

The role of primary care in the prevention of diabetic foot amputations

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A B S T R A C T : Diabetes mellitus has been described as an epidemic of the modern world. One of its major complications is the formation of ulcers on the diabetic foot that may lead to low amputation or death. The global community is sensitive on the diabetic foot and the prevention of ulcers through the implementation of health education programs on the population and through training programs for the health professionals. It is estimated that 85% of low amputations of the diabetic foot could be prevented with the growth of the development health education programs.

K E Y - W O R D S : Diabetes mellitus, lower foot amputation, diabetic foot, primary care

INTRODUCTION

Type II diabetes is described as an epidemic of the modern world, since it is estimated that 171 million people all over the world were suffering from the disease in the year 2000, while it is forecasted that this number could reach as high as 366 millions in 2030. It is the syndrome of the relative or total insulin deficiency that may be caused by either inadequate insulin production or by its inadequate use (type I and type II respectively). Type II diabetes is responsible for 95% of the total number of cases (Scollan-Koliopoulos 2004).

Type II diabetes mellitus is characterized by the presence of natural reduced or increased insulin levels. Increased levels of insulin often appear due to decreased tissue sensitivity or response to insulin. As the syndrome progresses pancreatic B-cells tend to produce an ever

decreasing quantity of insulin. The hyperglycemia that follows causes the setting of various mechanisms which lead to eye, kidney, peripheral vessels and nerve complications, as well as to cardiovascular problems (Scollan-Koliopoulos 2004).

During the life span of a diabetic patient, the danger of ulcerations to the lower foot is as high as 25%. It is estimated that every 30 seconds a low amputation takes place somewhere in the world as a direct complication of diabetes mellitus (Armstrong & Lavery 1998, Morris et al 1998, Boulton et al 2005).

Ulcers of the low foot are generally related to an increased danger of amputation due to loss of sensitivity and bad hematosi; conditions that, if combined with long term bad control of the blood glucose, create the necessary substratum for trauma infection and gangrene (Armstrong et al 1998, Adler 1999, Scollan-Koliopoulos 2004).

Specifically, the most important complications that lead to creation of low foot ulcers are peripheral neuropathy and peripheral vascular disease.



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The role of peripheral neuropathy is important as far as the danger of an unsuspected injury of the low foot is concerned. The patient does not realize the injury because of lack of sensitivity. Neuropathy of the autonomous nervous system includes malfunction of the sweat producing glands, which results to a dehydrated, dry skin prone to ulcers. Furthermore, it is noticed that patient show signs of unsteady walking that may lead to falls and subsequent injuries.

Muscular neuropathy is responsible for disfigurements that increase pressure while walking on parts of the foot such as: toe middle-joints and toe-end that can result to ulcerations. The "Charot" foot is the most representative case; it is a disease of the joints of the shin bone that occurs because of diabetes mellitus neuropathy. It starts with an ulcer of the diabetic foot. As time progresses, chronic inflammation and bone restructuring result to the abolishment of the foot arch. If the patient is not aware of the problem and continues to put pressure on the foot, then the thin skin of the arch, (skin that is not suitable for increased pressure during walking), becomes prone to ulcerations. The situation becomes more complicated by diabetic kidney disease that causes calcium and phosphorus metabolism disorder. That may lead to bone disease and skeletal deformities (Scollan-Koliopoulos 2004, Sieggreen 2005).

Peripheral neuropathy consists of atherosclerosis and thrombosis and is regarded as the primal cause of ischemia (Scollan-Koliopoulos 2004).

The risk factors for each of the above mentioned complications are:

A. Peripheral neuropathy

Unmodifiable risk factors

1. Disease duration
2. Age
3. Heredity
4. Gender (most common in men)
5. Race (e.g. African Americans)
6. Height

Modifiable risk factors

1. Hyperglycemia
2. High blood pressure (mainly diastolic)
3. Dyslipidaimia
4. Abnormal microcirculation (modifiable with anticoagulant treatment)
5. Use of alcohol

B. Peripheral vascular disease

1. Smoking
2. Dyslipidaimia
3. Hypertasis
4. Atherosclerosis
5. Peripheral neuropathy
6. Gender (most common in men)
7. Obesity
8. Way of life
9. Hyperglycemia
10. Hyperinsulinemia
11. Homocystein (Moss et al 1992, Scollan-Koliopoulos 2004).

Lower limb complications and especially amputations taking place as a result of diabetes mellitus create a number of problems to the patient himself, as well as to his family. These problems are related to body, psychology, functional and economic levels (Ragnarson-Tennrali et al 2000, Peters et al 2001).

It is suggested that amputations are the kind of diabetes complications that patients fear the most. In addition, patients with a history of ulcers or low amputations suffer an increased probability of ulcer reappearance and new amputation, while the mortality rate is also increased. Survival after amputation due to diabetes mellitus is calculated between 11–41% the first year, 20–50% the third year, and 39–68% the fifth year (Wild Setal 2004, Scollan-Koliopoulos 2004).

Diabetic foot complications are the most common cause of non-traumatic low amputation throughout the modern world. The amputation danger is 15–46 times greater in diabetic patients, as opposed to non diabetic patients. Amputations are a very common cause for hospitalization reaching up to 25% of the total number of diabetic patient hospitalizations in the USA and in the U.K. (Armstrong et al 1998).

Besides personal cost, the cost of diabetes mellitus is calculated to reach 25% of the total budget of Medicare in the USA. The annual cost of diabetic peripheral neuropathy and its complications in the USA is calculated to 4.6 and 13.7 billion dollars (type I and type II respectively) (Morris 1998, Apelquist et al 2000, Scollan-Koliopoulos 2004).

DIABETIC FOOT HEALTH TREATMENT

It has been observed that up to 85% of low foot amputations caused in the substrate of diabetes mellitus can

be prevented via ulcer prevention and ulcer cure in combination with prevention of ulcer reappearance and the training of patients for proper care of the diabetic foot (American Diabetic Society 2001).

The global Medical Society is sensitive in minimizing the reappearance of ulcers; consequently, this shall minimize the amputations caused by diabetes mellitus (Apelquist et al 2000).

In particular, the "Healthy People 2010" program, in the USA, aims at reducing low foot amputations caused by diabetes mellitus, down to 40% (US Department of Health and Human Services 2000).

In Europe, in 1989, at the Italian town of St. Vincent, delegations of health services and organizations of patients of every European country met, together with diabetes mellitus specialists, under the auspices of WHO and the World Organization of Diabetes Mellitus. They unanimously agreed that diabetes mellitus is a major, ever increasing health problem in Europe and threatens all ages. It causes chronic disease and death at a young age. It threatens at least 10 million European citizens.

Goals were set aiming at the growth of programs of prevention and information on two levels: Education and training of health professionals being the first, and informing and training of patients with diabetes mellitus being the second. The need to dispose resources and means for the on-time recognition of high risk individuals is underlined, as well as the need for prevention and cure of both the disease and, more importantly, its implications. Special attention is given to the wider society's awareness on the issue of diabetes mellitus, and to the actual participation of the patient himself to his cure.

The St. Vincent Declaration on the Diabetic Foot aimed at reducing low amputations caused by gangrene because of diabetes mellitus by 50% in Europe. (Diabetes Care and Research in Europe. The St. Vincent Declaration Geneva. World Health Org. 1989, ICP/CLR034, Diabetes Care and Research in Europe. The St. Vincent Declaration, 1990).

Evidently, steps need to be taken towards two basic directions:

- A. Creation of Health Structures, Health Professionals Awareness.
- B. Training the patients (Boulton 1995).

A. Creation of Health Structures, Health Professionals Awareness

Within the framework of the St. Vincent Declaration, organizational changes in the health system were put

forward in Belgium aiming at reducing the number of amputations caused by diabetes mellitus. During 1992 16 work groups were formed. These groups objective was to assess the condition of patients suffering from type II diabetes mellitus and showed all the risk factors for the creation of ulcers, through screening programs (Van Acker Metal 2001).

After the situation was described (46% of the patients belonged to high risk groups), the next step was to make the health professionals aware of the problems size as well as to implement health treatment programs with the patients (Van Acker Metal 2001).

The high percentage of low amputations is caused by ulcers that do not heal because of peripheral neuropathy and vascular disease, conditions leading to infection and gangrene. The implication of these cases can be reduced with "Interdisciplinary-Scientific Approach", i.e. the patient meeting with a group of scientists that should be comprised of a general physician, a podiatrist, an orthopedic, a vascular surgeon, a physiotherapist, a maker of special shoes and a nurse specializing in diabetes mellitus. Such an approach could cut down amputations by 50–85% (Assal et al 1985, Larsson et al 1995, Van Houtum et al 2004).

Health professionals started manifesting increased interest on the diabetic foot in the Netherlands. As a result the number of podiatrists was raised during the years 1995–2000, while a similar trend was manifested in interdisciplinary groups. Namely, the number of hospitals with a podiatrist increased from 32% in 1995 to 72% in 2000. The number of hospitals with interdisciplinary groups increased from 16% to 40%. Furthermore, a national agreement was reached during 1998 on the diabetic foot care according to the World Organization of Diabetic Foot.

These changes brought a reduction in the number of patients suffering from diabetes mellitus hospitalized for amputation. There is still great room for improvement in the community, as far as the implication of health programs is concerned (Assal et al 1985, Larsson et al 1995, Van Houtum et al 2004).

A similar attempt of restructuring the health system frameworks took place in Germany. The "Diabetic Foot", a German Diabetic Society work group, was formed in 1993, aiming at organizing annual conferences on the problems of the diabetic foot. The conferences were addressed to health specialists. It also gave directions on the prevention and cure of the diabetic foot syndrome. Post graduate seminars for general physicians were established, as well as health care programs for patients

with type II diabetes. From 1996 onwards, specialized doctors on the diabetic foot care, working together with patients unions, started evaluation cycles on foot care with patients and went on further with education (Holstein et al 2000, Trautner et al 2001).

A similar application of the interdisciplinary approach in Denmark managed to reduce cases of low amputations on diabetics by 40% during 1982–1993 (Ebskov & Ebskov 1996).

Similar results were observed in Sweden (Larsson & Apelquist 1995).

Generally, organizational changes should concentrate: on the awareness and education of health professionals, on the co-ordination of interdisciplinary groups, on keeping records of patients, and on the use of reminder systems and flow diagrams for the diabetic foot care. These measures could improve the participation of patients and health professionals in health care programs and in the diabetic foot care (Rith- Najavian et al 2000, Reuders et al 2001).

Health Professionals Awareness

There are references in the world bibliography for inadequate or even non-existent examination and guidance of health professionals to patients on the problems of the diabetic foot. Many diabetics, during their regular visits to their doctor, have not been examined for their feet condition, while at the same time they were not told of the importance of self care (Ronnemam Tet al 1997, De Bears 2004, Bell 2005).

An attempt was made in the Netherlands to assess the situation on the primary health care as far as ulcers and amputations on type II diabetics are concerned (Muller et al 2002). On primary health care it is estimated that 13% of the above mentioned patients are facing an increased risk of developing problems with their feet.

The most important interference relates to the on time recognition of high risk patients and to their guidance to the appropriate Interdisciplinary groups. Those patients can easily be identified by reviewing their medical records (mention of previous ulcers), and by a simple clinical examination.

The Diabetic Foot World Organization recommends: yearly examinations of the low foot for every diabetic and training in self care, every 3 months examination for patients with an ulcer, neuropathy or malformation history. In cases of ulcer relapse the patient needs to visit a specialized doctor within 2 weeks.

Studying the files of patients in the primary health care has proven that doctors are not working on the diabetic foot. This observation is relevant to the clinical examination and to the proper treatment of existing ulcers.

Doctors of primary care in the Netherlands refer patients to more specialized services. Due to the previous lack of interdisciplinary groups caring for the diabetic foot in the country, doctors often send ulcer patients to surgeons.

Research stresses that the diabetic foot is underestimated by the country's family doctors. Training health professionals on the correct method of identifying high risk patients during the clinical examination can reduce ulcer appearance and low amputations. Important differences have also been noticed in the treatment and the means of secondary prevention being proposed (e.g. belated reference to the surgeon). Finally, since they do not use a system of diabetic foot ulcer classification, they tend to confront it as a simple rupturing trauma, a fact that leads to increased low amputations.

In another report, Bruckner et al (1999) in an attempt to reduce the number of low amputations on patients with type II diabetes, started a training program for health professionals working on primary care services bearing the title: "Patients with high risk of ulcer appearance". The 560 professionals that participated followed 27 one hour seminars. The results were assessed by questionnaires on their knowledge and practices that they followed before and after the seminar, as well as by studying of the medical records both before and after the seminar.

Studying the medical records one year before and three months after the seminar has shown improvement, as far as practical care of the diabetic foot is concerned, on matters of:

1. Patients' training by health professionals on care of the diabetic foot.
2. Diagnosis and record of the peripheral vascular disease.
3. Record of the practices of self care of the diabetic foot.
4. Reference to the appropriate special podiatrists and diabetologists whenever necessary.

According to that study, proper training of the health professionals could shift the burden from curing the complications of diabetes mellitus, to preventing them, while improving the quality of care provided with significantly low cost.

Aguilla Del et al (1994), have also discovered that the more informed the health professionals were on the danger factors causing ulcers of diabetic foot and the possibilities of amputation, the more they were able to advise patients on taking precautionary steps on care.

The American "Orthopedic Foot and Ankle" Society has developed specific guidelines for the health professionals aiming at the prevention of diabetic foot ulcers. Some of those are:

- A. Screening examinations for
 - Evaluation of peripheral neuropathy
 - Evaluation of skin integrity
 - Evaluation of ulcers and wounds
 - Malformations
 - Vascular insufficiency
 - Special shoes (Maciejewski 2004)
- B. Training patients in order to self examine their low foot and for special practices of self care. Individual special care should be taken for peripheral neuropathy patients.
- C. Treatment: to be determined by the level of risk as defined by the presence of peripheral neuropathy, malformations and the history of ulcers. It combines:
 - Training patients
 - Orthoses
 - Special shoes (Maciejewski 2004)
 - Charters of continuous care of nails and skin.

Ulcer care consists of:

1. Calluses care
2. Surgical cleaning of infected or dead tissues
3. Dressing
4. Member discharge (Armstrong et al 1998, Singh et al 2005, Pinzur 2005, Sieggreen 2005).

B. Health treatment for patients

A number of efforts for the implementation of health training programs have been made mainly in the USA, where, according to the "Health People 2010" Program, the reduction of diabetic foot amputation by 40% has been assessed.

Special care was taken for lower social and financial level populations that had limited access to health services, and a unique culture.

According to Melissa Kolliopoulos (2004) the implications of type II diabetes mellitus in minorities is greater

than on the general population of the USA, especially on African Americans, where the incidence of the disease (both diagnosed and not diagnosed) in individuals under the age of 20 is 11.8%. Out of the 30 million African Americans in the country, 1.15 million suffer from diabetes mellitus. Also, diabetes mellitus is the 4th cause of death for African American women.

Low amputation is 2.5 times more probable to occur in that population than it is for whites in the USA. 15–20% out of the 16 million Americans of all races shall be hospitalised because of diabetic foot complications.

That particular study kept in mind the factors contributing to mistaken allocation of health services for the US minorities, especially for African Americans (namely: access to health services, financial situation, racism, trust in the white health professionals).

That is the reason for choosing the implementation of the health training program through church. It must be stressed that the American Diabetic Society has created the "Diabetic Sunday". During that day, priests are lecturing African Americans, after mass, about diabetes mellitus and the importance of self care.

Within that framework, 2 theories were used in planning the program: The Health Belief Model and Roy's Theoretical Model.

According to the Health Belief Model, health is a higher commodity and has limitations. The model's dimensions consist of the perceivable sensitivity and seriousness, the obstacles and advantages, the spark for action, demographic factors and the possibility for action on behalf of the individual. Various demographic, personal, and social factors may affect the person's health behaviour through their influence in the person's mobilisation and subjective view of things (Burns 1992). This model was used to precalculate self care of diabetics. It supports the balance of cost-benefit, where the individual weights the advantages deriving from the implementation of precautionary measures against the relative dangers.

The model supposes that knowledge of risk factors is a necessary requirement for the mobilisation of individuals in order to change their behaviour, or to take on new. It also supposes that the individual should know the risk factors before realizing that one of them is a threat to his health.

In the beginning, a questionnaire was handed out to people participating in the program in order to validate their knowledge on the risk factors that create ulcers. Furthermore, a questionnaire was handed out asking

them to describe their actions and habits while caring for the diabetic foot.

After the questionnaires were answered, they watched a 15 minute American Diabetic Society training film on "Taking care of my foot". Next, a specialised nurse showed them how to take care of the diabetic foot, and they were handed out leaflets. At the end of the program all participants were asked what measures they were going to take now for preventing ulcer appearance and amputation. 55% of them seem to put into practice self care.

It must be noted that there were participants that volunteered to receive training in order to make other members of their community aware of the problem.

Although the Health Belief Model has the advantage of being simple to use, it is all about training programs that are being put into practice by health professionals. It does not take into account factors such as racism, involuntary non-compliance, access to health services, and financial burden.

Roy's Theoretical Model considers the patient as an adaptive system interacting with the ever-changing environment, that sends stimulants. The individual reacts to stimulants through the knowledge he obtains or through the already build-in mechanisms according to defined models. These models are: the natural model, the self comprehension model-group identity, and the independence model (Scollan-Kolliopoulos 2004).

The natural model (consists of: breathing, eating, excretions, acting and resting, protection, senses, liquids, acid balance, neural function, endocrinal function) can be used to determine the content of the patients training by creating the structures for understanding the multiple risk factors that lead to low amputation because of diabetes mellitus.

The protection model refers to the evaluation of the diabetic foot skin's condition and to the training patients receive in using non alcoholic hydrating substances.

The self comprehension-group identity model refers to the cultural and moral factors that must be taken into account when planning a health treatment program. For example in African American populations.

The natural self model refers to the positive body image, the sexual activity, the psychological completion with body growth, adequate adaptivity to body and changes, adequate loss management mechanisms.

The individual self model refers to a steady model of self consequence, of completion of personal ideals, of adequate moral-ethical completion proceeding, of func-

tional self esteem, and of adequate threat management mechanisms.

The group model refers to adequate interpersonal relationships, supportive culture, positive thinking, group acceptance, interpersonal relationships based on principles, and interpersonal relationships build on values. Furthermore, it is also extremely important for patients with diminished functionality caused by neuropathy or by peripheral vascular disease, and also for patients that have undergone low amputation.

The model of role functions refers to role clarity, adequate behaviour procedure, the completion of first, second and third roles, adequate role performance, effective procedure of managing role changes, adequate completion of role within the group.

The independence model refers to emotional adequacy, steady give and take model, effective management of loneliness and separation, developmental adequacy and means adequacy. The advantage of that model is that it can be used for planning health programs for different populations, pinpointing at the same time the clinical parameters connected to diabetes mellitus and its complications. Those programs, because of the model's analytical structure, can be put to practice by non-clinical personnel (Scollan-Kolliopoulos 2004). The model is suitable for patients that face many diabetes mellitus risk factors.

Other researchers attempted to evaluate the effectiveness of educational interference for the improvement of patients in self care practices (Corbett 2003). They used the Interaction Model of Client Health Behaviours. This model examines 3 elements as important in health care: (1) individual-client characteristics (elements of individuality of the client), (2) health professional's interventions (elements of interaction between the client and the professional), and (3) elements of health results (Corbett 2003).

Random allocation of 40 patients in 2 groups was used and initially, the type II diabetes patients' level of knowledge on care of the low foot was examined via a questionnaire. The same questionnaire was used at the end in order to assess the effectiveness of the intervention.

Both groups had a basic guideline program for taking care of the diabetic foot that lasted 6 weeks. In one group patients followed care guidelines designed for each of them by health professionals according to the risk factors, the knowledge, self confidence, and care practices that each of them mentioned. Training was short (10-12 min) and included oral and written instructions to ev-

ery participant. Some patients were notified for specific washing, drying the foot, nail care and appliance of hydrating cream techniques. The oral training was interactive, since the participants could ask about specific issues or problems they face (Gorbett 2003).

The study results showed improvement of the patients' knowledge and practices in a time after the training took place after 3 months (Ward et al 1999), or after 6 months, (Gorbett 2003 et al).

Health training programs should be flexible, as far as time and place are concerned, and designed for each individual, as far as knowledge and practice of self care are concerned. The participants' demographic characteristics should also be taken into account. Furthermore, another important factor is the program duration and intensity. These are factors that can affect patient satisfaction of the provided health services. Ensuring the access of every patient to the appropriate Health Services is one of the priorities for every Health System (Ward et al 1999, Hielm et al 2002, Neder et al 2003, Beu et al 2005).

Diabetic Foot Health Training Program

Basic steps to be taken by every patient:

1. Observing the blood glucose levels and maintaining it within the natural limit
2. Proper eating and exercising
3. Quit smoking.

Instructions for diabetic foot care:

1. Since you could not be able to feel minor injuries, check your feet every morning, before you put on your shoes. Do the same each night before you go to bed. Check for red spots, wounds, blisters, even for small ones. Do not forget to check between your toes and your sole. If you are unable to do so yourself, ask someone else to help you.
2. Keep your toe nails cut. If you can do so yourself, use a nail-clipper and polish the edges with a nail-file. Do not cut the nails in a round shape as this may lead the nail entering the skin. If you are unable to do so yourself, ask a specialist to do it.
3. Ask your doctor to examine your foot every 3 to 6 months, or more often if there are problems. Do not try to extract calluses on your own. Every time you visit your doctor take your shoes off in order to remind him to check your feet.
4. Take foot-baths every day using warm water (29–35 °C). Do not use hot water as it can cause burns without you

realising it. Dry your feet well when you finish, especially between your toes. Apply hydrating cream on the top and bottom of your feet, but not between your toes.

5. If you can, keep your feet up while seating. Do not cross your legs to your knees or ankles, since this obstructs blood circulation. Move your heel and toes up and down 2 or 3 times a day for 5 min. Do not use warm blankets, as they may cause burns without you realising it.

About shoes and socks:

1. Always wear comfortable shoes that fit your foot well. Make sure there is enough space for your toes. Avoid sandals, open-front shoes or shoes with laces between the toes. Never walk barefoot.
2. Wear clean cotton socks every day and make sure that they are not tight under your knee. If you wear panty hose make sure they are not too tight and they do not have design or holes that could rub against your skin.
3. Every day you must inspect your shoes before wearing them to make sure there are not any other objects inside them that could hurt your feet.
4. If you observe an injury do not try to take care of it on your own. Seek your doctor's assistance. Remember that it is not just a simple wound and it therefore requires special care and attention.

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