Diabetic foot ulcer management in the community

Diabetic foot ulceration can be confusing and frustrating, and there can be difficulty in knowing exactly where to start. This article hopes to delineate the major areas of concern and act as an *aide-memoire*. The management of diabetic foot ulceration remains the domain of the specialist foot care teams, but the non-specialist practitioner can play a key part in early detection of problems and prompt an early referral.

"It is important that patients presenting with diabetic foot ulcers be quickly referred to a specialist service."

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In 2014, the global prevalence of diabetes was estimated to be 9% among adults aged 18 and over (World Health Organization, 2015). One in every seven individuals with diabetes, and perhaps as many as one in every four, is likely to develop a diabetic foot ulcer (DFU) (Setacci et al, 2009) over the course of their lifetime. It is also estimated that amputations are preceded by foot ulcers in 75–85% of cases, usually in association with infection and gangrene (Boulton et al, 2005). Following amputation, mortality increases and ranges from 50% to 68% at 5 years; this is comparable to or worse than rates for some cancers (Armstrong et al, 2007).

The cost of diabetic foot care in 2010/11 was estimated at £580m — almost 0.6% of NHS expenditure in England (Kerr et al, 2014). These figures do not represent the indirect cost to patients; having a foot ulcer also dramatically worsens physical, psychological and social quality of life (Singh et al, 2005).

In order to improve these statistics, it is important that patients presenting with DFUs be quickly referred to a specialist service. An integrated diabetic foot service enables a person with diabetes to access the best care in the right place. The earlier the patient is seen and the less severe the presentation, the better the outcome.

The current NICE guidelines for treating diabetic foot problems are being reviewed and are due to be published later this year. It is currently recommended that patients presenting with a DFU be referred within 24 hours to a multidisciplinary foot care team (MDFT), usually based in an acute setting (NICE, 2004). However, it is anticipated that this may change to incorporate a referral to either the MDFT or a community-based foot protection team (FPT).

The FPT comprises a team of healthcare professionals with specialist expertise in the assessment and management of disease of the foot in diabetes. Members of the FPT will work closely with the MDFT and may be part of it. The FPT should be easily contactable, and details of how to contact the team (e.g. phone number, fax or email address) should be made available to other healthcare professionals in the community (Diabetes UK, 2012). FPTs will normally be based in the community and led by a podiatrist who specialises in diabetes management. The team

should be able to:

- Assess, treat and manage most diabetic foot complications, including DFUs and mild to moderate diabetic foot infections
- Offer biomechanical assessment and offloading
- Give specialist advice on tissue viability, debridement and dressing selection
- Offer ongoing foot care management and health education
- Have clear referral guidelines and pathways to the MDFT.

The MDFT may be based in primary or secondary care and will be led by a named healthcare professional, normally a consultant diabetologist. The MDFT will generally manage diabetic foot problems that cannot be managed by the FPT.

The non-specialist practitioner is key in stratifying a patient's future risk of developing foot ulceration and initiating prompt limb and life-saving referrals. In the community setting, referrals may go to the local FPT in the first instance, unless the patient is systemically unwell. If there is severe infection, the patient should be sent to A&E and a referral initiated to the MDFT.

It should be remembered that prevention is better than cure and all people with diabetes should be screened annually by trained personnel to assess their risks of developing a foot ulcer (Scottish Intercollegiate Guidelines Network

Figure 1. ***Pes cavus foot.***

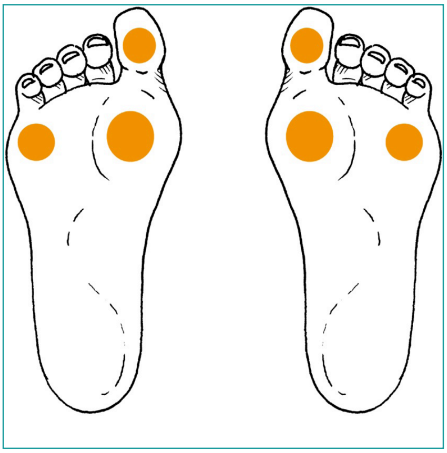

Figure 2. ***Sites that should be tested with a monofilament (Bakker et al, 2012).***

[SIGN], 2010; National Institute for Health and Care Excellence [NICE], 2011). The examination should consist of:

- Testing of foot sensation using a 10-g monofilament to exclude neuropathy
- Palpation of foot pulses to exclude ischaemia (peripheral arterial disease [PAD])
- Inspection of any foot deformity and footwear to identify high pressure areas that may break down
- Thorough visual inspection for signs of ulceration and/or infection.

Neuropathy

Neuropathy can be defined as signs or symptoms of peripheral nerve dysfunction in a patient with diabetes when other causes have been excluded. It usually manifests in three forms: sensory, motor and autonomic (Boulton et al 2008).

Motor neuropathy

Motor neuropathy is damage to the nerves that supply the muscles of the foot. It results in an altered foot structure. Motor neuropathy can cause a pes cavus foot type — this is a high-arched foot with retracted toes (*Figure 1*). In the pes cavus foot, pressure increases on the balls of the feet, and toes will often rub on the uppers of shoes.

Autonomic neuropathy

When the nerves of the autonomic nervous system are affected, this results in decreased sweating, leading to very dry skin. Dry skin can lead to fissures and an increased tendency to ulcerate, as the skin is less resistant to stresses. The autonomic nervous system is also responsible for vasodilation, and this can result in bounding foot pulses that could mask poor circulation. If suspected, refer onwards for a more detailed vascular assessment.

Sensory neuropathy

Sensory neuropathy can be described as a loss of the normal protective sensation of the feet. If a person cannot feel pain, they cannot tell if something is going wrong.

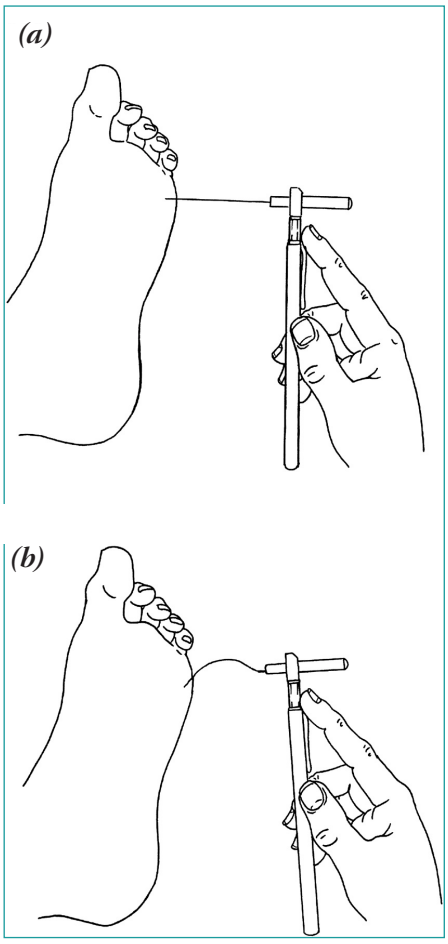

Figure 3. ***Using a monofilament. (a) The monofilament is applied at 90˚ to the site. (b) Sufficient pressure is then applied to cause the filament to bow in the middle (Bakker et al, 2012).***

Testing for sensory neuropathy is straightforward. Neurological assessment should be conducted using a 10-g monofilament or a 128 MHz tuning fork (NICE, 2011). The authors suggest using a 10 g monofilament, as the technique is much easier to standardise than a tuning fork. The International Working Group on the Diabetic Foot (Bakker et al, 2012) suggests three sites are tested on each foot (*Figure 2*):
1. Apex of the hallux
2. First metatarsal head
3. Fifth metatarsal head.

The examination should be carried out in a relaxed and quiet setting, where possible. The patient is asked to feel the sensation of the monofilament bowing on their hand and then asked to close their eyes for the test. The monofilament is applied at 90˚ to the site and sufficient pressure applied to cause the filament to bow in the middle. It is then removed (*Figure 3*). The three sites are tested in order, a minimum of twice, with at least one site being purposely omitted in the process and tested out of sequence in order to ensure the patient is actually feeling the applications.

Sensation is said to be present if the patient correctly identifies two applications at the same site and absent if they fail to identify application of the filament twice at the same site. It may, therefore, be necessary to make a third round of applications. The clinician needs two correct answers or two incorrect answers to make a diagnosis.

Charcot foot

Charcot foot should be suspected if a patient presents with a hot, red, swollen foot, and presence of neuropathy. This is a condition related to neuropathy, not just to diabetes, and it is not fully understood. It is thought that micro-fractures or trauma to the bones heal haphazardly, with altered bone absorption and formation.

Charcot can be devastating because the whole shape of the foot changes to form a 'rocker bottom'. This can lead to increased risk of ulceration, failure to heal and, potentially, amputation. These patients need urgent intervention and usually a non-removable below-knee cast. If Charcot foot is suspected, the patient should not weight-bear and must be referred immediately to the MDFT (NICE, 2011).

Ischaemia

Peripheral arterial disease is often known as poor circulation. It occurs when the arteries supplying the lower limbs become obstructed. The most common cause is atherosclerosis or 'furring up' of the arteries. It is a chronic systemic condition and the main cause of cardiovascular deaths in the UK (Fuster et al, 2010; Smith, 2012).

Overall, 20–40% of people with diabetes also have PAD (NICE, 2012). PAD is a significant independent prognostic marker of morbidity and mortality risk (Diehm et al, 2009). There is an associated 30% risk of death within 5 years and 50% within 10 years, primarily due to myocardial infarction (60%) or stroke (12%) (Tierney et al, 2000). Poor circulation to the feet is devastating when combined with diabetes, and it is, therefore, vital that it be identified as early as possible.

The two main pedal arteries are the posterior tibial artery and the anterior tibial artery. Absence of both pulses is an effective positive predictive tool for detecting PAD (Armstrong et al, 2010).

The anterior tibial artery or dorsalis pedis (the artery's name when it enters the foot) can be located by moving the index, middle and ring fingers up the patient's foot from the gap between the first and second toes until the bony bump of the navicular is reached. The pulse is located slightly lateral to this bump.

The posterior tibial artery can be located by placing the index, middle and ring fingers just behind the medial malleolus (inner ankle bone).

If a patient's pulses are absent or they have signs of claudication (cramp or tightness in their calves every time they walk), then they will need to be referred for a more detailed assessment, including an ankle brachial pressure index measurement.

If PAD is detected, the patient's modifiable cardiovascular risk factors must be addressed. According to NICE (2012), these are:
- Smoking cessation
- Control of hypertension
- Weight management/diet
- Commencement of a statin/lipid modification
- Commencement of an antiplatelet
- Sedentary lifestyle addressed
- Optimisation of diabetes control.

If the patient has gangrene or an unremitting pain in the legs that is worse when the leg is elevated and relieved when the leg is dependent (for example, when hanging it out of bed), then consider urgent referral to a vascular surgeon for investigation of critical limb ischaemia. This is a clinical emergency and referral should be initiated within 24 hours.

Pressure

Altered foot shape (foot deformity) as a result of diabetes can increase areas of high pressure and shear stress. Direct pressure can restrict blood flow to the tissues and result in tissue breakdown. If there is excessive friction, the callused skin tends to remain stationary while the dermal structures move, resulting in internal injury, aseptic necrosis and breakdown.

The main deformities seen are:
- Pes cavus (high-arched foot)
- Retracted, clawed, or hammer toes
- Bunions
- Charcot foot (rocker bottom foot).

Gross deformity and areas of callus should be noted. The feet should be inspected for areas of erythema

(redness) because this is a good indicator of excessive pressure or shear. If pressure areas are found, then referral to a specialist team for offloading should be initiated (NICE, 2012).

It is worth noting that ill-fitting shoes are the most frequent cause of ulceration, even in patients with ischaemic ulcers. Therefore, shoes should be examined meticulously in all patients (Bakker et al, 2012).

Total-contact casting (TCC) is the gold standard in pressure redistribution (NICE, 2004; SIGN, 2010). It ensures compliance because it cannot be removed by the patient. In an uncomplicated unilateral plantar ulcer, TCC can reduce healing time by about 6 weeks (SIGN, 2010). TCC must be applied by fully trained practitioners.

TCC must not be used if ischaemia or infection is present. Removable walkers, Scotchcast® (3M) boots, dressing sandals, crutches and wheelchair are alternative options. A 7–10mm poron liner in a postoperative sandal is the initial minimum recommendation (North West Podiatry Services Diabetes Clinical Effectiveness Group, 2014).

It is important to take into account the patient's preference when selecting a device. Non-removable casts prevent daily inspection, may allow skin to become irritated, may disturb sleep, may make bathing difficult and may keep the patient from working (Armstrong et al, 2004). Removable devices may be more suitable for patients who are less motivated, to help them to sleep more comfortably and wash more easily, although patients may not wear these devices as advised (Armstrong et al, 2004). A study by Armstrong et al (2003) found that patients wore their removable device less than 30% of their total day activity.

Ulceration

DFUs usually results from two or more risk factors occurring together — intrinsic elements (e.g. neuropathy, PAD and foot deformity), accompanied by an external trauma (e.g. poorly fitting footwear) (Bakker et al, 2012; International Best Practice Guidelines, 2013). Most ulcers can be classified as neuropathic, ischaemic, or neuroischaemic, and identifying the cause will aid future management (Bakker et al, 2012).

Table 1. SINBAD Wound Classification system (Ince et al, 2008).

Category	Definition	SINBAD score
Site	Forefoot	0
	Hindfoot	1
Ischaemia	Pedal blood flow intact (at least one pulse palpable)	0
	Clinical evidence of reduced pedal blood flow	1
Neuropathy	Protective sensation intact	0
	Protective sensation lost	1
Bacterial infection	None	0
	Present	1
Area	Ulcer <1 cm^2	0
	Ulcer ≥1 cm^2	1
Depth	Ulcer confined to skin and subcutaneous tissue	0
	Ulcer reaching muscle, tendon or deeper	1
Total possible score		6

If ulceration is found, then a ratified classification tool will aid assessment. The authors recommend the SINBAD classification system (*Table 1*), as advocated by International Best Practice Guidelines (2013) and the North West Podiatry Services Diabetes Clinical Effectiveness Group (2014). Ince et al (2008) compared its use over three continents and found SINBAD to be easy to use and a good predictor of outcome. A score of three or more is associated with poor healing.

However, the SINBAD system does not help the clinician gather information about the appearance of the base of the wound and the exudate (wound fluid). These are two major considerations for management, especially when selecting dressings.

Asking the following questions will enhance the wound assessment:

1. Is the wound exudate a normal consistency and colour?
   Pale yellow or straw-coloured thin exudate is considered normal. The presence of blood in the exudate indicates excess pressure or trauma to blood vessels. Thick yellow, green, brown or grey purulent (containing pus) exudate may indicate the presence of infection (Cutting 2004) (*Table 2*).
2. How much exudate is there?
   Slight, moderate or heavily exuding are the terms used. The more pressure or bacteria, the higher the volume of exudate and the greater the need to manage it.
3. What does the base look like?
   It will normally be one of:
   - Granulating (healthy healing tissue, pink in colour)
   - Over-granulating (dark red in colour). May be proud at wound base, usually as a result of pressure or increased bacterial burden. If increased bacterial load is suspected, a topical or systemic antimicrobial will be required. If due to increased pressure, specialist offloading is required

Table 2. Classification and severity of diabetic foot infection, the Infectious Diseases Society of America (Lipsky et al, 2012).

Uninfected	No systemic or local symptoms or signs of infection
Infected	At least two of the following items are present: - Local swelling or induration - Erythema >0.5 cm around the ulcer - Local tenderness or pain - Local warmth - Purulent discharge (thick, opaque to white or sanguineous secretion). Other causes of an inflammatory response of the skin should be excluded (e.g. trauma, gout, acute Charcot neuro-osteoarthropathy, fracture, thrombosis and venous stasis)
Mild infection	- Infection involving the skin/or subcutaneous tissue only (without involvement of deeper tissues and without systemic signs) - Any erythema present extends <2cm around the wound - No systemic signs or symptoms of infection (see below).
Moderate infection:	- Infection involving structures deeper than skin and subcutaneous tissues (e.g. bone, joint and tendon) - Erythema extending >2 cm from the wound margin - No systemic signs or symptoms of infection (see below).
Severe infection:	Any foot infection with the following signs of a systemic inflammatory response syndrome (SIRS). This response is manifested by two or more of the following conditions: - Temperature >38˚C or <36˚C - Heart rate >90 beats/minute - Respiratory rate >20 breaths/min or $PaCO_2$ <32 mmHg - White blood cell count >12,000 or <4,000 /cu mm, or 10% immature (band) forms.

- Sloughy (yellow-green dead tissue cells adhered to the base). This needs moisture balance, to help it lift off
- Necrotic, either as an eschar or as gangrene (brown-black in colour, can be dry or wet). If necrotic and no ischaemia is present, the aim is to rehydrate and aid autolytic debridement or lifting off. If gangrene is present then the rational is to dry the wound as much as is possible
- Epithelialising (healing fragile tissue, needs protection).

Infection

Infection is a major threat to DFUs. The ability to recognise and diagnose infection at an early stage is crucial to preventing progression of a mild infection to a severe infection, often with necrosis requiring amputation (Edmonds and Foster, 2004). The five signs of infection are erythema (redness), warmth, tissue odema (swelling), pain and purulent discharge (pus). A patient is said to have an infection if two or more of these are present (*Table 2*; Lipsky et al, 2012).

Diabetic foot infections can be classified based on the work of the Infectious Diseases Society of America (*Table 2*; Lipsky et al, 2012). All new diabetic foot infections should be sent for an X-ray (NICE 2011). If the wound probes to bone, this is a good positive predictive indicator that there is osteomyelitis, and treatment should be initiated until proven otherwise (Bakker et al, 2012).

In all instances of infection, patients should be referred to an MDFT. Deep-tissue swabs should be taken with moderate or severe infections; mild infections should be swabbed only if pus is present.

Risk stratification

Once a thorough assessment has been completed, the patient's risk of developing a future ulceration can be ascertained. The authors recommend using Diabetes UK's 2012 'Putting Feet First' traffic light guide (*Figure 4*).

Treatment

Effective care involves a partnership between patients and professionals, and all decision-making should be shared (NICE, 2011). Patients should be encouraged to engage with their treatment and its planning.

Regular, local, sharp debridement using a scalpel or forceps is considered the gold standard (International Best Practice Guidelines, 2013). This should be conducted only by specialists with the appropriate competencies. Sharp debridement can potentially be a radical and invasive procedure, so clinicians must fully explain the risks and benefits to enable the patient to make an informed decision about their treatment (Haycocks and Chadwick, 2008). It is important to understand that debridement is sometimes contraindicated, such as in the ischaemic foot. Gentle mechanical debridement can be achieved by non-specialist clinicians using Debrisoft, a method advocated by NICE (2014).

Dressing selection can be a daunting task, but working within local Trust guidelines and dressing formularies can give structure, parity and confidence in requesting dressings. Dressings should be chosen based on the amount of exudate in the wound base, and whether there is a need for an antimicrobial. There is no panacea, and choice is down to professional reasoning.

Summary

Amputation is not inevitable and if a DFU is managed correctly, it can largely be avoided. DFUs should heal if three aspects are addressed:

1. Pressure is removed or reduced (enact 'first aid' measures and refer to a specialist team).
2. Infection is controlled (both soft tissue and bony infections are best managed by a MDFT).
3. Blood flow is sufficient (i.e. ischaemia managed). If the patient's perfusion is poor, healing is unlikely. Therefore, early identification and referral are paramount for wound healing.

It is not merely sufficient to save the leg. The mortality rates for diabetes and peripheral arterial disease are worse than for some cancers (Armstrong et al, 2007; Norgren et al, 2007; Young et al 2008). It is, therefore, vital that the patient's modifiable cardiovascular risk be addressed.

Management of ulceration in DFU remains the speciality of the FPT and MDFT, but the non-specialist practitioner can play a key part in early detection of problems and prompt an early referral to specialist teams; so clinicians must ensure they know where and how to refer to their FPT/MDFT. WE

Further reading

- Diabetes UK. Putting Feet First campaign. www.diabetes.org.uk/putting-feet-first
- Diabetes UK. *Putting Feet First. Fast Track for a Foot Attack: Reducing Amputations.* http://bit.ly/1QjJhz3
- Diabetes UK, NHS Diabetes. *Putting Feet First: National minimum skills framework.* http://bit.ly/1FOxhCK
- NICE Guidance. www.nice.org.uk/CG10 www.nice.org.uk/CG119

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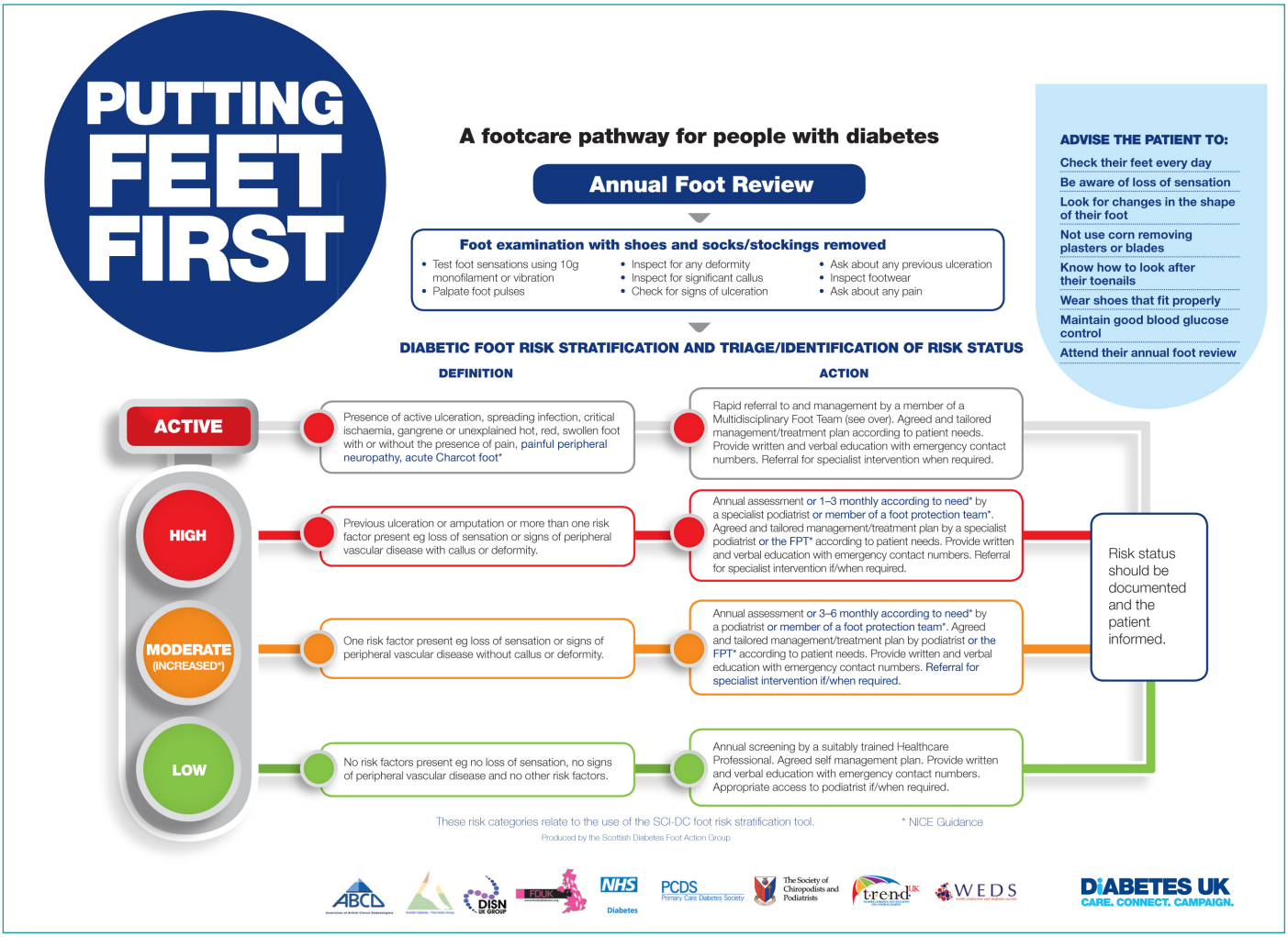

Figure 4. ***Putting Feet First: A footcare pathway for people with diabetes (Diabetes UK, 2012).***

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