnormal vital signs and/or client system responses.

TABLE 2

Neuman's Interventions for Secondary Prevention (George, 1995)

1.	Following stressor invasion.
2.	Protect the basic structure.
3.	Mobilize and optimize internal/external resources to attain stability and energy conservation.
4.	Facilitate purposeful manipulation of stressors and reactions to stressors.
5.	Motivate, educate, and involve the client in health care goals.
6.	Facilitate appropriate treatment and intervention measures.
7.	Support positive factors toward wellness.
8.	Promote advocacy by coordination and integration.
9.	Provide primary preventive intervention as required.

Tertiary prevention occurs after secondary prevention strategies have been initiated and reconstitution or stability has begun (George, 1995). The goals of tertiary prevention are re-adaptation and reeducation to prevent future occurrences and maintenance of stability. Tertiary prevention supports existing strengths, conserves energy, and leads back to primary prevention. There are five listed tertiary interventions listed in Neuman's model (Table 3). Examples include follow up and referral in the case of diabetes, as well as rehabilitation, palliative, and hospice care.

TABLE 3

Neuman's Interventions for Tertiary Prevention (George, 1995)

1.	During reconstitution, attain and maintain maximum level of wellness or stability following treatment.
2.	Educate, reeducate, and/or reorient as needed.
3.	Support client/client system toward appropriate goals.
4.	Coordinate and integrate health service resources.
5.	Provide primary and/or secondary preventative intervention as required.

Review of Literature

The following literature review will discuss interventions within the three levels of prevention used by healthcare providers in dealing with patients of DM. The following literature review includes interventions suggested in the medical and nursing literature as well as the nurse practitioner literature. This type of a review is justified in that nurse practitioners are advanced practice nurses licensed to practice in specific areas of medicine. Medline and CINAHL were used as databases for the literature review. Information was also pulled from primary care textbooks and Internet sources (see references).

The review of literature reveals protocols for diabetes intervention as well as suggestions to guide health care providers in the prevention, identification, and treatment of diabetes. Professional organizations, including the American Diabetes Association, the American Medical Association, and the American Nurses Association, have all published guidelines for health care professionals to use in identifying and treating diabetes mellitus.

Primary Prevention

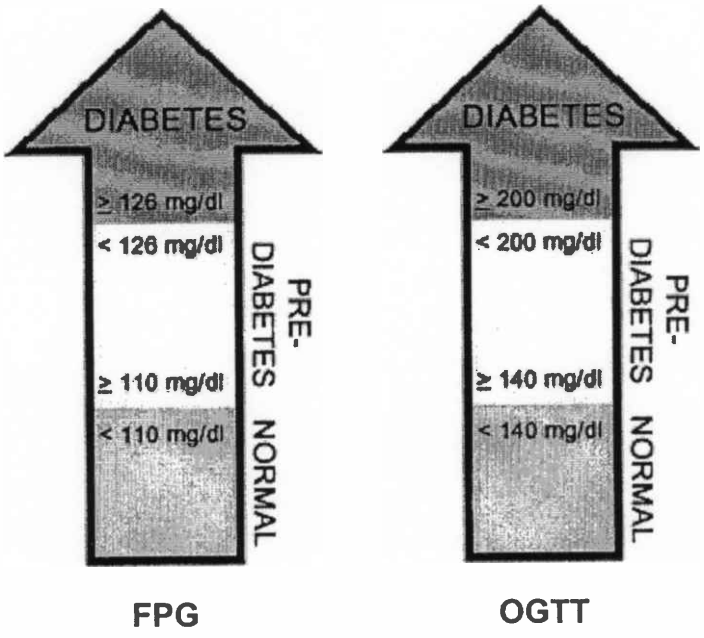
Primary prevention is an intervention appropriate prior to stressor reactions since the goal of this type of intervention is to retain optimal functioning by avoiding the stressor (Neuman, 1974). Nurse practitioners and other health care providers must be knowledgeable and aware of signs, risk factors, and interventions needed to prevent and target diabetes mellitus. Primary preventions include screening, diet and exercise education, and community collaboration in an effort to prevent diabetes mellitus.

Screening

An essential component of primary prevention is identification. It is estimated based on the presence of retinopathy that newly diagnosed type 2 diabetics in the U.S. have diabetes for an average of eight years before detection (Bell, 2002). Because the harmful effects of diabetes often occur prior to diagnosis, the American Diabetes Association recommends that everyone be initially tested for diabetes by age 45 and again at three-year intervals if initial and ongoing results continue to be normal (Cameron, 2002). Those who have obesity, hypertension, a nonwhite racial background, or a family history of diabetes should be tested at a younger age such as 30--and more frequently if indicated due to increased risk. Overweight children with two risk factors should be screened and tested at age 10 or younger (Caughron & Smith, 2002).

Diabetes can be diagnosed in nonpregnant adults by random plasma glucose (RPG), fasting plasma glucose (FPG), or by an oral glucose tolerance test (OGTT) (American Diabetes Association, 2002b). Symptoms of diabetes (polyuria, polydipsia, weight loss, etc.) and an RPG of 200 mg/dl, an FPG (glucose level after no caloric intake for at least eight hours) of 126 mg/dl, or a two hour postload glucose (glucose level two hours after OGTT initiation with 75 gram equivalence of glucose in water) of 200 mg/dl are all considered diagnostic if confirmed on a subsequent day. Some of these concepts are delineated in Figure 2. The FPG is the preferred test due to ease of use, patient acceptance, and low cost (American Diabetes Association, 2002b).

Figure 2. DM diagnostic blood sugar levels (American Diabetes Association, 2002a).



Impaired fasting glucose (IFG) or impaired glucose tolerance (IGT) are the terms used for hyperglycemia levels nondiagnostic of DM. IFG is an FPG level equal to or greater than 110 mg/dl and less than 126 mg/dl. IGT is a two-hour postload glucose equal to or greater than 140 and less than 200 mg/dl. Both IFG and IGT are risk factors for future diabetes and cardiovascular disease that should be treated with lifestyle interventions to reduce the rate of progression to type 2 diabetes. The American Diabetes Association recommends that a complete medical evaluation be performed along with testing so as to assess the presence or absence of diabetes complications, create an effective treatment plan, and provide a basis for continued treatment (American Diabetes Association, 2002b).

Education

Although the current medical and nursing research literature on primary prevention education for diabetes is lacking, primary prevention education is still an important part of DM treatment. The clinic environment can be utilized to communicate education to patients. Patients and the community can be informed that DM is a matter of great societal concern. Posters and brochures can be placed in the waiting room, patient rooms, and in bathrooms to promote awareness and education in high risk groups such as the obese, sedentary, elderly, nonwhite ethnicity, and those with strong family history (American Diabetes Association, 2002b).

Any patients who are at risk for developing DM specifically need to have diet and exercise education due to the fact that diabetes and associated complications can in some cases be prevented or improved by regular exercise and dietary modification (American

Diabetes Association, 2002b). These are discussed in more detail in the following two sections.

Diet modification

The goal of diet modification along with exercise is to assist in achieving desired glucose, lipid, and blood pressure values in the DM patient or patient at risk for diabetes. Goal values are achieved nutritionally by promoting healthy eating habits. This entails creating a meal plan with consistent meal times and consistent calorie, carbohydrate, protein, and fat levels in foods (Dube & Peiris, 2002). A study in the nursing literature by Nusbaum & Gant (1999), determined that obstacles to improved diabetic nutritional management were often due not to lack of objective knowledge, but due to patient and/or caregiver difficulties in accepting life-style changes. Focused nutritional interventions were found to be useful in improving patient skills at grocery shopping and motivating smoking cessation. Smoking cessation is also discussed under alcohol and tobacco screening section of secondary prevention.

Weight loss in obese patients will often decrease high glycemic, lipid, and blood pressure values. Ideal body weight (IBW) and basal caloric needs can be used to help determine what specific levels of calories, carbohydrate, protein, and fat should be used in each patient to facilitate therapeutic weight loss. IBW can be calculated by adding five pounds for every inch over five feet to 100 pounds in a woman and adding six pounds for every inch over five feet to 100 pounds in a man. Approximately 10% is then added or subtracted respectively for large or small builds. Basal caloric needs are calculated by multiplying the IBW by 10, with men adding 20-40% to this figure depending upon

physical activity. The figure comes out to roughly 30 cal/kg and again varies with individual (Bell, 2002).

A 3,600-calorie deficit is needed to lose one pound of fat. Roughly, 500 calories should therefore be excluded from daily caloric needs if a pound of fat is to be lost every week. Weight loss as little as 5% results in a significant and beneficially disproportionate decrease in insulin resistance and improved glycemic control in the DM patient or patient at risk for DM (Bell, 2002). Dietary referral is of benefit to all DM or high-risk patients and is discussed under the diet modification section under secondary prevention along with the recommended food group calorie divisions for diabetics.

Exercise

Exercise education involves stressing proven benefits such as enhanced well-being, reduced cardiovascular risk, increased endurance, and weight reduction (American Diabetes Association, 2002b). One hundred and fifty minutes per week of walking is enough to markedly lower insulin resistance and thereby improve glycemic control. A 6% decrease in insulin resistance occurs for every five miles a week walked by a nondiabetic, with an even greater decrease in DM and high-risk patients. Exercise is essential when considering that those in the lowest quartile for physical fitness have the highest incidence of diabetes and those diabetic patients in the lowest quartile for physical fitness have the highest mortality rate (Dube & Peiris, 2002). Before beginning any physical activity program the patient should first have a detailed medical evaluation with appropriate diagnostic studies to screen for any complications that may be worsened by the physical activity program. Any program and medication regimen should be

adjusted to the specific needs of the patient (American Diabetes Association, 2002b). Factors effecting adherence to diabetic management plans as discussed under the secondary prevention education section should be considered. Family and social support and a strong patient-provider relationship can improve compliance. Exercise screening prior to creating an exercise plan is discussed in more detail under secondary prevention.

Community Collaboration

All diabetic patients should be encouraged to carry a wallet size record book of test results as a source of provider information, especially if providers are changed frequently. A free card can be obtained from the ADA by dialing (800) DIABETES and packages of 100 can be bought by health care providers for $4.95 by calling (800) ADA-ORDER. Becton Dikinson (888-367-9539) provides a record book and a personal diabetes card that can be printed for patients at www.bd.com/diabetes (Cameron, 2002).

Many local health departments are involved in a federal or state initiative to identify and track people with diabetes. Enrollees are checked to ensure follow up care is being delivered. Diabetes education and other information can also be offered. Information on specific state diabetes initiatives can be found online through the National Diabetes Education Program (NDEP), at www.cdc.gov/diabetes/states (Cameron, 2002).

The NDEP is a joint effort by the Centers for Disease Control and Prevention and the National Institutes of Health to educate patients, providers, and the public, about the importance of early diabetic diagnosis and treatment. Educational materials from the current campaign are available at many local areas and are also available online at http://ndep.nih.gov/materials/pubs/control-for-life/index.html (Cameron, 2002).

Summary

Primary prevention of diabetes mellitus includes interventions focusing on the patient and the health care provider such as routine screening for DM in appropriate populations and education to improve public awareness and modify diet and exercise in currently diagnosed or high risk patients. Community collaboration is an excellent source to include in the initiation of secondary preventions (patient care) and tertiary preventions (follow up) discussed in the next following sections.

Secondary Prevention

Interventions under secondary prevention are applied after the stressor has occurred (Neuman, 1974). In the case of diabetes, there are often multiple stressors such as abnormal glucose, lipid, and blood pressure levels working in combination to cause long-term complications in essentially every part of the body. Secondary prevention aims at addressing and controlling these areas in all parts of the body. Most of the prevention data in this review will be focused on secondary prevention due to the abundance of information found in the literature review of diabetes interventions; although it is important to stress the equal importance of each intervention level and the fact that each level complements the other.

The goal of applying secondary prevention intervention is to assist the patient in attaining optimal functioning following the stressor (Neuman, 1974). Secondary prevention interventions to be discussed are screening, assessment, education, health care intervention, counseling, and documentation. Of these areas, screening and health care

interventions are divided into glycemic, hypertension, dyslipidemia, nephropathy, retinopathy, neuropathy, coronary artery disease, immunization, and alcohol & tobacco screenings and treatments. Glycemic treatment is divided into oral antidiabetics, insulins, and combination therapies. Education is divided into diet modification and exercise.

Screening

Regular screening in patients with DM is an essential component of secondary prevention due to the fact that early detection and intervention can prevent further complications (American Diabetes Association, 2002b). This is important to consider when long-term complications of retinopathy; nephropathy; peripheral neuropathy; autonomic neuropathy; atherosclerotic cardiovascular, peripheral vascular, and cerebrovascular disease; hypertension; abnormalities of lipoprotien metabolism; peridontal disease; and psychosocial dysfunction are not uncommon and often permanently debilitating (Caughron & Smith, 2002).

The Diabetes Control and Complications Trial Research Group (DCCTRC), completed an American multi-center clinical study (DCCT) that followed 1,441 patients with insulin-dependent diabetes mellitus (type 1) for up to nine years. In 1993, the DCCTRC reported that intensive blood glucose control, along with early detection of and intervention for diabetic complication resulted in an approximately 60% reduction in retinopathy, nephropathy, and neuropathy over the seven years of the study.

The United Kingdom Prospective Diabetes Study Group (UKPDSG) completed a study (UKPDS) of 3,867 people newly diagnosed with type 2 diabetes and followed them for 10 years. The UKPDSG also found that tighter glycemic control and early

intervention in initial stages of diabetic complication delayed or even prevented progression of microvascular disease (1998).

The evidence from these studies (DCCT, 1993), (UKPDS, 1998), supports patients receiving intensive medical care from a physician or nurse practitioner coordinated team. Such teams include, but are not limited to, physicians, nurse practitioners, nurses, dietitians, and mental health professionals (preferably with an interest and expertise in diabetes). Referral to an endocrinologist if a primary care provider is currently following the patient may also be necessary in complicated cases and/or in cases where the provider is inexperienced in diabetic care. Success of the management plan will also ultimately lie in the active participation of the patient (American Diabetes Association, 2002b). The following screening topics discussed should be routinely addressed in all diabetic patients during routine appointments. Coordination of screenings is also discussed in the assessment section of secondary prevention, which then leads into secondary prevention problem specific treatments.

Glycemic screening

An epidemiological review of the data from both the DCCT and the UKPDS showed that the risk for the microvascular complications such as retinopathy, nephropathy, and neuropathy, was decreased by approximately 30% for every percentage point drop in the HbA1c (Cameron, 2002). The DCCT data revealed that a 2% difference (9% vs. 7%) in the HbA1c blood test correlated with a 63% decrease in retinopathy development, a 54% decrease in nephropathy development, a 60 % decrease in the neuropathy development, and a 41% decrease in the development of macrovascular

disease in type 1 diabetic patients (UKPDS, 1998). The UKPDS data also revealed that the lower the HbA1c was, the lower the incidence of retinopathy, nephropathy, neuropathy, amputation, cataract, congestive heart failure, myocardial infarction, and stroke (Bell, 2002). Intensive hypertension control efforts in the study in patients with type 2 diabetes also significantly reduced the risk of heart failure, vision loss, stroke, and death from diabetes (Cameron, 2002).

Patients should be encouraged to self-monitor their blood glucose at home with frequency determined on an individual basis according to how well the patients can control their own glucose level (Caughron & Smith, 2002). Fasting blood glucose readings with every visit are not necessary if the patient keeps accurate records of home recordings. Methods of self-monitoring and accuracy of home machines should be observed and tested twice a year for accuracy in comparison to office screenings (Cameron, 2002).

Benefits of strict glucose control for patients with end-stage complications are unknown. DCCT (1998) results suggest that patients with known diabetes for 20 to 25 years without any subsequent complications may not benefit from intensive therapy. However, patients with life expectancies long enough to benefit from long-term glycemic control (10-20 years) and who are active, cognitively intact, and willing to under take the responsibility of self management, should be encouraged to do so. Higher target goals can be set for patients with end-stage complications or who are cognitively or functionally impaired due to the fact that hypoglycemia side effects are of a greater concern than microvascular complications (especially in any patients receiving exogenous insulin). A fasting glucose of less than or equal to 140 mg/dl and postprandial

glucose less than or equal to 200-220 mg/dl are acceptable goals for this population (Cameron, 2002).

The HbA1c test can and should be performed in addition to self-blood glucose monitoring. This offers the clinician a good picture of average glucose control over the past three months and should reflect the self-monitoring values recorded by the patient. Patients can choose to have the HbA1c test done only twice a year if they have achieved their target degree of control (usually less than or equal to 7%), or four times a year for motivation (Cameron, 2002). ADA recommendations are quarterly for patients who have not reached control goals (2002b).

The target goal for optimal control has been defined by the ADA as a HbA1c level less than or equal to 7%, and has more recently been lowered to less than or equal to 6.5% by American Association of Clinical Endocrinologists guidelines (Dube & Peiris, 2002). However, the incidence of severe hypoglycemia increases in trying to maintain HbA1c levels less than or equal to 6.5% and the ADA recommendation is still less than or equal to 7%. Lower HbA1c levels are easier to achieve in the type 2 patient due to the lower incidence of hypoglycemia, which is even less problematic in type 2 patients taking only metformin and/or a thiazolidinedione or less (Bell, 2002). Treatment regimens should be altered if frequent or severe hypoglycemia occurs. This can be done by changing medications or lifestyle and/or setting higher goal levels. Postprandial glucose monitoring and therapies targeting postprandial excursions may be necessary to reduce the risk of hypoglycemia and still maintain goals (American Diabetes Association, 2002b). Glycemic treatment is discussed under the health care intervention section of secondary prevention.

Hypertension screening

According to the sixth report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNCVI), blood pressure is divided into four categories (see figure 3). Of these categories, hypertension is further broken down into three stages based on the average of two or more readings taken at each of two or more visits after an initial screening (National Institute of health, 1997).

Hypertension affects approximately 20% of the U.S. population and 20-60% of people with diabetes, depending on age, obesity, and ethnicity. Of this population, approximately 25% are unaware of the disorder and approximately 25% are uncontrolled (National Institute of Health, 1997). The disorder increases the risk for cardiovascular disease, stroke, and microvascular complications. It is often the result of underlying nephropathy (compensation to maintain glomerular filtration) in DM type 1; and often present as part of the metabolic syndrome (insulin resistance syndrome) in combination with obesity, hyperglycemia, and dyslipidemia, in DM type 2 (American Diabetes Association, 2002b).

Figure 3. Blood pressure classifications (National Institute of Health, 1997).

CLASSIFICATION OF BLOOD PRESSURE FOR ADULTS AGE 18 AND OLDER*

Category	Systolic (mm Hg)		Diastolic (mm Hg)
Optimal†	<120	and	<80
Normal	<130	and	<85
High-normal	130-139	or	85-89
Hypertension‡			
Stage 1	140-159	or	90-99
Stage 2	160-179	or	100-109
Stage 3	≥180	or	≥110

* Not taking antihypertensive drugs and not acutely ill. When systolic and diastolic blood pressures fall into different categories, the higher category should be selected to classify the individual's blood pressure status. For example, 160/92 mm Hg should be classified as stage 2 hypertension, and 174/120 mm Hg should be classified as stage 3 hypertension. Isolated systolic hypertension is defined as SBP of 140 mm Hg or greater and DBP below 90 mm Hg and staged appropriately (e.g., 170/82 mm Hg is defined as stage 2 isolated systolic hypertension). In addition to classifying stages of hypertension on the basis of average blood pressure levels, clinicians should specify presence or absence of target organ disease and additional risk factors. This specificity is important for risk classification and treatment.

† Optimal blood pressure with respect to cardiovascular risk is below 120/80 mm Hg. However, unusually low readings should be evaluated for clinical significance.

‡ Based on the average of two or more readings taken at each of two or more visits after an initial screening.

The UKPDS(1998) (see also glycemic screening) has shown that a modest reduction in systolic blood pressure on the order of 10 to 15 mm Hg is associated with a 10 to 15% reduction in death, myocardial infarction, and microvascular complications. The Hypertension Optimal Therapy (HOT) Study compared the outcomes of maintaining diastolic blood pressure to goals 80, 85, or 90 mm Hg in a large number of subjects (Hansson, Zanchett, & Carruthers, 1998). In the nondiabetic group, there was almost a 10% difference in cardiac events when diastolic blood pressures of 90 mm Hg were compared with diastolic blood pressures of 80 mm Hg, where as in the diabetic group there was almost a 50% difference. Because of these and other studies, the current recommendations are that hypertension should be treated to a blood pressure level of 130/80 mm Hg or below in the diabetic patient and if albuminuria is present (>20 mg/min, 30 mg/day, or 30 mg/g creatinine) to a level of 120/75 mm Hg or below (Bell, 2002).

Patients with elevated blood pressures should have their blood pressure re-examined within 1 month to confirm the presence of hypertension before initiating treatment (unless the systolic blood pressure is >180, or the diastolic blood pressure is >110 mm Hg, and treatment should then be immediate). Hypertensive patients should then be seen as often as needed to get blood pressure under control and then seen as necessary to treat hypertension and other cardiovascular risk factors, such as hyperlipidemia, smoking, and hyperglycemia (American Diabetes Association, 2002b). Hypertensive treatment is discussed under the health care intervention section of secondary prevention.

Dyslipidemia screening

Cardiovascular disease accounts for 75-80% of the mortality in diabetic patients (Dube & Peiris, 2002). Death rate from myocardial infarction in diabetic patients is similar to the death rate in nondiabetic patients with preexisting cardiac disease, thus making DM a risk equivalent to established coronary artery disease. Intensive efforts to achieve desired lipid levels are mandatory since lipid lowering is as effective in reducing coronary artery disease in DM as it is in nondiabetic patients. A fasting lipid profile (LDL, HDL, total cholesterol, and triglycerides) should be completed every year in adults and every two years if values are in the low-risk range. In children older than two years of age, a lipid profile should be drawn after diagnosis of diabetes and when glucose control has been established. If values are considered low risk and there is no family history, assessments should be repeated every 5 years (American Diabetes Association, 2002b). Risk categories are delineated in figure 4. Treatment is discussed in the health care interventions section of secondary prevention.

Figure 4. Dyslipidemia risk categories (American Diabetes Association, 2002b).

Risk	LDL cholesterol	HDL cholesterol*	Triglyceride
High	130	<35	400
Borderline	100–129	35–45	200–399
Low	<100	>45	<200

Data are given in milligrams per deciliter.

*** For women, the HDL cholesterol values should be increased by 10 mg/dl.**

Nephropathy screening

Eighty percent of type 1 diabetic patients and 20% of type 2 diabetic patients with microalbuminuria will progress to diabetic nephropathy unless treatment to slow its advancement is utilized (Bell, 2002). In an effort to monitor nephropathy progression the DCCT (1993) and the UKPDS (1998) use the urine test for microalbuminuria as the most sensitive indicator of diabetic kidney damage. A cheaper and less sensitive urine dipstick for gross protein is recommended initially at the time of diabetes diagnosis to determine if significant damage has already occurred. The dipstick is sensitive to kidney damage at a later stage (gross protienuria) than the microalbuminuria test. If the dipstick is positive, continued dipstick tests for gross protienuria are recommended to monitor the progression of kidney disease. If the test is negative, annual urine testing for microalbuminuria is recommended in all type 1 diabetics who have had DM for more than 5 years and all type 2 diabetics at the time of diagnosis. There are no recommendations on whether testing should be continued once clinical microalbuminuria is confirmed since the microalbuminuria testing is the more expensive test (Cameron, 2002).

Testing for microalbuminuria can be performed by 24-hour urine collection and by timed (four-hour/overnight) collection. At least two of three tests measured within a 6-month period should show elevated levels before a patient is designated as having microalbuminuria (American Diabetes Association, 2002b). This is due to the fact that certain conditions such as recent exertion, urinary tract infection, hyperglycemia, heart failure, and fever can cause transient elevation in microalbumin excretion. Positive results from spot checks should be confirmed by repeated testing over three to six months

and by more sensitive methods such as the 24-hour timed urine collections for albumin and creatinine (Bell, 2002).

Microalbuminuria screening in the primary care setting can be done using a random spot check of albumin-to-creatinine ratio on an early morning specimen when albumin excretion is highest (Cameron, 2002). Normally albumin is < 30 mg/g of creatinine. Albumin levels between 30 and 300 mg/g of creatinine are diagnostic of microalbuminuria, and levels more than 300 mg/g of creatinine are diagnostic of macroalbuminuria and diabetic nephropathy (Bell, 2002).

Retinopathy screening

Diabetic retinopathy is a specific vascular complication that occurs in both type 1 and type 2 diabetic patients and is strongly related to duration of diabetes. It is estimated to be the most frequent cause of new cases of blindness among adults aged 20-74 years (American Diabetes Association, 2002b).

Visual decline in retinopathy is caused by macular edema, nonperfusion, proliferative growth of new vessels, and retinal hemorrhaging; which are all strongly associated with poor glycemic control, hypertension, and dyslipidemia (Cameron, 2002). Hyperglycemia increases retinal capillary permeability to fluids and fatty acids, causing retinal edema, fatty deposits in the retina, and vitreous hemorrhages. Hypertension forces more fluid and deposits through the already permeable capillary walls causing macular edema. Hyperlipidemia increases fatty deposits in the retina making vessels more apt to break and bleed. New weaker blood vessels grow in the retina to replace the damaged ones, but they in turn leak, break, and bleed. Treatment is therefore aimed at gaining

control of hyperglycemia, dyslipidemia, and hypertension, and is discussed in the corresponding health intervention sections of secondary intervention and under retinopathy treatment of secondary intervention.

The current ADA screening recommendations are an annual eye examination through a dilated pupil in everyone with diabetes over age 21 years or who has had diabetes for more than five years (Bell, 2002). Women with pre-existing diabetes should have a comprehensive eye examination and should be counseled on the risk for development and progression of diabetic retinopathy when planning pregnancy. Pregnant diabetic patients should have a comprehensive eye examination in the first trimester and close follow-up throughout pregnancy and for one year postpartum. (American Diabetes Association, 2002b).

Neuropathy screening

Diabetes can have a harmful effect on any aspect of the entire nervous system resulting in complications as diverse as pain, loss of sensation, impaired motor coordination, postural hypotension, gastrointestinal dysfunction, sexual dysfunction, and foot ulceration (Nobles, 2001). Peripheral neuropathy resulting in pain, loss of sensation, foot ulceration, and even amputation, are some of the most common consequences of diabetic neuropathy, and are a major cause of morbidity and disability in people with diabetes. Peripheral neuropathy is the most common cause of amputation and will be the focus of discussion in this section.

Early recognition and management of risk factors can delay or even prevent peripheral neuropathy progression to ulceration and/or amputation. The risk of ulcers or

amputations is increased in people who have had diabetes greater than 10 years, have poor glucose control, or have cardiovascular, retinal, or renal complications. Foot conditions associated with an increased risk for amputation include: peripheral neuropathy with loss of protective sensation, altered biomechanics resulting in increased pressure with visible erythema or hemorrhage under a callus, bony deformity, peripheral vascular disease with decreased or absent pedal pulses, a history of ulcers or amputation, and severe nail pathology (American Diabetes Association, 2002b).

Daily self-inspection of the feet and an annual (or more frequent) sensory foot exam by a health care professional are extremely important for early detection of neuropathy. Semmes-Weinstein monofilaments for testing foot sensation are available through the Lower Extremity Amputation Prevention (LEAP) Program in the Bureau of Primary Health Care and can be obtained online at www.bphc.hrsa.gov/leap, and at most medical supply stores. Screening entails pressing the filament against specific metatarsal-phalangeal joints and toes until the filament bends. Loss of sensation in specific areas are recorded along with exam dates (Cameron, 2002).

When monofilament screening is negative, additional information in the assessment of foot damage may be obtained by measuring vibratory sensation with a tuning fork. To perform this test, a tuning fork (128 Hz or 256 Hz) is placed on a bony body area and the patient is asked to tell the clinician when vibratory sensation ceases. Cessation of vibration is then verified by bringing the tuning fork to the wrist or fingers of the healthcare provider and documented (Cameron, 2002).

An effective tool in preventing amputation once neuropathy is confirmed is patient education. A study by Watts, Dally, Anthony, McDonald, Khoury, & Dahar

(2001), found that age and gender are not clear determinants of foot ulceration risk, but that high risk patients (as discussed previously), and patients with high HbA1c levels are clearly at risk. The study stressed that nurse practitioners can effectively screen for amputation risk factors and closely monitor HbA1c levels to reduce the incidence of vascular complications and associated amputation. Education should include informing patients to always wear shoes and to break in new shoes slowly by wearing them no more than four hours a day initially. Extra-depth shoes with molded insoles and rocker bottoms can be used. Feet should be inspected in the morning and evening with immediate provider notification of any breakdown. Hot water and hot surfaces should also be avoided (Bell, 2002). Treatment options for neuropathy are also discussed further in the neuropathy treatment section of secondary intervention.

Coronary artery disease screening

According to the ADA (2002b), cardiovascular risk factors should be assessed annually to identify the need for CAD diagnostics and follow up in diabetic patients without clear or suggestive symptoms of CAD. Risk factors include dyslipidemia, hypertension, smoking, a family history of premature coronary disease, and the presence of micro or macroalbuminuria. Criteria for exercise stress (ECG) testing include: patients with typical or atypical cardiac symptoms, an abnormal resting ECG, a history of peripheral or carotid occlusive disease, sedentary lifestyle, age above 35 with plans to begin a new exercise program, or those with two or more of the afore mentioned risk factors (Caughron & Smith, 2002). Any abnormal ECG or inability to perform testing requires additional or alternative testing. Stress nuclear perfusion and stress ECHO are

the next-level diagnostic procedures. Cardiology consultation is recommended for further work-up (American Diabetes Association, 2002b). Additional treatment is discussed under the corresponding health care intervention section of secondary prevention.

Immunization screening

People with diabetes may have lowered immune systems such that normally preventable illnesses such as influenza and pneumonia may destabilize glycemic control, initiate ketosis, and increase the risks of hospitalization and death if patients are not immunized. Patients should be reminded that pneumococcal vaccines are recommended for all people with diabetes at the time of diagnosis and again at age 65 if more than five years have elapsed since the first vaccination. The influenza vaccine is recommended annually for those aged six months and older (Cameron, 2002). The influenza vaccine has been shown to reduce diabetes-related hospital admission by as much as 79% during flu epidemics. Indications for repeat vaccination include nephrotic syndrome, chronic renal disease, and other immunocompromised states such as post organ transplantation (American Diabetes Association, 2002b).

Alcohol and tobacco screening

Cigarette smoking is the cause of one in every five deaths in the U.S. and is an important modifiable cause of premature death. Morbidity and premature death associated with the development of both microvascular and macrovascular complications are increased in diabetic patients who smoke (American Diabetes Association, 2002b).

Alcohol inhibits gluconeogenesis, impairs judgement, and can cause hypoglycemia in patients taking oral glucose lowering medications or insulin and drinking on an empty stomach (Cameron, 2002). If diabetics are going to drink, the recommendations are the same as for the general population meaning no more than two drinks (12 ounce beer, 5 ounce wine, or 1.5 ounce distilled spirits) per day for men and no more than one drink per day for women. However, diabetics should be encouraged to drink with meals and must add the calories of alcoholic beverages to the total of their caloric intake. It is recommended that the caloric count be substituted for fat calories when adding the calorie count of the alcohol to the total of caloric intake (Caughron & Smith, 2002). Smoking cessation and caution with alcohol ingestion should be a routine part of every visit in diabetic patients.

Nurses can play an integral role in smoking cessation. In a recent study by Canga, De Irala, Vara, Duaso, Ferrer, & Martinez-Gonzalez (2000), the effectiveness of a nurse-managed smoking cessation intervention for diabetics was assessed. The intervention consisted of a 40-minute nurse visit inclusive of counseling, education, and a negotiated contractual cessation date; with follow up of telephone calls, letters, and visits. After six months, 17% of the intervention group had stopped smoking and only 2.3% of the control group receiving regular care had stopped (confirmed by self-reports and urine nicotine concentration). Those still smoking reduced cigarette consumption from an average of 20 per day to 15.5 in the intervention group and from an average of 19.7 to 18.1 in the control group. Structured interventions by nurses can effectively make changes in the behaviors of diabetic smokers.

Assessment

The initial visit should set up a plan and discuss the concerns and wishes of the patient (Dube & Peiris, 2002). The plan should be a team effort of coordination between the patient, the family, and the health care team, with a focus on self management education. Work, school, age, activity, medical condition, eating habits, and social and cultural factors should all be considered in formulating the plan (American Diabetes Association, 2002b). The plan should include short term and long term goals discussing nutrition, medication, lifestyle, monitoring instruction, vaccination, birth control in child bearing women, dental hygiene, specialty consultation, and agreement on continued follow up (Caughron & Smith, 2002).

A complete history and physical should be obtained with the initial visit. History should review: symptoms with focus on evidence of hypoglycemia or hyperglycemia, previous laboratory results pertaining to diagnosis and management of diabetes, previous treatment programs; history of foot, skin, dental and genitourinary infections, and current treatment if any (Caughron & Smith, 2002). Dietary history and level of understanding, weight history, growth and development in children, medications, glucose monitoring, exercise routine, and previous acute complications and frequency, should all be discussed. Ophthalmologic, podiatry, neurologic, and cardiac, evaluation should be discussed including risk factors of atherosclerosis, family medical history, birth history, and assessment of sociocultural factors with an influence on diabetic management such as education level, use of alcohol and tobacco, and comorbid conditions (Dube & Peiris, 2002). Since diffuse autonomic neuropathy can also occur in

diabetics altering digestion, sexual organs, urination, and sweat glands, questions should also be asked pertaining to these areas (University of Maryland Medicine, 2001).

A physical exam should address: height, weight, and body build, with attainment of developmental milestones in children and adolescents, determination of blood pressure including orthostatic measurements, fundoscopic evaluation under dilatation, oropharyngeal examination under direct visualization, and thyroid palpation (Dube & Peiris, 2002). Evaluation of the cardiovascular and pulmonary system, neurological and reproductive system, and abdomen, hands, feet, and extremities for adequacy of circulation should be obtained with attention to morphology of joints, skin, injection sites, pigmentation, body hair patterns, striae, and signs of infection (Caughron & Smith, 2002).

Initial laboratory testing should include a fasting glucose and lipid profile, HbA1c, bedtime glucose, thyroid stimulating hormone, basic metabolic panel, liver function tests, urinalysis with microalbumin, and electrocardiogram in adults (Dube & Peiris, 2002). Standing orders for routine diabetic testing will increase the likelihood of patients actually receiving the screening tests regardless reason for visitation (Cameron, 2002).

Education

There are multiple studies in the nursing literature on the subject of diabetes education and patient adherence to education plans. According to a study by Lo and MacLean (2002), the coping process is different in type 1 and 2 diabetics, and health care professionals need to recognize differences in order to provide appropriate care. Type 1

diabetics are more likely to feel the impact of the diagnosis more severely than type 2 diabetics and are more likely to use avoidance, denial, and fantasy strategies in their attempts to cope with the diagnosis and its implications. Intensive support efforts should therefore be focused in the early adjustment period after initial diagnosis when stress is high for type 1 diabetics. The residual effects of not being ill were more likely to be felt by type 2 diabetics. Intensive efforts should there for be made at times when patients are feeling well, reminding them that continuation of the treatment plan is essential. The study by Lo and MacLean (2002) also found that those who showed determination not to be beaten by the disease tended to use more positive coping techniques in making the adjustment.

According to Cameron (1996) there are five psychological and social factors involved in patient compliance with any treatment regimen. These include: (1) knowledge and understanding including communication, (2) quality of the interaction including the patient-provider relationship and patient satisfaction, (3) social isolation and social support including the effect of the family, (4) health beliefs and attitudes-health belief model variables, and (5) factors associated with the illness and treatment including the duration and complexity of the regimen. A study by Lo (1999), found that success in complying with a diabetic health regimen was associated with good family support and rapport with health professionals, an absence of chronic stress, and the capacity to take up the challenges posed by the disease. Recommendations to improve patient adherence were to engender optimism, maintain enthusiasm, and encourage maintenance in health behavior. An interpretive study by Whittemore, Chase, and Mandle (2002), described the process of integrating lifestyle change in type 2 diabetics as

multifaceted and complex with challenges inclusive of emotional reconciliation, structure composition, striving for satisfaction, self-exploration and conflicts, and balance and discovery. Challenges require acknowledgment in order for participants to progress toward integration. Balance between structure and flexibility, fear and hope, conflict and acceptance, diabetes and life, was the integral component to integration stressed in the study.

A study of diabetic patients by Toljamo and Hentinen (2001) determined that poor metabolic control, smoking, and living alone were associated with a neglect of self-care (neglect of every aspect of self-care despite appropriate knowledge base). Another study on motivation and dietary self-care by Senecal, Nouwen, and White (2000), determined that self-efficacy (belief that behaviors and actions will influence health) was associated with adherence and that autonomous self-regulation was associated with more life satisfaction. The study proposed that interventions be made to increase self-efficacy and autonomous self-regulation. This would mean reinforcing how current behaviors and actions have influenced health and allowing the patient as much control in regulating meal plans as possible. Similarly, a study by Vallis (1998), found that adherent patients experienced less negative emotional impact from diabetes, perceived greater benefits of adherence, and experienced few barriers to adhering to the dietary aspect of their self-care regimen. Rose, Fleige, Hildebrandt, Schirop, and Klapp (2002) again similarly found that self-efficacy and active coping behaviors strongly influence adherence and attainment of treatment goals.

Similarly to those at risk for DM, any patient with DM also needs to have diet and exercise education and intervention in an effort to achieve treatment goals and to prevent

complications (American Diabetic Association, 2002b). These topics are discussed under primary prevention and in more detail below.

Diet modification

Individualized medical nutrition therapy (MNT) provided by a registered dietitian familiar with diabetes components of MNT is recommended for all diabetic patients in an effort to achieve treatment goals. This should be provided at diagnosis and at least annually thereafter. MNT evaluates the patient's food intake, metabolic status, lifestyle, and readiness to make changes. Dietary instruction should have individualized goals and plans which take into account culture, lifestyle, and financial considerations. Behavioral issues that have an impact on adolescent diets should be considered and caution should be taken to avoid over aggressive dietary manipulation in the very young. Glucose, HbA1c, lipids, blood pressure, and renal status are monitored to evaluate nutrition-related outcomes. If goals are not met, changes must be made in the overall diabetes care and management plan (American Diabetes Association, 2002b).

A diet plan can be formulated for patients by counting carbohydrates (Dube & Peiris, 2002). First the ideal body weight, basal calorie ingestion, and desired calorie intake should be determined as discussed in the diet modification section under primary interventions. The recommended daily calorie percentages are 55-60% carbohydrate, 15-20 % protein, and <30% fat. Cholesterol intake should be <300 mg/day, sodium <2,400-3000 mg/day (<2,000 if hypertensive with nephropathy), and fiber 35-40 g/day. Consumption of large amounts of soluble fiber has a positive impact on serum lipids. Carbohydrate calories per day are equal to the total calories multiplied by the percent

carbohydrate. Carbohydrate grams per day are equal to the carbohydrate calories divided by four divided by 1,000. Carbohydrates should be evenly allocated throughout the day in order to maintain glycemic levels (Dube & Peiris, 2002). There is insufficient evidence to recommend higher or lower protein intake levels than the 10-20% average of daily caloric intake in the normal population. However, reduced protein intake should be considered with the onset of nephropathy. The National Cholesterol Education Program recommends that all individuals limit total fat consumption to <30% of total calories, saturated fat to <10% of calories, and monounsaturated fat to between 10-15% of calories. A decrease in dietary fat intake should also be considered if obesity and weight loss are primary concerns. Additional vitamin and mineral supplementation is unnecessary if there is adequate dietary intake (Caughron & Smith, 2002).

Exercise

After a physical assessment including retinal and podiatric exams, analysis of glycemic control, and consideration of an exercise stress test if the patient is at high risk for cardiac disease, the following recommendations may be made. Exercise should be started cautiously and unplanned exercise avoided. Blood glucose should be monitored before, during, and after exercise, with extra carbohydrate consumption for unplanned exercise (20 to 30 grams per 30 min of exercise). Exercise should be done with partners who can assist if needed and a consistent pattern should be maintained in relation to time of day and meals. Patients should ensure adequate pre-exercise hydration, warm-up, and cool-down. People with preexisting complications should exercise extra caution. A goal of at least a 20 to 30 minute minimum of aerobic activity should be set (& Constance,

2002). The program and medication regimen should be adjusted to the specific needs of the patient (American Diabetes Association, 2002b).

Health Care Intervention

There are a multitude of medication options available to the diabetic patient. Of the multitude of medications available the most commonly prescribed, least expensive, and most commonly used and available will be discussed in detail since they are unique to the treatment of DM. These include the oral antidiabetic agents (alphaglucosidase inhibitors, meglitinides, metformin, sulfonylureas, and thiazolidinediones), and the various forms of insulin (regular, semilente, lispro, aspart, NPH, lente, glargine, PZI, and ultralente) (Slagle, 2002). Oral antidiabetics are usually the initiatory treatment for the type 2 DM patient unresponsive to diet and exercise programs (Dube & Peiris, 2002). Medication combinations and insulin are then considered based on patient response.

Oral antidiabetic agents

Alpha glucosidase inhibitors are competitive and reversible inhibitors of alpha-amylase from the pancreas and alpha-glucosidase in the brush border of the small intestine. The inhibition results in reduced postprandial increases in blood glucose levels by delaying the digestion of dietary carbohydrates. Contraindications include renal insufficiency (serum creatinine >2mg/dL), cirrhosis, diabetic ketoacidosis, known hypersensitivity to the drug, and any disorders of digestion or absorption. Adverse effects include abdominal pain, diarrhea, and flatulence, which can be reduced by slow dose titration. Drug interactions include reduced levels of digoxin, propranolol, and

ranitidine. The alphaglucosidase inhibitors are less effective when taken with other intestinal adsorbents or digestive enzymes. The two drugs available are both pregnancy category B medications and include acarbose (precose), and miglitol (glyset). Acarbose comes in 50 mg and 100 mg tablets. Miglitol comes in 25 mg, 50 mg, and 100 mg tablets. The starting dose for both tabs is 25 mg TID with a usual range of 50-100 mg TID taken with the first bite of each meal. If used in combination with other antidiabetics, hypoglycemia may occur. Oral dextrose should be given in this situation rather than sucrose due to the pharmacology of the drugs (Slagle, 2002).

Meglitinides stimulate the glucose-dependent release of insulin from functioning beta cells in the pancreas. Contraindications include diabetic ketoacidosis, type 1 diabetes, and known hypersensitivity to the drug. Adverse effects include headache, upper respiratory tract infection, and arthralgia. Repaglinide has also been associated with hypoglycemia, chest pain, and cardiac ischemia. Azole antifungals, erythromycin, MAO inhibitors, nonselective beta blockers, NSAIDs, probenecid, salicylates, and sulfonamides may cause hypoglycemia with meglitinides in combination with other antidiabetics. Rifampin, calcium channel blockers, corticosteroids, estrogens, isoniazid, nicotinic acid, oral contraceptives, phenothiazines, phenytoin, sympathomimetics, thiazide diuretics, and thyroid supplements may cause hyperglycemia with meglitinides. The two drugs available are pregnancy class C medications and are nateglinide (Starlix) and repaglinide (Prandin). Nateglinide comes in 60 mg and 120 mg tablets and has a usual dose range of 60-120 mg TID. Repaglinide comes in 0.5 mg, 1 mg, and 2 mg tablets. The usual dose range is 0.5-4 mg BID-QID. The two agents should be taken 1-30 minutes prior to meals and skipped if meals are skipped (Slagle, 2002).

Metformin (Glucophage, Glucophage XR) decreases hepatic gluconeogenesis and glucose absorption in the intestines, and increases sensitivity to insulin by increasing peripheral glucose uptake and utilization. Contraindications include renal insufficiency (serum creatinine >1.5 in males and >1.4 in females) and acidosis. Metformin should be held 48 hours before and 48 hours after any radiologic procedure where iodinated contrast material is administered. It should also be held in the case of acute MI, CHF exacerbation, surgery, or shock. Adequate hydration should be ensured and the drug may be restarted once good renal function is confirmed. Adverse effects include gastrointestinal problems (avoided by gradual dose titration and ingestion with meals), low b12 levels (should be checked every two years), metallic taste, and in rare cases lactic acidosis (risk increases with alcohol consumption). Hypoglycemia is also rare. Azole antifungal agents, levofloxacin, nifedipine, and MAO inhibitors, may increase the risk for hypoglycemia when taking metformin. Cationic drugs such as cimetidine, cotrimoxazole, digoxin, morphine, procainamide, quinine, ranitidine, and vancomycin increase the risk for lactic acidosis. Glucophage is available in 500 mg and 850 mg immediate release tabs, and in 500 mg extended release tabs. Starting does are 500 mg BID with meals or 850 mg QD with breakfast for the immediate and 500 mg QPM with meal for the extended release. Maintenance doses are 1500-2550 mg/day divided into meal time doses for immediate and 500-2000 mg/day divided in a BID dose or taken with evening meal. Metformin is a pregnancy category B medication (Slagle, 2002).

Sulfonylureas increase pancreatic beta cell insulin secretion. Contraindications include known hypersensitivity to the drug and pregnancy for most of the agents. All are pregnancy category C except for Glynase and Micronase which are category B. Adverse

effects include dizziness, drowsiness, headache, gastrointestinal effects, hypoglycemia, syndrome of inappropriate antidiuretic hormone, skin reactions, and possible increased cardiac mortality in combination with tolbutamide. Androgens, anticoagulants, azole antifungals, ciprofloxacin, clofibrate, fluconazole, gemfibrozil, H2 antagonists, magnesium salts, methyldopa, MAO inhibitors, sulfonamides, and tricyclic antidepressants can potentiate sulfonylureas causing hypoglycemia. Beta blockers, calcium channel blockers, cholestyramine, corticosteriods, estrogens, isoniazid, nicotinic acid, oral contraceptives, phenothiazines, rifampin, sympathomimetics, thiazide diuretics, and thyroid medications, can inhibit sulfonylureas causing hyperglycemia (Slagle, 2002).

There are seven forms of sulfonylureas available on the market. Acetohexamide (Dymelor) is available in 250 mg and 500 mg tablets and has a usual dose range of 250-1500 mg/day in divided doses. Chlorpropamide (Diabinese) is available in 100 mg and 250 mg tablets and has a usual dose range of 100-500 mg/day dependent on patient response and or hepatic/renal function. Glimepiride (Amaryl) is available in 1 mg, 2 mg, and 4 mg tablets and the usual dose range is 1-8 mg QD. Glipizide (Glucotrol, Glucotrol XL) is available in 5 mg and 10 mg immediate and extended release tablets and has a usual dose of 5-40 mg/day for the immediate and 5-20 mg/day for the extended release tablets. Glyburide (DiaBeta, Micronase, and Glynase) comes in 1.25 mg, 2.5 mg, and 5 mg tablets and 1.5 mg, 3 mg, and 6 mg micronized tablets with a dose range of 1.25-20 mg/day for nonmicronized and 0.75-12 mg/day for micronized tablets. Tolazamide (Tolinase) comes in 100 mg, 250 mg, and 500 mg tablets and has a usual dose range of 100-1000 mg/day in single or divided doses. Tolbutamide (Orinase) comes in 500 mg tablets has a usual dose range of 0.25-3 g/day in single or divided doses (Slagle, 2002).

Thiazolidinediones increase insulin sensitivity, decrease hepatic gluconeogenesis and increase insulin-dependent glucose uptake into muscle. They do not increase insulin secretion. They have also been shown to somewhat synergistically improve lipid levels when used with statins and fibrates (Bell, 2002). Contraindications include known hypersensitivity to the drug and baseline liver function tests >2.5 times the upper limit of normal. Liver function monitoring should be done before starting therapy and should be done every 2 months for the first 12 months of therapy, and then periodically while the patient is being treated. The agents should be discontinued if ALT levels remain elevated above three times the upper limit of normal and full effects of the drug may not be seen until 8-12 weeks after the start of therapy. Adverse effects include anemia, edema, headache, myalgia, upper respiratory tract infection, and weight gain. Both of the thiazolidinediones available are pregnancy category C and may decrease the effectiveness of oral contraceptives. Rosiglitazone (Avandia) is available in 2 mg, 4 mg, and 8 mg tablets and has a usual dose range of 4-8 mg a day in single or divided doses. Pioglitazone (Actos) is available in 15 mg, 30 mg, and 45 mg tablets and has a usual dose range of 30-45 mg a day (Slagle, 2002).

Insulins

Insulin is produced by beta cells of the pancreas. It lowers blood glucose by increasing peripheral glucose uptake (mostly into fat and skeletal muscle) and inhibiting hepatic gluconeogenesis. Contraindications include known hypersensitivity to the insulin and hypoglycemia. Adverse effects include hypoglycemia, hypokalemia, lipodystrophy if injection sites are not rotated, and injection site reactions. Acetazolamide, albuterol,

calcitonin, corticosteroids, dextrothyroxin, diltiazem, diuretics, dobutamine, epinephrine, estrogens, HIV antivirals, lithium, isoniazid, morphine, niacin, oral contraceptives, phenytoin, and terbutaline are some of the more common drugs that may decrease the effectiveness of insulin. ACE inhibitors, alcohol, anabolic steroids, beta blockers, calcium, clonidine, fluoxetine, lithium, MAO inhibitors, octreotide, propoxyphene, pyridoxine, salicylates, sulfonamides, and tetracyclines, are some of the more common drugs that may increase the effectiveness of insulin. Exogenous insulin is mandatory for the survival of patients with type 1 DM. Some of the more common human and human analog insulin agents are discussed below with all of them being pregnancy category B medications except glargine and aspart which are pregnancy category C (Slagle, 2002).

Regular (Humulin R, Novolin R) has an onset of 0.5-1 hours, peak of 2.5-5 hours, duration of 8-12 hours, and should be given 30-60 minutes prior to meal. Semilente (Iletin) has an onset of 1-1.5 hours, peak of 5-10 hours, and duration of 12-16 hours. Lispro (Humalog) has an onset of 0.25 hours, peak of 0.5-1.5 hours, duration of 6-8 hours, and should be given 15 minutes prior to or immediately after a meal. Aspart (NovoLog) has an onset of 0.25 hours, peak of 1-3 hours, duration of 3-5 hours, and should be given 5-10 minutes prior to a meal. NPH (Humulin N, Novolin N) has an onset of 1-1.5 hours, peak of 4-12 hours, and duration of 24 hours. Lente (Humulin L, Novolin L) has an onset of 1-2.5 hours, peak of 7-15 hours, and duration of 22-24 hours. Glargine (Lantus) has an onset of 1.1hours, peak of 5 hours, duration of 24 hours, and should be given once a day at bedtime. PZI (Protamine Zinc Iletin I) has an onset of 4-8 hours, peak of 14-24 hours, and duration of 36 hours. Ultralente (Humulin U, Ultralente) has an onset of 4-8 hours, peak of 10-30 hours, and duration >36 hours (Slagle, 2002).

NPH is also sold in premixed set combinations with regular (Humulin 70/30, Novolin 70/30, and Humulin 50/50) and with lispro (Humalog Mix 75/25, and Humalog mix 50/50). When mixing insulins, such as regular and NPH, the regular insulin should be drawn into the syringe first. Glargine should not be mixed with any other insulin or given IV (Slagle, 2002).

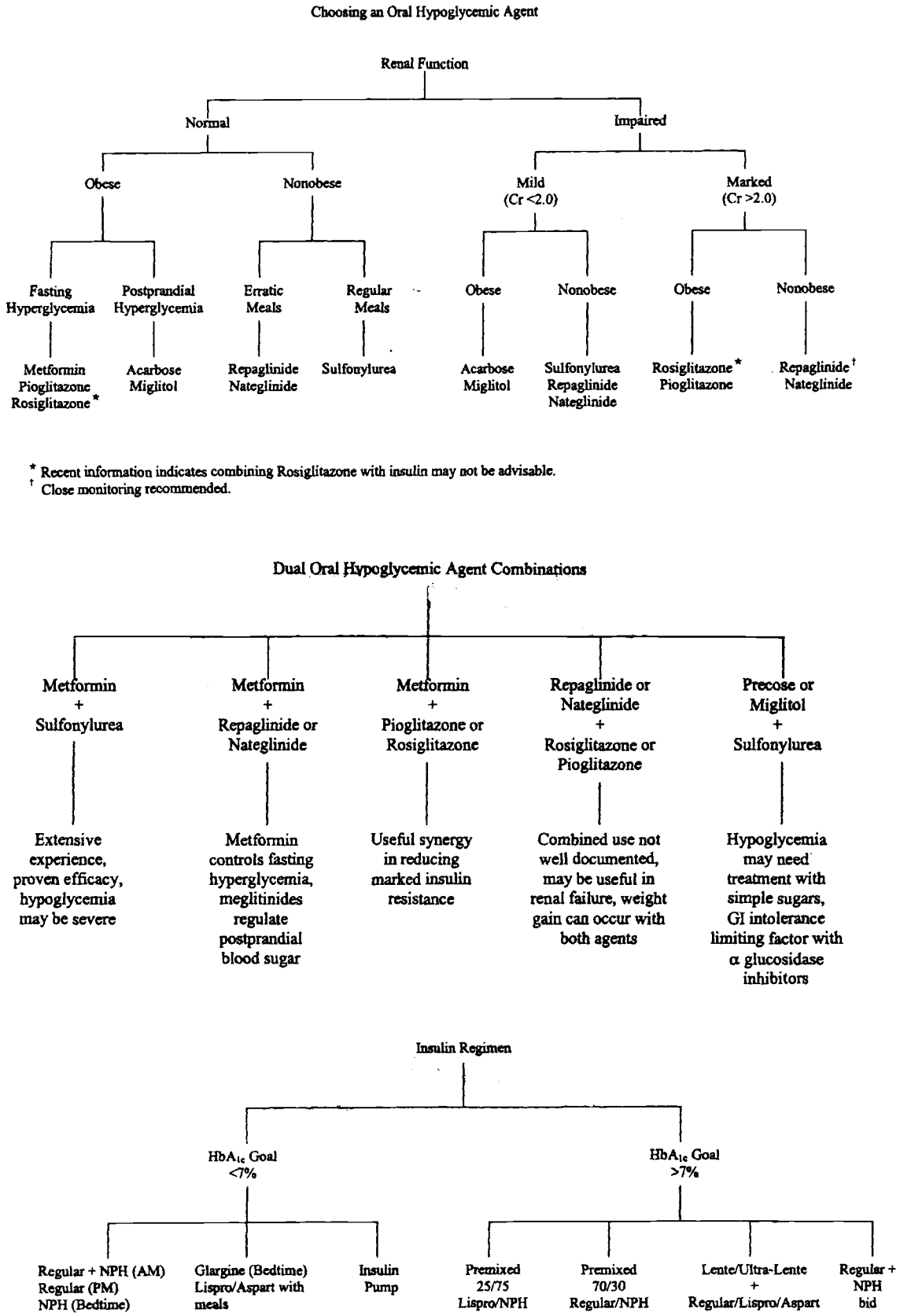
Failure to achieve adequate HbA1c levels with low fasting blood sugars may indicate pronounced post prandial hyperglycemia. Meglitinides, alpha-glucosidase inhibitors, and short acting insulin (Lispro and Humalog) may be considered in these cases due to their effects on post prandial levels. A value of less than 140 to 160 mg/dL in the post prandial period may be optimal but difficult to achieve without increasing hypoglycemia risk. The newer insulin glargine (Lantus) provides a 24-hour basal insulin requirement and may be associated with less nocturnal hypoglycemia. Glargine can be combined with a rapid-acting insulin to cover post prandial levels and excursions via sliding scale (Dube & Peiris, 2002).

Most patients require 0.5-1 units/kg/day of insulin with dosing highly individualized based upon patient response (Slagle, 2002). Patients with symptoms of hyperglycemia and or blood sugar levels consistently above 300 should initially be started on insulin due to the toxic effect of high blood sugar on pancreatic beta cells and on peripheral tissue cells causing increased insulin resistance. A transition can be made from insulin to oral antidiabetics in the type 2 patient when symptoms and blood sugars have been stabilized (Dube & Peiris, 2002).

Combination therapies

In some patients it may be necessary to use more than one antidiabetic agent, combine antidiabetic agents with insulin, and/or use more than one insulin in order to obtain stabilization. Each choice of medication and/or medication combination must be tailored to meet the needs of the patient given the diversity of patient populations and medication pathways and side effects. When monotherapy is unsuccessful it may be necessary to combine agents. However, cost and compliance need to be considered before any more than two antidiabetics are combined. Failure with oral agent combinations is an indicator for insulin. Many times the addition of a bedtime injection of NPH insulin is sufficient to improve glycemic control. One fourth of the patient weight in kilograms is the initial unit dose number used. Oral insulin sensitizing agents should be continued with daily insulin initiation but agents such as the sulfonylureas and or meglitinides can be discontinued. Figure 5 has three algorithms for choosing the antidiabetic for the proper patient specification, combining (dual agent) antidiabetics together, and combining (dual agent) insulins (Dube & Peiris, 2002).

Figure 5. Oral antidiabetic and insulin selections (Dube & Peiris, 2002).



Special considerations need to be applied when considering the elderly and children. Older patients can be treated with the same drug treatments as younger patients but careful monitoring and dosage is essential. Drugs should be started at the lowest possible dose and titrated up gradually until targets are reached or side effects develop. Specifically, metformin is often contraindicated in the elderly due to renal insufficiency. It is also contraindicated in heart failure as are the thiazolidinediones. The sulfonylureas and other insulin secretogogues can often result in profound hypoglycemia and the insulins require good visual skills, motor skills, and cognitive ability of the patient or caregiver. Glycemic goals may need to be adjusted in children to take into account the fact that most children younger than 6 or 7 years lack the cognitive ability to recognize and respond to hypoglycemic symptoms and may be at greater risk for problems associated with hypoglycemia (American Diabetic Association, 2002b).

Hypertension treatment

Reduced sodium and alcohol intake with increased activity levels, smoking cessation, and weight loss in obese populations, have been shown to be effective in reducing blood pressure in the normal population. These lifestyle changes can also improve hyperglycemia and or dyslipidema and are discussed in more detail under their corresponding alcohol and tobacco, and diet and exercise, screening and treatment sections of secondary intervention. Decreasing blood pressure with antihypertensive drugs including angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), beta-blockers, diuretics, and calcium channel blockers has been shown

to effectively lower cardiovascular events and slow progression of nephropathy and retinopathy in some medications (American Diabetes Association, 2002b).

Initial therapy may be ACEs, ARBs, beta-blockers, diuretics or other drug classes (American Diabetes Association, 2002b). However, angiotensin-converting enzyme inhibitors remain agents of choice for hypertension and/or the presence of microalbuminuria or protienuria. They should also be first line in patients over 55 with another cardiovascular risk factor to reduce risk of cardiovascular events (with slow titration to avoid complications). ARBs should be substituted if the ACE is not tolerated. The Heart Outcomes Prevention Evaluation (HOPE) (2000) study indicated a 25% reduction of cardiovascular death, stroke, and myocardial infarction in high-risk patients given ramipril. The beneficial effects of ramipril were demonstratable even after adjusting for blood pressure effects (Dube & Peiris, 2002). ACE inhibitors also significantly lower insulin resistance (Bell, 2002). Renal function and serum potassium should be monitored for renal insufficiency and hyperkalemia. In patients with a recent myocardial infarction, beta-blockers should be considered in addition to reduce mortality. If target blood pressure is not reached on three drugs including a diuretic and/or severe renal disease is present, patients should be referred to a specialist experienced hypertension treatment (American Diabetes Association, 2002b).

Dyslipidemia treatment

Lipid management aimed at lowering LDL cholesterol, raising HDL cholesterol, and lowering triglycerides has been shown to reduce macrovascular disease and mortality in patients with type 2 diabetes mellitus (American Diabetes Association, 2002b). For

patients without preexisting cardiovascular disease, pharmacological therapy should begin after lifestyle modification is first attempted (Caughron & Smith, 2002). Lifestyle modifications such as exercise, glycemic control, and diet modification and weight loss (see corresponding secondary intervention sections) should allow some patients to reach goal lipid levels (American Diabetes Association, 2002b). However, pharmacological therapy should be initiated simultaneously with lifestyle modifications in patients with known cardiovascular disease and/or with very high LDL levels (greater than or equal to 130 mg/dL) (Caughron & Smith, 2002).

Pharmacological treatment should also be started if there is an inadequate response to lifestyle modifications and improved glucose control. The first priority of pharmacological therapy is to lower LDL cholesterol to a target goal of <100 mg/dl (2.60 mmol/l). For LDL lowering, statins are the drugs of choice. Statins raise HDL modestly, but a greater increase is usually achieved with fibrates. Statins have also been shown to decrease the progression of diabetic nephropathy and may help in its prevention (Bell, 2002).

In patients with LDL between 100 mg/dl and 129 mg/dl (3.30 mmol/l), a variety of treatment strategies are available, including more aggressive nutrition intervention and pharmacological treatment with a statin. In addition, if the HDL is <40 mg/dl and the LDL is between 100 and 129 mg/dl, a fibric acid such as fenofibrate might be used. Niacin, or nicotinic acid, is the best drug for raising HDL but may significantly increase blood glucose. Glycemic control may be maintained with appropriate adjustment of diabetes therapy and moderate doses of nicotinic acid (less than or equal to 3 g/day). A combination of statin and a fibrate can be used for patients needing treatment for all three

lipid fractions but is associated with an increased risk for myositis and/or rhabdomyolysis. For patients with triglyceride levels >1000 mg/dL, immediate intervention is needed to immediately lower the level to <400 mg/dL, and < 200 mg/dL thereafter (American Diabetes Association, 2002b). The addition of omega-3 fatty acids (1,000 to 3,000 mg daily) in the form of fish oil or flaxseed oil may also be beneficial in reducing elevated triglyceride levels. Omega-3 fatty acids may also reduce coronary events and mortality (Dube & Peiris, 2002).

Nephropathy treatment

The ADA recommends that angiotensin-converting enzyme (ACE) inhibitors be considered in the management of microalbuminuria (30 mg to 299 mg per 24 hours) in all patients with type 1 diabetes, even in the absence of hypertension, since they have been shown to delay the progression of renal disease in diabetes (Cameron, 2002). In hypertensive type 2 diabetic patients with microalbuminuria or clinical albuminuria ARBs are the initial agents of choice. If one class is not tolerated the other should be substituted and both can be used in combination to decrease albuminuria further than with monotherapy (American Diabetes Association, 2002b). A low-protein diet (0.8 g/kg of body weight) may also be helpful in lowering albuminuria and slowing the decline in renal function. All radio contrast materials should be avoided and patients should receive high volume IV fluids before, during, and after any type of angiography (Bell, 2002). Patients should be seen by a specialist when the GFR has fallen to either <70 ml/min/m2, serum creatinine has increased to >2.0 mg/dl, or difficulties occur in the management of

hypertension or hyperkalemia associated with ACEs or ARBs (American Diabetes Association, 2002b).

Retinopathy treatment

All diabetic patients with retinopathy should be on ACE inhibitors due to their preventative capabilities in the progression of the disease (Bell, 2002). Early detection of retinopathy by ophthalmologists and early laser treatment for retinopathy, can reduce vision loss. Patients should be informed that an eye exam performed by a primary health care provider doesn't provide the information that can be obtained from the recommended exam with an ophthalmologist (Cameron, 2002). Patients can also be informed that aspirin therapy does not prevent retinopathy or increase the risks of hemorrhage (American Diabetic Association, 2002b). Treatment is aimed at improving glycemic control, hypertension, and dyslipidemia since these are all factors known to increase retinopathy progression. These topics are individually discussed in corresponding health care intervention sections of secondary intervention.

Neuropathy treatment

Problems involving the feet such as ulcers and wound care should be referred to a podiatrist or a surgeon experienced in ulcers and wound care. A multidisciplinary approach is also recommended for persons at risk for foot ulcers (American Diabetic Association, 2002b).

Painful burning and tingling of the feet due to neuropathy can be treated by the primary care provider with antiepileptic and tricyclic medications. Better glycemic

control should be attempted to raise pain thresholds and the use of ACE inhibitors will increase microcirculatory neural blood flow. Only in severe cases should analgesics be used since neuropathic pain requires much larger doses of narcotics for relief than somatic pain. Most patients will not experience complete relief with treatment and attempts to completely relieve symptoms usually results in significant dose-related medication side effects. Neuropathic symptoms are often worse at night and therapy goals should be therefore aimed at the patient attaining adequate sleep. If pain is uncontrolled the patient will seek relief by getting out of bed and walking around only to have the symptoms reoccur upon returning to bed. Sleep loss results in depression and worsening of symptoms making treatment essential to well being (Bell, 2002).

Some of the more common antiepileptics and dosages for neuropathic pain treatment include: clonazepam 0.5-2.0 mg hs, gabapentin 300-3600 mg qd, carbamazepine 100-600 mg qd, and topiramate 25-200 mg qd. Some of the more common tricyclic antidepressants and dosages include amitriptyline HCl 10-30 mg hs, and imipramine 25-100 mg hs. Other common medications and treatments include prolixin 1 mg tid, pentoxifylline 400 mg tid, capsaicin 0.75% cream prn, mexiletene HCl 50-450 mg qd, transcutaneous electrical nerve stimulation (TENS), and acupuncture (Bell, 2002). All medications have side effects, drug interactions, and contraindications that need to be considered prior to initiation.

Coronary artery disease treatment

In addition to the benefits of glycemic, blood pressure, and dyslipidemia screening and treatment, as discussed in corresponding secondary prevention sections,

anticoagulant therapy should be considered in the coronary artery disease management of patients with diabetes. Diabetic patients are generally considered hypercoaguable and an aspirin a day (81 to 325 mg/day) is recommended for patients older than 30 years of age (Dube & Peiris, 2002). No evidence supports specific dosage and using the lowest possible dosage and enteric-coated preparations may help reduce side effects. There is also no benefit of aspirin as a preventative in those younger than 30 years of age, and it should not be used in patients under 21 years of age due to increased risk of Reye's syndrome. An approximate 30% decrease in myocardial infarction and a 20% decrease in stroke has been shown to occur in a wide range of patients taking aspirin (American Diabetes Association, 2002b).

Counseling

Depression has been reported to be as high as 31 percent of the chronically medically ill (Buffum & Buffum, 1997). Depression may be slightly more common in persons with diabetes than in non-diabetic persons (Morley, 1999). Depression has been demonstrated to be a major factor in causing hospital admission and death in persons with diabetes mellitus. Depression is an especially important issue of concern with diabetics due to the ready availability of tools to commit suicide (oral antidiabetics and insulin). Screening for depression and suicide in persons with diabetes followed by counseling or other intervention when needed is therefore essential.

Documentation

Once treatments are in place, it is extremely important to document accurately and concisely for future medical and legal assessments. Photographs are of benefit in the patient with foot ulceration, wound, and or amputation to monitor progression. Flow sheets make it easier for providers to see which screening tests are needed. Information that patients have recorded on their own, such as blood glucose self-monitoring and eye exam dates, should be reviewed and addressed by providers at each visit (American Diabetes Association, 2002b). Documenting an individualized plan and level of patient participation expected should be included in the chart with both patient and physician signatures to enhance communication and facilitate better outcomes. Failure to achieve desired objectives is an indication for subspecialty consultation. (Dube & Peiris, 2002).

Summary

The best outcome in terms of diabetes management will result from a concerted team effort to achieve and maintain the desired blood sugar levels, lipid parameters, and blood pressure levels in diabetic patients (Dube & Peiris, 2002). There are multiple prevention and intervention strategies on the level of primary and secondary prevention to attain treatment plan goals. With the patient actively participating in care, diabetics can live longer, healthier, and happier lives.

Tertiary Prevention

Neuman (1974) describes tertiary prevention as occurring following the active treatment where some degree of reconstitution or stability has occurred. The goal of the interventions under tertiary prevention is maintenance of optimal functioning. Tertiary prevention interventions include routine follow-up and referral.

Routine Follow up and Referral

Follow-up support and referral should be offered to all DM patients. Many of these interventions are brief discussions of existing community and support services available with an emphasis on continuing of routine visits. Follow up and referral should focus on attaining maximal level of wellness after initiation of treatment. These tertiary interventions lead back to nearly all of the interventions discussed in primary and secondary prevention and involve the review and modification of any current primary and/or secondary interventions being implemented currently.

Follow up examination should include weight, blood pressure, height and sexual maturation in younger patients, and fundoscopy and foot examination in at-risk patients. Follow up visits should review the previous treatment and the past and present degrees of glycemic control and any other areas of concern such as blood pressure, dyslipidemia, blood glucose levels, hyperglycemia and hypoglycemia interventions, self-care, exercise, referral, follow up, psychosocial adjustment, nutrition, self-management skill, diabetes knowledge, goal achievement, and complications and problems should also be reviewed on a regular basis such as quarterly but can be adjusted to patient response and preferences (Caughron & Smith, 2002). Illnesses are more frequent in young children

and sick day management rules including assessment for ketosis with illness should be taught to prevent DKA requiring hospitalization (American Diabetic Association, 2002b).

As discussed in previous sections, continuing testing should include HbA1c at least twice a year, annual fasting lipid profile unless low risk, annual microalbumin measurement if indicated and optional fasting plasma glucose level. Laboratory tests appropriate to the evaluation of each patient's general medical condition should also continue to be performed (Caughron & Smith, 2002).

Summary

Tertiary treatment involves routine follow-up and referral and should lead back to primary and secondary intervention reinforcement, adjustment, and implementation. It is a cyclical, never ending process in the treatment of the diabetic population.

Summary

Betty Neuman's Systems Model classifies interventions as either primary, secondary, or tertiary interventions. Health care providers should use all three intervention types in the care of any diabetic patient. The model can be beneficially used to organize care in the treatment of diabetes patients and serve as a guideline as to what interventions are appropriate given the current patient status. The literature review reveals multiple intervention protocols and suggestions for health care provider treatment of patients of all types presenting with many complications of diabetes from simple acute onset to multifactorial chronic disease management. A review of the medical and nursing literature discloses proven effective intervention strategies focusing on all three levels.

CHAPTER III

RESEARCH METHODOLOGY

The research method, instrumentation, sample, and data collection protocol employed for the primary study are described.

Research Method

A metaanalysis is a research method that takes the results of many studies in a specific area and synthesizes their findings to draw conclusions regarding the state of the art in the area of focus (LoBiondo-Wood & Haber, 2002). This was an appropriate method for this study since the researcher did not conduct the original analysis of data in the area but rather took the data from already published studies and synthesized the information by following a set of controlled and systematic steps.

Instrumentation

Medline (Medical Literature, Analysis, and Retrieval System Online) was the database used to retrieve the most current medical literature on diabetes mellitus (DM). Medline is the U.S. National Library of Medicine's (NLM) bibliographic database that contains over 12 million references to journal articles in life sciences with a concentration on biomedicine. Citations from over 4,600 worldwide journals currently in 30 languages are available. About 52% of current cited articles are published in the U.S and for the time period of 1997-2001, nearly 89% of cited articles are published in English. Citations for MEDLINE are created by the National Library of Medicine, international partners, and other collaborating organizations. Medline has provided information in basic

biomedical research and the clinical sciences since 1966 in the areas of nursing, dentistry, veterinary medicine, pharmacy, allied health, and pre-clinical sciences. Medline also covers life sciences that are vital to biomedical practitioners, researchers, and educators, in biology, environmental science, marine biology, plant and animal science, biophysics, and chemistry (National Library of Medicine, 2002).

CINAHL (Cumulative Index to Nursing and Allied Health) was the database used to provide the most current nursing literature on diabetes. CINAHL provides authoritative coverage of the literature related to nursing and allied health. English-language publications are indexed along with the publications of the American Nurses Association and the National League for Nursing. More than 1200 journals are regularly indexed and online abstracts are available for more than 800 of these titles. The database also provides access to healthcare books, nursing dissertations, selected conference proceedings, standards of professional practice, educational software and audiovisual materials in nursing. More than 10,000 CINAHL subject headings provide specific access to NAHL citations and approximately 70% of CINAHL headings also appear in MEDLINE. CINAHL supplements these headings with over 2,000 additional terms designed specifically for nursing and allied health (Ovid, 2002).

Sample

The sample of literature data used for this metaanalysis research was drawn from the search results of Medline and CINAHL as discussed above, and from texts, Internet sources, and lecture material. The sample is outlined in detail by database in table 4.

TABLE 4

Sample According to Database

Medline	CINAHL	Texts	Internet	Lecture
Bell, 2002	Cameron, 1996	George, 1995	American Diabetes Association, 2002a	Dokken, 2001
Buffum & Buffum, 1997	Canga, De Irala, Vara, Duaso, & Ferrer, 2000	LoBiondo-Wood & Haber, 2002	American Diabetes Association, 2002b	
Caughron & Smith, 2002	Lo, 1999	Meleis, 1997	National Institute of Health, 1997	
Cameron, 2002	Lo & MacLean, 2001	Neuman, 1974	National Library of Medicine, 2002	
DCCT, 1993	Nusbaum & Gant, 1999	Neuman, 1989	Ovid, 2002	
Dube & Peiris, 2002	Rose, Fliege, Hildebrandt Schirop, & Klapp, 2002	Neuman, 1995	University of Maryland Medicine, 2001	
Flood & Constance, 2002	Senecal, Nouwen, & White, 2002	Neuman, 1996		
Hansson, Zanchett, & Carruthers, 1998	Toljamo & Hentinen, 2001	Noble, 2001		
Heart Outcomes Prevention Evaluation Study, 2000	Vallis, 1998	Olds, London, & Ladewig, 2000		

Medline	CINAHL	Texts	Internet	Lecture
Morley, 1999	Watts, Daly, Anthony, McDonald, Khoury, & Dahar, 2001			
National Institute of Health, 1997	Whitemore, Chase, Mandle, & Roy, 2001			
Slagle, 2002				
UKPDS, 1998				

Data Collection Protocol

Medline and CINAHL reference data were collected using the search word "diabetes mellitus," solely and in combination it with other keywords such as "nursing," "nurse practitioner," "interventions," "treatment," and "education." References were limited to English written research articles published within the last five years (1997 to 2002). It is important to note that not all research articles sited by Medline and CINAHL were used as reference data. Enough articles were read, used, and referenced by the researcher until the information gathered on each area of diabetes was found to be similar from one source to the next and that the body of information discussed in this study in each area of diabetes could be found in more that one source.

Several of the references were also found as references within the articles from Medline and CINAHL search lists. These include (Buffum & Buffum, 1997), (Cameron,

1996), (DCCT, 1993), (Hansson, Zanchett, & Carruthers, 1998), (Heart Outcomes Prevention Evaluation Study, 2000), (National Institute of Health, 1997), and (UKPDS, 1998). Previously discussed texts used for nurse theory and for medical and nursing diabetic information were limited to those owned by the researcher. American Diabetes Association websites (2002a) and (2002b), and the University of Maryland website (2001) were found by typing the search word "diabetes mellitus" into the internet search engine www.google.com. Lecture material was taken from a graduate level nurse practitioner class at the University of Arizona (Dokken, 2001).

Data Analysis Plan

To answer the first question, what interventions are recommended for A/FNPs to treat diabetes mellitus, the researcher read and recorded recommended interventions found in the literature. Neuman's systems model was then used to divide the interventions into categories and subcategories. To answer the second and third research questions, are the interventions recommended for A/FNPs to treat DM theoretically supported and are the interventions for A/FNPs empirically supported, each intervention category was compared to the theory literature and to research literature.

Summary

A metaanalysis was utilized to explore what interventions are recommended for A/FNPs in DM treatment and to determine if these interventions were supported theoretically and empirically. The research method, instrumentation, sample, and data collection protocol employed for the primary study were described.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

Characteristics of the study sample are described in this chapter. The results of the metaanalysis are also presented.

Sample Characteristics

The study sample of information used in the metaanalysis of this study was drawn from the references used in the study. There were a total of 40 references used in this metaanalysis. Seventeen of the references discussed medical treatment interventions of diabetes mellitus (DM) (see Table 5) and 13 of the references discussed nursing treatment interventions of DM (see Table 6). Seven of the references discussed theory. Of these, one was a review article (Neuman, 1996), one was a research article (Piazza, Foote, Wright, & Holcombe, 1992), and five were texts (George, 1995), (Meleis, 1997), (Neuman, 1974), (Neuman, 1989), (Neuman, 1995). Two of the references were statistical/fact sheets discussing Medline (National Library of Medicine, 2002) and CINAHL (Ovid, 2002) data retrieval systems, and one reference was a text discussing metaanalysis (LoBiondo-Wood & Haber, 2002).

TABLE 5

DM Medical Intervention Data

Review articles	Research articles	Text	Statistic/fact sheets
American Diabetes Association, 2002b	DCCT, 1993	Noble, 2001	American Diabetes Association, 2002a
Bell, 2002	Hansson, Zanchett, & Carruthers, 1998		University of Maryland Medicine, 2001
Buffum & Buffum, 1997	Heart Outcomes Prevention Evaluation Study, 2000		
Cameron, 2002	UKPDS, 1998		
Caughron & Smith, 2002			
Dokken, 2001			
Dube & Peiris, 2002			
Morley, 1999			
National Institute of Health, 1999			
Slagle, 2002			

TABLE 6

DM Nursing Intervention Data

Review articles	Research articles	Text
Flood & Constance, 2002	Cameron, 1996	Olds, London, & Ladewig, 2000
	Canga, De Irala, Vara, Duaso, Ferrer, Martinez-Gonzalez, 2000	
	Lo, 1999	
	Lo & MacLean, 2001	
	Nusbaum & Gant, 1999	
	Rose, Fleige, Hildebrandt, Schirop, & Klapp, 2002	
	Senecal, Nouwen, & White, 2000	
Toljamo & Hentinen, 2001	Vallis, 1998	
	Watts, Daly, Anthony, McDonald, Khoury, & Dahar, 2001	
	Whitemore, Chase, Mandle & Roy, 2002	

Results

Research question 1

The findings of this metaanalysis revealed multiple DM intervention recommendations for A/FNPs in both medical and nursing healthcare fields. The recommendations were found in review articles, texts, and Internet sources, and were based on the findings of multiple research studies. A total of ten intervention categories with 22 subcategories were formulated on the levels of primary, secondary, and tertiary prevention. Each level is discussed individually in the following pages.

Primary prevention

Primary prevention categories included screening, education, and community collaboration, with education subcategories of diet modification and exercise as outlined in table 7.

TABLE 7

Primary Prevention Interventions

Category	Subcategory	Recommendation References
Screening	Not Applicable (N/A)	American Diabetes Association, 2002a American Diabetes Association, 2002b Bell, 2002 Cameron, 2002 Caughron & Smith, 2002
Education	Diet modification	American Diabetes Association, 2002b Bell, 2002 Dube & Peiris, 2002
Education	Exercise	American Diabetes Association, 2002b Dube & Peiris, 2002
Community Collaboration	N/A	American Diabetes Association, 2002b Cameron, 2002

Secondary prevention

Secondary prevention categories included screening, assessment, education, health care intervention, counseling, and documentation. Screening subcategories included glycemic, hypertension, dyslipidemia, nephropathy, retinopathy, neuropathy, coronary artery disease, immunization, and alcohol & tobacco screening. Education included subcategories of diet modification and exercise. Health care intervention included subcategories of oral antidiabetic agents; insulins; combination therapies; and hypertension, dyslipidemia, nephropathy, retinopathy, neuropathy, and coronary artery disease treatment. These are outlined in the next three pages of table 8.

TABLE 8

Secondary Prevention Interventions

Category	Subcategory	Recommendation References
Screening	Glycemic	American Diabetes Association, 2002b Bell, 2002 Cameron, 2002 Caughron & Smith, 2002 Dube & Peiris, 2002
Screening	Hypertension	American Diabetes Association, 2002b Bell, 2002 National Institute of Health, 1997
Screening	Dyslipidemia	American Diabetes Association, 2002b Dube & Peiris, 2002

Category	Subcategory	Recommendation References
Screening	Dyslipidemia	American Diabetes Association, 2002b Dube & Peiris, 2002
Screening	Nephropathy	American Diabetes Association, 2002b Bell, 2002 Cameron, 2002
Screening	Retinopathy	American Diabetes Association, 2002b Bell, 2002 Cameron, 2002
Screening	Neuropathy	American Diabetes Association, 2002b Bell, 2002 Cameron, 2002
Screening	Coronary artery disease	American Diabetes Association, 2002b Caughron &Smith, 2002
Screening	Immunization	American Diabetes Association, 2002b Cameron, 2002
Screening	Alcohol & tobacco	American Diabetes Association, 2002b Cameron, 2002 Caughron & Smith, 2002
Assessment	N/A	American Diabetes Association, 2002b Cameron, 2002 Caughron & Smith, 2002 Dube & Peiris, 2002 University of Maryland Medicine, 2001

Category	Subcategory	Recommendation References
Education	Diet modification	American Diabetes Association, 2002b Caughron & Smith, 2002 Dube & Peiris, 2002
Education	Exercise	American Diabetes Association, 2002b Flood & Constance, 2002
Health Care Intervention	Oral antidiabetic agents	Slagle, 2002 Bell, 2002
Health Care Intervention	Insulins	Slagle, 2002 Dube & Peiris, 2002
Health Care Intervention	Combination therapies	American Diabetes Association, 2002b Dube & Peiris, 2002
Health Care Intervention	Hypertension treatment	American Diabetes Association, 2002b Bell, 2002 Dube, & Peiris, 2002
Health Care Intervention	Dyslipidemia treatment	American Diabetes Association, 2002b Bell, 2002 Caughron & Smith, 2002 Dube & Peiris, 2002
Health Care Intervention	Nephropathy treatment	American Diabetes Association, 2002b Bell, 2002 Cameron, 2002
Health Care Intervention	Retinopathy treatment	American Diabetes Association, 2002b Bell, 2002 Cameron, 2002

Category	Subcategory	Recommendation References
Health Care Intervention	Neuropathy treatment	American Diabetes Association, 2002b Bell, 2002
Health Care Intervention	Coronary artery disease Treatment	American Diabetes Association, 2002b Dube & Peiris, 2002
Counseling	N/A	Buffum & Buffum, 1997 Morley, 1999
Documentation	N/A	American Diabetes Association, 2002b Dube & Peiris, 2002

Tertiary prevention

Tertiary prevention categories included routine follow up and referral as outlined in table 9 and should lead back to primary and secondary prevention.

TABLE 9

Tertiary Prevention Interventions

Category	Subcategory	Recommendation References
Routine follow up and referral	N/A	American Diabetes Association, 2002b Caughron & Smith, 2002

Research question 2

The findings of this metaanalysis revealed that the recommended DM interventions for A/FNPs were theoretically supported on all prevention levels of the theory. Tables 1,2, and 3, of chapter two (pages 24-25), reveal specific theory interventions on the levels of primary, secondary, and tertiary prevention. These interventions were congruent with the recommendations such that the researcher was able to use the theory as a framework to organize the recommended literature interventions into categories and prevention levels. To clarify, theory prevention levels and interventions were used to separate recommended DM interventions in the literature into prevention and intervention categories. The tables are repeated again in this chapter.

For example, initial screening recommendations for DM in the literature (see screening under primary prevention) fell within the classifying stressors theory intervention of primary prevention (table 1-intervention 1).

TABLE 1

Neuman's Interventions for Primary Prevention (George, 1995)

1.	Classifying stressors that threaten stability of the client/client system and preventing stressor invasion.
2.	Providing information to retain or strengthen existing client system strengths.
3.	Support positive coping and functioning.
4.	Desensitize existing or possible noxious stressors.
5.	Motivate toward wellness.
6.	Coordinate and integrate interdisciplinary theories and epidemiological input.
7.	Educate or reeducate.
8.	Use stress as a positive intervention strategy.

Ongoing screening recommendations for DM in the literature (see screening under secondary prevention) fell within the following stressor invasion theory intervention of secondary prevention (table 2-intervention 1).

TABLE 2

Neuman's Interventions for Secondary Prevention (George, 1995)

1.	Following stressor invasion.
2.	Protect the basic structure.
3.	Mobilize and optimize internal/external resources to attain stability and energy conservation.
4.	Facilitate purposeful manipulation of stressors and reactions to stressors.
5.	Motivate, educate, and involve the client in health care goals.
6.	Facilitate appropriate treatment and intervention measures.
7.	Support positive factors toward wellness.
8.	Promote advocacy by coordination and integration.
9.	Provide primary preventive intervention as required.

Follow up and referral recommendations for DM in the literature (see follow up and referral under tertiary prevention) fell within the attain and maintain maximum level of wellness theory intervention of tertiary prevention (table 3-intervention 1). The same can be said for the other recommendations for DM in the literature and the other interventions in each of the tables of the theory.

TABLE 3

Neuman's Interventions for Tertiary Prevention (George, 1995)

1.	During reconstitution, attain and maintain maximum level of wellness or stability following treatment.
2.	Educate, reeducate, and/or reorient as needed.
3.	Support client/client system toward appropriate goals.
4.	Coordinate and integrate health service resources.
5.	Provide primary and/or secondary preventative intervention as required.

Research question 3

The findings of this metaanalysis revealed that the recommended interventions for A/FNPs are empirically supported on all levels of prevention. Data retrieval from Medline, CINAHL, and other sources, as discussed previously in this chapter revealed empirical data on all levels of diabetic intervention. A total of 16 study articles on diabetes treatment and interventions were used in this metaanalysis to provide a strong body of evidence based knowledge and findings on diabetes treatment and intervention. It is important to mention that there are many more than 16 studies available in the literature. Each of the review articles used in this metaanalysis sited multiple research references (which were not individually referenced in this metaanalysis), and not all studies found in the database searches were used. Empirical studies discussed in this metaanalysis are discussed in more detail in the literature review of chapter two and are outlined in tables 7, 8, and 9.

TABLE 7

Primary prevention interventions

Category	Subcategory	Research References
Screening	N/A	
Education	Diet modification	Nusbaum & Gant, 1999
Education	Exercise	
Community Collaboration	N/A	

TABLE 8

Secondary prevention interventions

Category	Subcategory	Research References
Screening	Glycemic	DCCT, 1993 UKPDS, 1998
Screening	Hypertension	Hansson, Zanchett, & Carruthers, 1998 UKPDS, 1998
Screening	Dyslipidemia	
Screening	Nephropathy	DCCT, 1993 UKPDS, 1998
Screening	Retinopathy	DCCT, 1993 UKPDS, 1998
Screening	Neuropathy	DCCT, 1993 UKPDS, 1998 Watts, Dally, Anthony, McDonald, Khoury, & Dahar, 2001
Screening	Coronary artery disease	DCCT, 1993 UKPDS, 1998
Screening	Immunization	
Screening	Alcohol & tobacco	Canga, De Irala, Vara, Duaso, Ferrer, Martinez-Gonzales, 2000
Assessment	N/A	DCCT, 1993 UKPDS, 1998

Category	Subcategory	Research References
Education	N/A	Cameron, 1996 Lo, 1999 Lo & McLean, 2002 Rose, Fleige, Hildebrandt, Schirop, & Klapp, 2002 Senecal, Nouwen, & White, 2000 Toljamo & Hentinen, 2001 Vallis, 1998 Whittemore, Chase, & Mandle, 2002
Education	Diet modification	
Education	Exercise	Flood & Constance, 2002
Health Care Intervention	Oral antidiabetic agents	DCCT, 1993 UKPDS, 1998
Health Care Intervention	Insulins	DCCT, 1993 UKPDS, 1998
Health Care Intervention	Combination therapies	DCCT, 1993 UKPDS, 1998
Health Care Intervention	Hypertension treatment	DCCT, 1993 UKPDS, 1998 HOPE, 2000
Health Care Intervention	Dyslipidemia treatment	
Health Care Intervention	Nephropathy treatment	DCCT, 1993 UKPDS, 1998
Health Care Intervention	Retinopathy treatment	DCCT, 1993 UKPDS, 1998
Health Care Intervention	Neuropathy treatment	DCCT, 1993 UKPDS, 1998

Category	Subcategory	Research References
Health Care Intervention	Coronary artery disease treatment	DCCT, 1993 UKPDS, 1998
Counseling	N/A	
Documentation	N/A	

TABLE 9

Tertiary prevention interventions

Category	Subcategory	Recommendation References
Routine follow up and referral	N/A	DCCT, 1993 UKPDS, 1998

Summary

The findings of this metaanalysis revealed multiple DM intervention recommendations from both medical and nursing bodies of information for A/FNPs. Recommended DM interventions for A/FNPs were theoretically supported on all prevention levels of the theory. The recommended interventions were also empirically supported on all levels of prevention.

CHAPTER V

DISCUSSSION OF RESULTS AND SUMMARY

Findings from this study are discussed in chapter 5. The strengths and limitations of this study are discussed. Implications for nursing practice are considered. Recommendations for further study are offered.

Discussion of Findings

The findings of this metaanalysis revealed multiple diabetes mellitus (DM) intervention recommendations for A/FNPs in both medical and nursing healthcare fields on the levels of primary, secondary, and tertiary intervention. These intervention recommendations are well established by the American Diabetes Association, the American Medical Association, and the American Nurses association. A/FNPs have many screening tools, medications, and other resources available to them to treat diverse populations of diabetic patients. These interventions are backed by nursing theory and by a large body of research based evidence supporting their use.

Strengths and Limitations

This project addresses the need for effective interventions to control diabetes mellitus and prevent multiple complications. Interventions discussed were research based and theoretically supported making them easily defendable due to their theoretical base and proven effectiveness on patient outcomes. Effective interventions enhance the quality of life for the patient by decreasing disease complications and also reducing the

cost of health care spent on diabetes by decreasing the incidence of DM and/or by decreasing allocations spent on the care of associated DM complications.

This study was limited in that it only explored current research studies and recommendations as well as theory literature interventions. It did not explore what NPs are actually doing in practice despite this body of knowledge. This is discussed more under recommendations for future research below. As mentioned previously, the study was also limited in that not all sources found in Medline and CINAHL databases were reviewed and texts used for nurse theory and for medical and nursing diabetic information were limited to those owned by the researcher.

Implications for Nursing Practice

This study has demonstrated that effective interventions used by healthcare providers have the potential to decrease the incidence of diabetes and or complications, which in turn decreases the high costs spent on diabetes each year. The study can serve as a guideline and/or reference for A/FNPs assuming care of the DM patient seeking to provide safe, research based, theory-supported, cost-contained, effective care.

Recommendations for Further research

Further research is needed to assess what A/FNPs are actually doing in practice. There were no studies found that assessed what interventions A/FNPs were actually using in practice despite the current recommendations and studies found and discussed in this metaanalysis. No studies were found specifically linking DM interventions and Neuman's model even though the model can be used as a framework to organize care as

seen in this study. If current practice interventions of A/FNPs are congruent with the recommendations of this metaanalysis than the interventions of A/FNPs have both theoretical and empirical support. If practice interventions are incongruent with the recommendations of this metaanalysis than A/FNP training and education should be implemented to improve practice. More studies would then need to be done on A/FNP training and education programs to incorporate the findings of this study into care and to assess how such training and education would create practice changes.

Summary

Betty Neuman's Systems Model classifies interventions as either primary, secondary, or tertiary interventions. Health care providers should use all three intervention types in the care of any diabetic patient. The model can be beneficially used to organize care in the treatment of diabetes patients and serve as a guideline as to what interventions are appropriate given the current patient status. The medical and nursing literature review reveals multiple effective research proven and theory based intervention protocols and suggestions for health care provider treatment of DM patients of all types presenting with many complications of diabetes from simple acute onset to multifactorial chronic disease management. More studies are needed to assess whether current practice behaviors of A/FNPs are in accordance with these recommendations, and if A/FNP training and education can improve the current practice behaviors of providers not delivering care in accordance with recommendations.

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