

Diabetic foot care

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Abstract

People with diabetes are more prone to vascular and neurological impairment, especially when glycaemic levels are uncontrolled. Diabetic foot problems are a common complication of type 2 diabetes mellitus, mainly caused by peripheral neuropathy, and could lead to ulceration and amputation. The frequency of foot examinations and the appropriate level of care are determined by the patient's risk profile. Regular diabetic foot assessment and good foot care practices are essential measures to prevent complications and to ensure optimal patient outcomes.

Keywords: type 2 diabetes, foot care, ulceration, risk assessment, prevention strategies, pharmacist

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Introduction

Diabetes mellitus (DM) is a chronic non-communicable disease, affecting 422 million people worldwide, in both low- and middle-income countries.^{1,2} It is identified by the World Health Organization (WHO) as a global health threat,^{1,2} and is currently the second most common natural underlying cause of death in South Africa.³ Uncontrolled glycaemic levels result in micro- and macrovascular complications, which will affect the eyes, feet, heart, blood and the kidneys of the diabetic patient.⁴⁻⁶ Maintaining targets for diabetes control, including haemoglobin A1c, fasting- and postprandial plasma glucose levels, body mass index and blood pressure are therefore essential to monitor patient progress and to avoid complications.⁷

Type 2 DM in particular is associated with life-threatening long-term complications, usually due to hyperglycaemia that is poorly managed.^{8,9} Diabetic neuropathy is caused by nerve ischaemia due to microvascular complications from hyperglycaemic effects on the neurons.¹⁰ Diabetic peripheral neuropathy causes nerve damage of the hands and the feet,¹⁰ resulting in less sensitivity to pain and discomfort and not being able to feel irritation and injury.¹¹ The consequences of diabetic neuropathy can be skin ulceration, recurrent infections of the lower extremities, and ultimately gangrene, with subsequent amputation.^{12,13} Diabetic foot problems contribute significantly to morbidity and mortality amongst diabetic patients with a negative impact on diabetes-associated healthcare costs.¹²

Diabetic foot ulcers

Diabetic patients with peripheral neuropathy are most likely to develop diabetic foot problems as there is loss of sensation in the nerves of the lower leg, leading to muscle weakness and insufficient blood supply to the tissues.^{14,15} Subsequently this can result in

wounds, referred to as diabetic foot ulcers.^{14,15} The prevalence of diabetic foot ulcers is on the increase with a subsequent increase in diabetes-related amputations.¹⁶ In African countries, diabetic foot ulcers contribute 4–19% of diabetes complications associated with neuropathy, while generally the lifetime risk of diabetic foot ulcers ranges from 10–25%.^{12,17} Furthermore, in countries where amputations are not included as part of the management plan, severe diabetic foot ulcers account for approximately 50% of inpatient mortality rates.¹⁷

Considering the high risk of diabetic foot ulcers and serious complications, prevention of diabetic foot ulcers through regular foot assessments, is of paramount importance.¹² However, although data from South Africa are very limited, results from two small surveys (community health centres and a regional hospital) suggested that foot examinations were recorded in less than 15% of diabetes patients' records.¹²

Risk factors for diabetic foot ulcers

Diabetic foot ulcers most commonly occur on the heel, underside of the toes, tips of prominent toes and tips of deformed toes of the patient's feet.⁴ Risk factors for diabetic foot ulcers include previous history of foot ulcers or amputation and poor knowledge of, and practices of foot care.^{14,18} The following characteristics are associated with a high risk of diabetic foot ulcers, and should therefore be considered when a diabetic foot assessment is done:¹²

- Previous history of ulceration or amputation
- Neuropathy
- Structural foot deformity and limited joint mobility
- Peripheral arterial disease (PAD)
- Microvascular complications (i.e. retinopathy, nephropathy). Patients on renal replacement therapy (e.g. dialysis) are at particularly high risk.

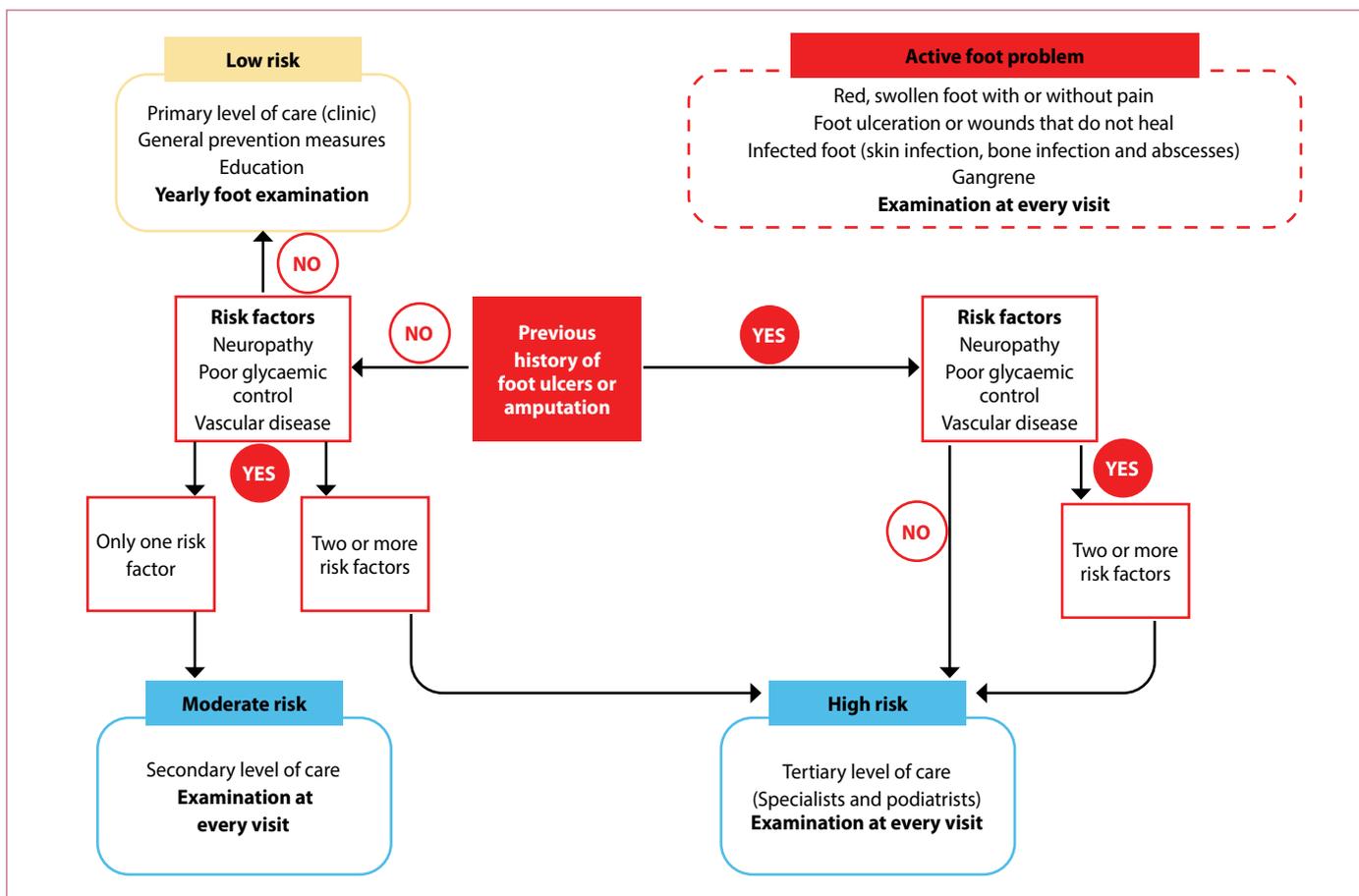


Figure 1. Risk categorisation for diabetic feet and recommendations for future foot examination and care^{12,19}

Figure 1 shows the risk categorisation of diabetic patients for foot ulcers with recommendations for future foot examinations and level of care.^{12,19}

Prevention of diabetic foot ulcers

It is of utmost importance for diabetic patients to be aware of the fact that poorly controlled blood glucose levels are a major leading factor in the development of complications associated with DM, such as foot ulcers.^{20,21} Patients must understand the significance of adherence to medication, so as to control glycaemic levels, and delay or prevent foot ulcers and subsequent infections and amputations.^{10,21}

A number of studies have shown that smoking is a risk factor in some diseases, for example, cardiovascular and cerebrovascular disease.²²⁻²⁴ Adequate blood flow is essential in diabetic foot care, and smoking may restrict blood flow to the feet.²⁵ As a result, smoking has been shown to be linked with diabetic foot amputations.²²

With poor foot care practices being one of the factors contributing to the development of diabetic foot ulcers, it is essential to educate patients on proper foot care.²⁶ Previous research has shown that when healthcare professionals failed to provide patients with sufficient information on foot care during routine check-ups, these patients experienced complications.¹⁴ Patient education

on foot care should be conducted regularly, as this will increase the patient's understanding of its importance, and ensure that proper foot care is practised.^{14,26} In addition, it is recommended that diabetic patients undergo feet examinations at least once per year.²⁷ Healthcare professionals working at primary care level should also receive frequent training on diabetes management, including foot care.¹⁵ Figure 2 shows an infographic on diabetic foot prevention strategies, which could be shared with patients as part of their education.

Diabetic foot care

Daily routine

Patients living with diabetes must be advised to inspect their feet daily as part of their daily foot care routine.⁴ Daily inspection of the feet helps patients to check for swelling, blisters and skin breaks that could lead to ulcers.¹⁸ The advantage of daily inspection is that it will ensure that patients seek medical care immediately when abnormalities are observed.¹⁸ In addition, it is recommended that they wash their feet gently using mild soap and lukewarm water.^{4,27} Moisturisers should be used afterwards, to help prevent skin injuries and keep feet healthy.^{4,27}

Protective care

Trauma to the feet is one of the factors that may lead to the development of foot ulcers.¹² Walking barefoot should be avoided



Graphics: Zeenat Hassim

Figure 2. Infographic for patients on diabetic foot care

in diabetic patients, as a way of good foot hygiene and avoiding trauma.⁴ Self-inflicted trauma is contributing to 4% of diabetic foot ulcer development and may involve cutting toenails.^{12,27} Hence, it is important for diabetic patients to cut toenails straight across, to prevent ingrown toenails and always file them to remove sharp edges.^{12,27}

Diabetic footwear

Type 2 diabetes patients are at an increased risk of developing poor circulation and nerve damage in their feet.²⁶ Minor issues such as calluses, blisters, and cuts, can develop into serious problems, lead to infection and poor wound healing, due to reduced circulation to the feet.²⁶ Nerve damage can result in loss of sensation in the feet, hence patients might not feel anything when stepping onto something sharp, which could result in cuts or tears on their feet, or

if their shoes are pinching or rubbing.^{25,26} Diabetic patients who are at risk of foot ulcers, should therefore not walk bare foot, neither indoors nor outdoors.²⁵

Using appropriate footwear is an important measure to prevent foot ulcers. Previous research has shown that inappropriate footwear contributed to poor foot care practices, whereas appropriate footwear was associated with the reduction or recurrence of foot ulcers in diabetic patients with a neuropathy complication.^{21,28,29} Shoes should be checked for any damage before being worn. If they are damaged, it is advisable not to wear them, as this poses a risk of getting a scratch that can lead to foot ulceration.^{12,25} Diabetic shoes are designed in a way that will allow the feet to be comfortable inside the shoe, thereby reducing the risk of pressure and rubbing on the feet, caused by regular footwear.^{12,25} A podiatrist should be consulted before buying shoes, as they can provide advice and recommend the best type of shoes for diabetic patients.²⁶ Box I shows a checklist that can be used by diabetic patients to minimise the risk of inappropriate footwear.^{12,21,25}

Antiperspirant

Hyperhidrosis is characterised by excessive sweating, as the nervous system is responsible for signalling the sweat glands to cool down the body when it gets too warm.³⁰ Patients with diabetic neuropathy may have excessive sweating of the feet, which can be prevented by using an antiperspirant.^{25,30} Irritation of

the skin must be monitored and the aim should be to keep the feet dry at all times.²⁵

Periodic foot examinations

Periodic foot examinations attempt to reduce the onset of diabetic foot ulcers.²¹ This will assist in early detection of ulcerations, and lower the risk of complications leading to amputations.²¹ It is essential that diabetic foot management be compulsory for every clinic or doctor's visit, for screening and to regularly update patients on how to improve taking care of their feet.²¹ Examinations of the foot include limb movement, health, moisture, colour, temperature, oedema, pain and sensation.²¹

The first foot examination must be done at diagnosis of diabetes type 2, and when normal it must be repeated annually. When

Box I. Checklist for diabetic footwear^{12,21,25}

Shoes fit comfortably with the correct length and width. Toes can wiggle	Yes <input type="checkbox"/>	No <input type="checkbox"/>
If feet are not the same size, a shoe size is chosen according to the bigger foot	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Shoes are made of soft leather, or other flexible material, which will have some stretch as you wear them	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Shoes have a soft and smooth inner lining, with no seams <i>Use your fingers to check</i>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Shoes have cushioned interiors to absorb some of the impact when walking	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Shoes follow the outline of the foot <i>Shoes should not have a pointed toe box</i>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Shoes have closed toes <i>Open-toe shoes increase the risk of injury</i>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
The toe box is wide enough so that it does not pinch the foot, and not so wide that the foot can slide from side to side	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Shoes have laces or other closures that allow adjustment of the fit of the shoe	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Shoes have supportive soles without high heels <i>Heels should not be higher than 4 cm</i>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
The sole of the shoe is flexible and can bend easily	Yes <input type="checkbox"/>	No <input type="checkbox"/>
The sole of the shoe is non-slip	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Shoes fit well and are NOT the slip-on type of shoe	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Shoes are comfortable for activity to be undertaken	Yes <input type="checkbox"/>	No <input type="checkbox"/>
When shopping for new shoes, shoes are fitted with the socks likely to be worn with the shoes	Yes <input type="checkbox"/>	No <input type="checkbox"/>
When shopping for new shoes, shoes are fitted before buying them	Yes <input type="checkbox"/>	No <input type="checkbox"/>
When shopping for new shoes, they are tried-on early in the day <i>Feet can swell over the course of the day, hence may feel too tight by the end of the day</i>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Shoes are in good condition and are not worn-out or damaged (e.g. having cuts)	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Important: If you ticked 'No' to any of the items applicable to your situation, you may be at an increased risk of developing foot problems as a result of inappropriate footwear. Please take this checklist to your podiatrist to discuss ways to reduce these risks.		

abnormal, regular foot examinations are advised at every visit (see Figure 1).¹² The Society for Endocrinology, Metabolism and Diabetes of South Africa (SEMDSA) Type 2 Diabetes Guideline Expert Committee published a very useful diabetes foot screening assessment tool for standard foot examination and risk assessment.^{12,19} Assessment includes the skin, bones, nerves, and vasculature by a trained healthcare professional.¹²

Management of diabetic foot ulcers

Although the management of diabetic foot ulcers is challenging, it aims to decrease the burden of care in an efficient and cost-effective manner.³¹ A multidisciplinary approach is required for success.³¹ Assessment, grading and classification of the ulcer are considered to be the first step in choosing the most appropriate method of managing the ulcer.³² Furthermore, the most effective

methods in the management of diabetic foot ulcers include local care which may be debridement, off-loading and infection control.³²

Debridement

Debridement mainly involves the removal of necrotic tissue as part of ensuring wound healing and includes sharp-, enzymatic-, autolytic-, mechanical- and biological debridement.^{31,32} Autolytic, enzymatic and sharp debridement are the most preferred methods.⁴ Autolytic debridement is recommended for patients who experience pain from foot ulcers and is mainly comprised of creating a moist environment for the wound, using dressings.^{31,32} The necrotic tissue is cleared out by white blood cells as part of the host's defense mechanism, using the body's enzymes.^{4,31} Similarly, enzymatic debridement involves the use of proteolytic enzymes applied topically to the wound.³² The process is much faster as compared to autolytic debridement and the clearing out of the necrotic tissue does not affect healthy tissue negatively.^{4,31} The sharp debridement method is the most commonly used method.³² However, the procedure requires the skills of a surgeon, as it involves the use of scalpels to remove the necrotic tissue from wound bed.^{4,31}

Off-loading

Off-loading entails the removal of any pressure or mechanical stress to the wound to promote wound healing.³³ The off-loading process requires the use of devices such as total contact casts, cast walkers and shoe modification, which further requires the special skills of a podiatrist.³²

Total contact casts are considered to be an effective method to use when a patient's management plan requires the removal of pressure to the wound.^{31,34} In the case of diabetic foot ulcers located on the forefoot and the midfoot, total contact casting is a good treatment method.³² In addition, patients using total contact casts have also experienced faster wound healing.³² It must be noted though, that it is highly recommended for patients with infected ulcers, severe foot ischaemia and a deep abscess, to not use total contact casts.^{31,32}

Infection control

Diabetic foot ulcers have a 56% chance of being infected, with 20% of these patients having to go through foot amputation.¹⁹ The type of treatment initiated depends on the severity of the infection according to grading.³⁵ Grade 1 represents the absence of an infection, grades 2 and 3 are considered to be mild and moderate infections respectively, while grade 4 represents severe infections.³⁵ Antibiotics can be used, of which those active against staphylococci, streptococci, coliforms, and anaerobic bacteria are most preferred.^{7,35,36}

According to the South African Standard Treatment Guidelines and Essential Medicines List, oral amoxicillin/clavulanic acid is recommended for the treatment of diabetic foot ulcers at primary care level.⁷ Polymicrobial infection is managed at secondary care

level. Topical antibiotics are not indicated and oral amoxicillin/clavulanic acid is recommended for at least 10 days.³⁷ In the case of severe infection, intravenous (IV) amoxicillin/clavulanic acid is recommended.³⁷ All patients with a severe penicillin allergy are referred to secondary level care, in which case recommended treatment includes a combination of oral clindamycin and IV gentamycin.³⁷

It is important that both clinical signs and symptoms together with microbiology tests are done to diagnose the infection, although treatment should not be delayed while waiting for microbiology results.¹⁹ The rate of wound healing should be monitored, as it usually takes six to seven weeks for a neuropathic ulcer to heal.¹⁹ In the case of deep tissue infection, classified as grade 3, antibiotic therapy is recommended for one to three weeks.¹⁹ Superficial critical colonisation and osteomyelitis are categorised as grades 2 and 4.¹⁹ These severe infections are usually more effectively treated within the hospital setting, for a period of two to four weeks.^{35,36} For biofilms and chronic persistent infections, debridement and wound cleansing must be done more often with the use of antiseptics and surfactants.¹⁹ In addition, antimicrobial dressings can be used to prevent biofilms from forming again.¹⁹

Role of the pharmacist

An effective way of managing diabetic foot ulcers is through a multidisciplinary team approach, involving a physician, a pharmacist, a podiatrist, a nurse and a surgeon.³¹ Each of these healthcare professionals has a particular role to play.

Pharmacists play a more active role in the prevention of diabetic ulcers. They are involved in providing patient education on the importance of adherence to diabetic medication to ensure that blood glucose levels are controlled, which is a major factor that may prevent diabetes-associated complications.^{33,38} Pharmacists' knowledge of medicines further enables them to provide advice to other healthcare professionals regarding the relevant medication to consider when treating diabetic foot ulcers, more especially those that are already infected.³⁸ In addition, pharmacists are able to determine when patients are not responding to treatment and are better suited to make referrals to specialists when patients experience poor wound healing.³⁵

From a public health perspective pharmacists can play an important role in preventing morbidity and mortality associated with diabetic foot ulcers. They can detect abnormalities that could result in foot ulcers at an early stage, as patients frequently visit pharmacies to refill their prescriptions. This serves as an opportunity for the pharmacist to provide patient education on proper diabetic foot care.³⁸

Conclusion

Diabetic foot ulcers are more common in type 2 diabetes, and develop as a result of a combination of factors such as diabetic neuropathy, hyperglycaemia, vascular disease and trauma to the feet. It is important for patients to ensure that glycaemic levels are

kept within the targets of control to avoid diabetes complications, and to examine their feet daily to identify changes in the skin that can lead to diabetic foot ulcers.

Diabetic foot care and preventative strategies can reduce morbidity and mortality from diabetic foot ulcers, optimise patient outcomes, improve quality of life and ultimately reduce costs for the healthcare system. Pharmacists, especially at primary care level, can play an important role in regular diabetic foot screening and patient education, to ensure maximum effective foot care practices.

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