MANAGING DIABETIC FOOT ULCERS: BEST PRACTICE

Despite a wealth of evidence and clinical guidelines, the prevention and management of diabetic foot ulcers remains a challenge. This article aims to define best practice through the exploration of ten key points taken from current evidence and guidelines in an attempt to help non-specialist practitioners to implement best practice when treating patients with diabetes.

Caroline McIntosh and Veronica Newton are Senior Lecturers in Podiatry, University of Huddersfield

Figure 1. Diabetic foot ulcer.

The need for standardised care in diabetes has been highlighted by the development of numerous clinical guidelines and best practice statements from key sources such as the National Institute for Health and Clinical Excellence (NICE, 2004); the Department of Health (Dept of Health, 2001); the Scottish Intercollegiate Guidelines Network, (SIGN, 2001), and the Royal College of General Practitioners (Hutchinson et al, 2000) (*Table 1*). New evidence is constantly emerging within the field of diabetes care, making it difficult for the non-specialist practitioner to remain up-to-date with current best evidence. This review aims to identify the basic requirements of diabetic foot examination and to define best practice for effective management of diabetic foot ulceration through the exploration of 10 key elements.

Diabetes mellitus

To gain an understanding of the complexities of diabetic foot ulceration, it is important to have an appreciation of the underlying disease process.

Diabetes mellitus occurs when there is inadequate uptake of glucose by the cells of the body resulting in raised blood glucose levels (Pocock and Richards, 2004).

Insulin, a hormone produced in the pancreas, regulates the storage and release of energy from food. Diabetes can occur due to failure of the pancreas to produce enough insulin or to the development of insulin resistance, both resulting in high blood glucose levels (hyperglycaemia). Diabetes is a progressive disease characterised by chronic hyperglycaemia.

There are two main types of diabetes: type 1 and type 2. In people with type 1 diabetes, the pancreas does not produce enough insulin. This is an autoimmune disease whereby the insulin producing β-cells are destroyed by the body's own immune system. Without insulin, the storage and release of energy from food cannot be regulated and high levels of glucose remain in the bloodstream (hyperglycaemia) (Davey, 2004). Type 1 diabetes affects approximately 15% of all people living with diabetes in England and primarily affects the

Table 1

Clinical guidelines and best practice statements

International Consensus on the Diabetic Foot (International Working Group on the Diabetic Foot, 1999)

National Service Framework for Diabetes (Department of Health, 2001)

Management of Diabetes: A National Clinical Guideline (Scottish Intercollegiate Guidelines Network [SIGN], 2001)

Type 2 Diabetes: Prevention and Management of Foot Problems (National Institute for Health and Clinical Excellence [NICE], 2004)

younger population (<30 years of age) (Dept of Health, 2001).

Type 2 diabetes affects approximately 85% of all people living with diabetes in England (Dept of Health, 2001). Type 2 diabetes usually occurs later in life; it is most common in people over the age of 40 years. In people with type 2 diabetes, the β-cells are not able to produce enough insulin, or there is a degree of insulin resistance where the cells in the body can not respond to the insulin that is produced by the β-cells. The storage and release of energy from food is not regulated and hyperglycaemia occurs.

Self-monitoring of blood glucose levels is advocated to people living with diabetes, with a level of 7mmols/l being the optimum. It is also possible for trained healthcare professionals to measure the percentage concentration of glucose in red blood cells in a test called HbA_{1C}.

HbA_{1C} is a measure of how much glucose is attached to the haemoglobin part of the red blood cell (glycosylated haemoglobin) and is usually expressed as a percentage. Levels of 6.5–7.5% are optimum figures.
The effect of prolonged, uncontrolled hyperglycaemia increases the risk of developing a number of chronic problems associated with diabetes, namely vascular and neurological

Diabetes mellitus occurs when there is inadequate uptake of glucose by the cells of the body resulting in raised blood glucose levels (Pocock and Richards, 2004).

complications. This is primarily due to damage of small blood vessels (microvasculature disease). Initially changes are reversible, but with prolonged exposure to high glucose levels damage can be irreversible and the likelihood of chronic complications increases (Dept of Health, 2001).

Standard diabetic foot examination

All individuals with diabetes should receive annual assessment by trained practitioners as part of ongoing diabetes care (NICE, 2004). The minimum requirements of a basic foot examination are detailed in *Table 2*.

Following a basic foot examination, the risk status for ulceration can be established. Early identification of risk factors for diabetic foot ulceration is fundamental to establishing ulcer risk and allowing strategies to be implemented to prevent ulceration (American Diabetes Association, 2004). If at-risk individuals are identified early, diabetes-related foot problems are largely preventable. *Table 3* describes risk classifications. A traffic light system has been provided as a visual guide to highlight risk status: green denotes low-risk foot, amber denotes at-risk to high-risk foot and red denotes ulcerated foot.

Table 2

Basic foot examination

The examination should include:

Use of a 10g monofilament to assess sensory status

Palpation of foot pulses

Inspection of the feet for deformities

Inspection of footwear for wear and tear and foreign objects that may traumatise the foot

Source: NICE (2004)

Ten key points in effective management of diabetic foot ulceration

NICE (2004) guidelines state that individuals presenting with ulceration should be referred to the diabetes specialist multidisciplinary team within 24 hours. The team members must then undertake a comprehensive assessment to establish a management plan tailored to meet the needs of the individual, while conforming to best practice in diabetes. *Figure 2* shows the 10 key elements in effective management of diabetic foot ulceration.

Each point will now be explained and then considered in relation

Table 3

Classification of risk status

Low-risk	No complications: annual review recommended
At-risk foot	Neuropathy or absent pulses or bone/joint deformity such as bunion formation or toe deformities: 3–6 month review recommended
High-risk foot	Neuropathy or absent pulses or bone/joint deformity/previous ulcer: a 1–3 month review with an individualised management plan is recommended
Ulcerated foot	Urgent treatment

From: International Working Group on the Diabetic Foot (1999); NICE (2004)

to the current evidence base and clinical guidelines, and recommendations made to facilitate the practitioner in implementing best practice.

1. Advocate tight glycaemic control

NICE guidelines (2002) for patients with type 2 diabetes recommend self-monitoring and management of blood glucose with HbA_{1C} measurements by a healthcare professional at 2–6 monthly intervals. A level of 6.5–7.5% is a measure of good glycaemic control (McIntosh et al, 2001). High glycaemic levels can detrimentally affect the tissue electrolyte balance and white blood cell activity and hence prolong infection and delay healing, which is why controlling blood sugar in the absence of other disease processes aids normal healing.

It has been demonstrated in randomised controlled trials that prolonged episodes of hyperglycaemia increase the risk of developing both macro- (large) and micro- (small) vessel disease (Diabetes Control and Complications Research Group, 1993; UK Prospective Diabetes Study [UKPDS] Group, 1998). The same studies showed that patients with intensive blood glucose (i.e. with more frequent glucose monitoring points throughout the day), who controlled their diabetes with either sulphonylureas or insulin, had fewer microvascular complications. The UK Prospective Diabetes Study (UKPDS) Group (1998) also demonstrated an increased risk of cardiovascular events such as myocardial infarction and strokes when HbA_{1C} concentrations rise above the normal range.

Use of combination therapy (treatment with more than one type of oral hypoglycaemic) for management of type 2 diabetes can optimise glycaemic control further by increasing sites of action of drug therapy, leading to reduced episodes of hyperglycaemia (NICE, 2002). Therefore, the practitioner should always advocate tight glycaemic control for patients with type 2 diabetes.

Glycaemic control can be further reinforced by dietary advice to encourage patients to play a role in controlling their diabetes. A healthy diet for people with diabetes is low in fat, sugar and salt, high in fruit and vegetables and moderate in bread, potatoes, cereals, pasta and rice. Everyone with diabetes should receive dietary information and support. A state-registered dietician can provide specific dietary advice that takes into account lifestyle and cultural preferences (Diabetes UK, 2006).

2. Identify aetiological factors

Patient assessment should include evaluation of their vascular and neurological status, skin assessment and a thorough medical and social history to establish the cause of the wound. The International Working Group on the Diabetic Foot (IWGDF, 1999) suggests most ulcers on the diabetic foot can be classified as neuropathic, ischaemic or neuroischaemic.

The IWGDF (1999) and NICE (2004) suggest that the most frequent cause of diabetic foot ulceration is ill-fitting shoes, which may be too small, too big or excessively worn and advise meticulous routine examination of footwear in all patients. Practitioners should examine them for wear and tear and foreign objects such as small stones, glass fragments, drawing pins, pet hairs, etc that may traumatise the foot (NICE, 2004).

Underlying complications in the diabetic foot are vascular changes resulting in ischaemic ulceration and neurological changes resulting in neuropathic ulceration. Edmonds and Foster (1999) argue that it is rare to see pure ischaemic changes without neuropathic alterations. Approximately 50% of people who present at diabetic foot

clinics have neuropathy, and 50% have neuroischaemic feet (Edmonds and Foster, 1999). Other common causes of diabetic foot ulceration include previous ulceration. Recurrence rates of diabetic foot ulceration are high. For example, Pound et al (2005) identified that 40% of patients developed a recurrent/new ulcer within four months of the original ulcer healing. Another common cause is trauma in an insensate foot as a result of peripheral neuropathy.

Foot deformities can give rise to abnormal sites of high pressure on the foot, resulting in tissue breakdown and foot ulceration. Socioeconomic status is also an important consideration because of the related poor access to health care and education associated with low status (IWGDF, 1999).

3. Establish and quantify vascular status

Patients with diabetes mellitus are more prone to peripheral vascular disease (PVD) than the non-diabetic population (Shaw and Boulton, 2001). This includes proximal vessel disease (affecting the lower abdomen and thigh), and more distal vessel disease (affecting calf and foot) (SIGN, 2001).

Practitioners should establish and quantify the number of risk factors associated with: peripheral vascular disease (PVD); hypertension; dyslipidaemia; coronary heart disease; smoking; hyperglycaemia; renal disease; and sedentary lifestyle (American Diabetes Association, 2003; NICE, 2004).

The duration of diabetes and the severity of hyperglycaemia have a strong association with the development of vascular complications below the knee (Diabetes Control and Complications Trial Research Group, 1993; UKPDS Group, 1998). Measurement of PVD extends from simple pulse palpation of the foot pulses (dorsalis pedis and posterior tibial) to more sophisticated assessment by specialist practitioners, i.e. using Doppler ultrasound to obtain the ankle brachial pressure index (ABPI) and the toe brachial pressure index (TBPI).

HbA_{1C} measurement is a predictor of the rate of development of micro- and macro-vascular disease; therefore, a 2–6-monthly review is recommended (Hutchinson et al, 2000).

4. Manage arterial risk factors

The presence of arterial disease is a risk factor for foot ulceration in the diabetic foot. Arterial risk factor management is essential to ensure effective control of the underlying issues in type 2 diabetes. These are identified as hypertension, dyslipidaemia, coronary heart disease, smoking, hyperglycaemia, renal disease and sedentary lifestyle (UKPDS Group, 1998).

Prevalence of hypertension in type 2 diabetes is higher than that in the general population. Hypertension (defined by a blood pressure greater than

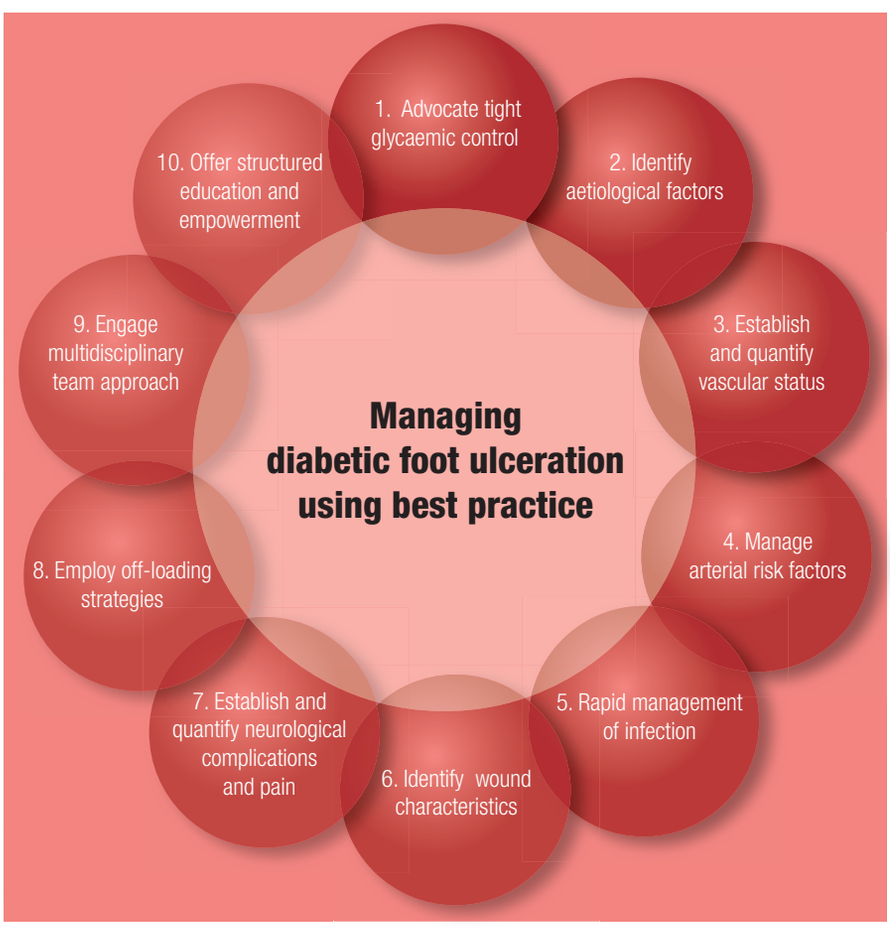

Figure 1. Ten key elements in effective management of diabetic foot ulceration.

140/90mmHg) is present in more than 80% of people with type 2 diabetes. The incidence of microvascular (small vessel) and macrovascular (large vessel) disease increase incrementally with increasing systolic blood pressure. Therefore, it is essential to reduce the blood pressure to near-normal levels. Guidelines suggest patients should aim for near-normal levels — HbA_{1c} <7% and blood pressure <140/<80mmHg (UK Prospective Diabetes Study (UKPDS) Group, 1998).

Lipid changes are regularly seen in patients with diabetes, as insulin is a key regulator of lipid metabolism. Typical lipid changes in type 2 diabetes are:

- An increase in triglycerides
- A decrease in high-density lipoprotein-cholesterol (HDL-C)
- An increase in small, low-density lipoprotein (LDL) particles.

All these changes are associated with an increased risk of atherosclerosis; an underlying disease process that increases the clinical risk of diabetic foot ulceration (NICE, 2002). Lipid-lowering therapy has demonstrated a relative risk reduction in major cardiovascular events in patients with or without type 2 diabetes (Robless et al, 2001).

Other factors, such as coronary heart disease, smoking, hyperglycaemia, renal disease and a sedentary lifestyle should be managed on an individual basis in accordance with the National Service Framework (2001), NICE guidelines and other international guidelines (*Table 1*).

5. Rapid management of infection

Practitioners must remain vigilant for signs of infection and, if in doubt, patients should be referred urgently to the specialist foot care multidisciplinary team for assessment. Current guidelines promote aggressive management of infection with appropriate systemic antibiotic therapy (IWGDF, 1999; NICE, 2004).

A major challenge for diabetes care providers is the prompt recognition of infection in the diabetic foot. Clinical diagnosis of infection relies on the important signs associated with infection: pain or discomfort, swelling, warmth and erythema (Edmonds et al, 2004). However, in the diabetic foot these signs can be absent even in the presence of infection as a result of neuropathy and a reduced arterial supply.

A major challenge for diabetes care providers is the prompt recognition of infection in the diabetic foot.

Wound infection is associated with delayed wound healing, and in the neuroischaemic foot can rapidly give rise to spreading infection (cellulitis) that can progress to tissue death (necrosis). NICE (2004) guidelines stipulate that wound management should employ the use of intensive systemic antibiotic therapy for non-healing/progressive ulcers with signs of infection. SIGN (2001) suggests treatment with a broad-spectrum antibiotic in conjunction with appropriate debridement. Antibiotic regimens can then be modified with reference to clinical response and microbiological test results.

Additionally, it is important to maintain good metabolic control blood glucose measures of approximately 7 mmols/l, or HbA_{1c} <7% would be considered desirable and would optimise cardiovascular function to improve the chances of wound healing (Cutting et al, 2005; Edmonds, 2005).

A recent study aimed to develop further criteria for early recognition of infection in the diabetic foot (Cutting et al, 2005). The signs identified include cellulitis, lymphangitis, purulent exudate and pus/abscess.

6. Identify wound characteristics

In a chronic diabetic foot wound, the cellular processes are disrupted and abnormal functions may be due to a variety of intrinsic (e.g. cellular level) or extrinsic (e.g. mechanical forces) factors, acting on their own or in combination. The philosophy of wound bed preparation (WBP) is now widely accepted as a useful strategy to assist the practitioner when implementing care plans for patients with complex wounds (Watret, 2005).

Sibbald et al (2000) defined wound bed preparation as 'a changing paradigm that links treatment to the cause and focuses on three components of local wound care, 'debridement, wound-friendly moist interactive dressings and bacterial balance'. WBP principles attempt to assist the clinician in understanding and identifying

Table 4

Clinical application of TIME principles

Tissue management (non-viable or deficient)	Assess the amount of viable and non-viable tissue. The presence of slough and necrotic tissue can delay healing and the need for regular debridement should be considered (Watret, 2005)
Infection and/or inflammation	Diabetic foot ulcers are prone to infection
Moisture imbalance	Wound assessment should encompass analysis of wound exudate, e.g. volume, consistency etc (Gray and White, 2004)
Edges of the wound (non-advancing or undermined)	Closure of diabetic foot ulcers is delayed in the presence of non-viable tissue such as a callus. Frequent debridement by a skilled podiatrist is needed to promote proliferation of healthy granulation tissue to facilitate normal wound healing (Watret, 2005)

the underlying molecular and cellular abnormalities that prevent the wound from healing. WBP involves optimising the local wound environment for healing. The acronym TIME which stands for Tissue (non-viable or deficient), Infection/inflammation, Moisture (imbalance) and Edge (non advancing or undermined), is often discussed in conjunction with the principles of WBP and has been suggested in papers by Schultz et al (2004) and Watret (2005) as a systematic approach to facilitate wound management (*Table 4*).

Regular wound debridement is recommended to remove necrotic tissue and callus, reduce pressure, allow a full inspection of the wound bed and stimulate wound healing in the diabetic foot (Leaper, 2002; Edmonds et al, 2004; Watret, 2005). NICE (2004) guidelines support this view and advise that dead tissue should be carefully removed from foot ulcers to facilitate healing, unless surgical revascularisation of the vessels is required in which case debridement may further traumatise compromised tissues.

As many as 50% of patients attending a diabetic foot clinic will have one or more of the symptoms of peripheral neuropathy (Baker et al, 2005).

While debridement is recognised as an important adjunct to stimulate healing in the neuropathic foot (Edmonds et al, 2004), wound debridement must be undertaken with caution in the sensitive ischaemic foot to prevent any additional pain during treatment and to prevent any further trauma to vascular-compromised tissues. If in any doubt as to whether debridement is appropriate, a referral must be made to the diabetes multidisciplinary team for further assessment.

Effective wound management should also aim to maintain a moist wound environment to promote healing while preventing excess wound exudate that can cause excessive hydration (maceration) and damage to the surrounding skin (White and Cutting, 2004).

In the absence of any strong evidence for the most appropriate dressing choice, NICE (2004) recommends that practitioners should use wound dressings that best match clinical experience, patient preference, and the anatomical location of the wound, while also considering cost.

7. Establish and quantify neurological complications and pain

Symptoms of diabetic peripheral neuropathy (neurological damage to the nerves in the upper and lower limbs) are diverse, with symptoms ranging from painless to painful, affecting many nerve pathways. The key clinical features of peripheral neuropathy in the leg and foot are:

- Motor neuropathy which presents as muscle wasting and diminished or absent reflexes
- Sensory neuropathy which presents as diminished or absent sensation of touch, pain, temperature and vibration
- Autonomic neuropathy which presents as a foot with dry skin, warm to the touch, pink in colour with abnormally bounding pulses due to thermoregulation defects.

It is widely recognised that peripheral neuropathy is a major contributory factor in the development of foot ulceration. As many as 50% of patients attending a diabetic foot

clinic will have one or more of the symptoms of peripheral neuropathy (Baker et al, 2005). Ulcer prevalence and the risk of amputation can be reduced if people diagnosed with sensory neuropathy are offered foot care education, podiatry and, where required, therapeutic footwear (Dept of Health, 2001).

Pain in the insensate foot is a sign of deep structure disruption, including infection of the bone and its marrow (osteomyelitis) or Charcot arthropathy changes (Sibbald, 2003), both of which require prompt management to prevent adverse outcomes such as tissue necrosis and severe deformity, respectively. Patients with painful diabetic neuropathy may benefit from prescription of a tricyclic antidepressant, e.g. amitriptyline, which has been shown in trials to reduce symptoms of painful neuropathy (SIGN, 2001). It is important to remember that glycaemic control, ethnic background, duration of disease, and cardiovascular factors are all associated with increased risk of complications (NICE, 2004).

Key Points

- There is an urgent need for standardised care in diabetes.
- With new evidence constantly emerging, it is difficult for the non-specialist to keep up-to-date with current best practice.
- To understand the complexities of diabetic foot ulceration, an appreciation of the underlying disease process is necessary.
- There are two main types of diabetes: type 1 and type 2.
- The non-specialist can play a key role in the early detection of problems and prompt referral to the diabetes foot care multidisciplinary team.
- Amputation risk is decreased when patients receive care from specialist foot care multidisciplinary teams.

8. Employ off-loading strategies

Removal of pressure, known as off-loading, can be achieved by a number of strategies, including avoidance of weight bearing, the use of irremovable and removable cast walkers, half shoes, orthotic devices and therapeutic footwear. Armstrong et al (2001) suggest that the central goal of any programme designed to heal active foot ulceration is effective reduction of pressure. In the presence of neuropathy, diabetic patients generally develop foot ulceration over sites of high pressure and shear on the sole (plantar aspect) of the foot primarily related to normal walking (Armstrong et al, 2003).

A randomised controlled trial investigated off-loading strategies for diabetic foot ulcers (Armstrong et al, 2001). Findings suggest that the total contact cast (TCC), a type of below-knee walking cast made from either plaster of Paris or fibreglass, healed a higher proportion of wounds in a shorter amount of time than removable cast walkers (RCWs) that can be removed to facilitate dressing changes. Armstrong et al (2001) suggest that it is perhaps the removability of the RCW that is its biggest detriment in healing times. The TCC has therefore been suggested as the 'gold standard' in off-loading diabetic foot ulcers (SIGN, 2001; NICE, 2004). However, in the presence of ischaemia and/or infection, the TCC can be contraindicated because of inaccessibility to the wound (Edmonds et al, 2004) and, therefore, other commercially available designs of RCWs should be considered, such as the Aircast pneumatic walker.

Therapeutic footwear is frequently prescribed as a management strategy in the primary and secondary prevention of diabetic foot ulceration and as an adjunct to aid healing when ulceration is present. Maciejewski et al (2004) reviewed evidence for the effectiveness of therapeutic shoes in preventing ulceration and found several studies that reported statistically significant protective benefits from therapeutic footwear. However, used alone, therapeutic footwear may not provide sufficient pressure relief to off-load effectively, and should be used in combination with orthotic devices. A thorough assessment of the structure and mechanics of the foot needs to be undertaken by a podiatrist and/or orthotist before insole prescription (McIntosh and Newton, 2005) and patients requiring off-loading devices should be referred to the specialist diabetes multidisciplinary team for further assessment.

9. Engage multidisciplinary team approach

The aim of the multidisciplinary team, as described in the

National Service Framework (Department of Health, 2001) and NICE (2004) guidelines, is to minimise the impact of the long-term complications of diabetes. This is done through early identification of risk factors and effective management, thus maximising the quality of life for those with diabetes. Evidence suggests that amputation risk is reduced when patients receive care from specialist foot care multidisciplinary teams (Foster and Edmonds, 2002).

Diabetes mellitus is a chronic condition that can impact on almost every aspect of someone's life. Individuals living with diabetes will require the support of numerous health professionals at differing stages, e.g. at first diagnosis and in the short- and long-term management of complications. The need for a multidisciplinary team approach is outlined within section 12 of the National Service Framework for Diabetes (Department of Health, 2001) and within the NICE (2004) and SIGN (2001) guidelines. The aim is to ensure that people with diabetes receive integrated health and social care, with effective communication between all healthcare providers involved in order to achieve an optimal individualised care package.

10. Offer structured education and empowerment

Standard 3 of the *National Service Framework for Diabetes* (DoH, 2001) aims to encourage people with diabetes to self manage their diabetes on a day-to-day basis, in terms of achieving good glycaemic control to reduce the risk factors for long-term complications, eating a balanced diet and taking regular activities or exercise to promote optimal health. Furthermore, this care should be patient-centred so that services can match individual care with individual needs (Department of Health, 2001).

Diabetes mellitus is a chronic condition that can impact on almost every aspect of someone's life.

Since its publication in 2001, the *National Service Framework for Diabetes* has contributed to the attempt to structure education to prevent some of the devastating complications associated with diabetes. The National Service Framework recommends structured education to improve patients' knowledge and understanding of their condition, thus enabling them to undertake effective self-care (Dept of Health, 2005). A number of structured education programmes have recently been introduced to educate patients and encourage those living with diabetes to manage their own diabetes and foot care independently. These include:

- The expert patient programme
- Dose Adjustment For Normal Eating for type 1 diabetes (DAFNE)
- Diabetes Education and Self Management for Ongoing and Newly Diagnosed for type 2 diabetes (DESMOND).

These programmes provide a national network of health professionals and patients who are able to offer help support and advice to people living with diabetes.

Lifestyle management can help improve the patient's quality

Glossary

Charcot arthropathy or Charcot neuroarthropathy: is a chronic, progressive, degenerative disease of osseous (bone) tissue. It is suggested that this results from autonomic neurological dysfunction causing rapid changes in bone density that can cause severe foot deformity

Dyslipidaemia: an excess of lipids (a type of fat) in the blood

High-density lipoprotein (HDL): this is a type of cholesterol sometimes referred to as the 'good' type of cholesterol. Low levels of HDL in the bloodstream have been correlated with the development of heart disease

Insensate: lacking physical sensation

Ischaemia: blood deficiency and relative tissue hypoxia usually as a result of arterial disease/obstruction

Low-density lipoprotein (LDL): this is a type of cholesterol, sometimes referred to as the 'bad' type of cholesterol. The higher the value of LDL in the bloodstream above the normal values, the higher the risk of vascular disease

Lymphangitis: a state of inflammation of the lymphatic vessels seen radiating from a site of infection

Monofilament: instrumentation used in neurological testing to assess sensory perception

Neuroischaemia: pathophysiological changes (the disordered physiological processes associated with disease or injury) resulting in neurological and vascular signs/symptoms

Neuroischaemic: denotes pathological changes in both neurological and vascular systems

Neuropathy: pathological changes in the nerves affecting structure and function

Triglycerides: a type of circulating fat (obtained from the diet). Elevations of this type of fat in the bloodstream have been correlated with the development of arterial disease

of life through education, self-monitoring of glucose levels, dietary management, physical exercise, smoking cessation and reduction of alcohol intake (European Diabetes Policy Group, 1999).

Conclusion

Despite a wealth of evidence and clinical guidelines, the prevention and management of diabetic foot ulceration remains challenging for diabetes care providers and a real problem for those living with diabetes. Approximately 15% of diabetic patients will develop foot ulceration during their lifetime (Plank et al, 2003) and, while the management of ulceration remains the speciality of the diabetes foot care multidisciplinary team, the non-specialist practitioner can play a key role in the early detection of problems and prompt referral to the team.

This article has addressed issues related to best practice in diabetes foot ulcer care derived from current evidence and published guidelines. It is anticipated that the information presented will help non-specialist practitioners to implement best practice into their own clinical practice. **WE**

American Diabetes Association (2003) Peripheral arterial disease in people with diabetes. *Diabetes Care* **26(12):** 3333–41

American Diabetes Association (2004) Preventative foot care in diabetes. *Diabetes Care* **27(Suppl 1):** S63–S64

Armstrong DG, Lavery LA, Kimbriel HR, Nixon BP, Boulton AJ (2003) Activity patterns of patients with diabetic foot ulceration: patients with active ulceration may not adhere to a standard pressure off-loading regimen. *Diabetes Care* **26(9):** 2595–7

Armstrong DG, Nguyen HC, Lavery LA, van Schie CH, Boulton AJ, Harkless LB (2001) Off-loading the diabetic foot wound: a randomized clinical trial. *Diabetes Care* **24(6):** 1019–22. Erratum in *Diabetes Care* 2001 **24(8):** 1509

Baker N, Murali-Krishnan S, Rayman G (2005) A user's guide to foot screening. Part 1: peripheral neuropathy. *The Diabetic Foot* **8(1):** 28–37

Cutting KF, White RJ, Mahoney P, Harding KG (2005) *Clinical Identification of Wound Infection: A Delphi Approach*. European Wound Management Association (EWMA) Position Document. MEP Ltd, London

Davey P (2004) *Medicine at a Glance*. Blackwell Science Ltd, Blackwell Publishing, Oxford, UK: 15

Diabetes Control and Complications Trial (DCCT) Research Group (1993) The effect of intensive treatment of diabetes on the development and progression of long term complications in insulin-dependent diabetes mellitus. *N Engl J Med* **329(14):** 977–86

Diabetes UK (2006) Food and Diabetes (online) Diabetes UK, London (http://www.diabetes.org.uk/eatwell/food_diabetes/index.html) (Last accessed: 4 May 2006)

Department of Health (2001) National Service Framework for Diabetes: Standards. Department of Health, London (http://www.dh.gov.uk/PublicationsAndStatistics/Publications/PublicationsPolicyAndGuidance/PublicationsPolicyAndGuidanceArticle/fs/en?CONTENT_ID=4002951&chk=09Kkz1) (Last accessed: 4 May 2006)

Department of Health (2005) *Structured Patient Education in Diabetes: Report from the Patient Education Working Group*. Department of Health, London

Edmonds M (2005) Infection in the neuroischaemic foot. *Int J Low Extrem Wounds* **4:** 145–53

Edmonds M, Foster A (1999) *Managing the Diabetic Foot*. Blackwell Science, Oxford

Edmonds ME, Foster AVM, Sanders LJ (2004) *A Practical Manual of Diabetic Footcare*. Blackwell publishing, Oxford.

Edmonds M, Foster AVM, Vowden P (2004) Wound bed preparation for diabetic foot ulcers. In: European Wound Management Association (EWMA). *Position Document: Wound Bed Preparation in Practice*. MEP Ltd, London: 6–11

European Diabetes Policy Group (1999) A desktop guide to type 2 diabetes mellitus. *Diabet Med* **16(9):** 716–30

Foster A, Edmonds M (2002) The National Service Framework: will it save the diabetic foot? *Practical Diabetes* **19(5):** 127–8

Gray D, White R (2004) The Wound Exudate Continuum: an aid to wound assessment. *Wounds UK* (Applied Wound Management Supplement) **1(2):** 1–30

Hutchinson A, McIntosh A, Feder G, Home PD, Young R (2000) *Clinical Guidelines for Type 2 Diabetes: Prevention and Management of Foot Problems*. Royal College of General Practitioners, London

International Working Group on the Diabetic Foot (1999) *International Consensus on the Diabetic Foot*. International Working Group on the Diabetic Foot, Amsterdam, The Netherlands

Leaper D (2002) Sharp Technique for Wound Debridement. World Wide Wounds (http://www.worldwidewounds.com/2002/december/Leaper/Sharp-Debridement.html) (Last accessed 4 May 2006)

Maciejewski ML, Reiber GE, Smith DG, Wallace C, Hayes S, Boyko EJ (2004) Effectiveness of diabetic therapeutic footwear in preventing reulceration. *Diabetes Care* **27(7):** 1774–82

McIntosh C, Newton V (2005) Superficial diabetic foot ulcers In: White R (2005) *Skin Care in Wound Management: Assessment, Prevention and Treatment*. Wounds UK, Aberdeen: 47–73

McIntosh A, Hutchinson A, Home PD et al (2001) *Clinical Guidelines and Evidence Review for Type 2 Diabetes: Management of Blood Glucose*.

ScHARR, University of Sheffield, Sheffield

NICE (2002) *Management of Type 2 Diabetes – Managing Blood Glucose Levels*. National Institute for Health and Clinical Excellence, London

NICE (2002) *Management of Type 2 Diabetes — Management of Blood Pressure and Blood Lipids*. National Institute for Health and Clinical Excellence, London

NICE (2004) *Type 2 Diabetes: Prevention and Management of Foot Problems. Clinical Guideline 10*. National Institute for Health and Clinical Excellence, London

Plank J, Haas W, Rakovac I, Görzer E, Sommer R, Siebenhofer A, Pieber TR (2003) Evaluation of the impact of chiropodist care in the secondary prevention of foot ulcerations in diabetic subjects. *Diabetes Care* **26(6):** 1691–5

Pocock G. Richards CD. (2004) *Human Physiology. The Basics of Medicine*. 2nd edn. Oxford University Press, Oxford 606–8

Pound N, Chipchase S, Treece K, Game F, Jeffcoate W (2005) Ulcer-free survival following management of foot ulcers in diabetes. *Diabet Med* **22(10):** 1036–9

Robless P, Mikhailidis DP, Stansby G (2001) Systematic review of antiplatelet therapy for prevention of myocardial infarction, stroke or vascular death in patients with peripheral vascular disease. *Br J Surg* **88(6):** 787–800

Schultz G, Barillo, Mozingo, and Chin, (2004) The Wound Bed Advisory Board Members Wound bed preparation and a brief history of TIME. *Int Wound J* **1:** 19

Shaw JE, Boulton AJM (2001) The diabetic foot. In: Beard JD, Gaines PA, eds. *Vascular and Endovascular Surgery.* 2nd edn. WB Saunders, London: 105–26

Sibbald RG, Williamson D, Orsted HL, Campbell K, Keast D, Krasner D, Sibbald D (2000) Preparing the wound bed – debridement, bacterial balance and moisture balance. *Ostomy Wound Manage* **46:** 14–35

Sibbald GR (2003) Wound diagnosis. Pisa Satellite Symposium — Wound Pain Management: An Interdisciplinary Case-Based Approach. Proceedings from European Wound Management Association (EWMA) Conference, Saturday 24 May 2003, Pisa

Scottish Intercollegiate Guidelines Network (2001) Section 7: Management of diabetic foot disease. In: *Management of Diabetes: A National Clinical Guide*. Scottish Intercollegiate Guidelines Network, Edinburgh (http://www.sign.ac.uk/guidelines/fulltext/55/section7.html) (Last accessed 4 May 2006)

UK Prospective Diabetes Study (UKPDS) Group (1998) *Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes*. UKPDS