INTERNATIONAL CONSENSUS DOCUMENT

# Implementation strategies for the prevention and management of diabetes-related foot disease

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## Contributors

**Prof. Dr. Harikrishna KR Nair (Chair)**, MD, PhD, MSc (WHTR), FRCPI, FRCPE, FCWCS, Professor and Head, Wound Care Unit, Department of Internal Medicine, Kuala Lumpur Hospital, Kuala Lumpur, Malaysia; President, World Union of Wound Healing Societies

**Prof. Dr. Zulfiqarali G Abbas (Co-Chair)**, MBBS, M Med, DTM&H (UK), FRCP (Lond.), FRCP (Glasgow); Abbas Medical Centre, Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania. University of Staffordshire, Stoke-on-Trent, UK

**Dr Salma E Khuraibet**, Diabetic Foot and Wound Surgeon; Head of the Diabetic Foot and Wound Unit, Jaber Al Ahmed Al Sabah Hospital, Kuwait; President-Elect, D-Foot International

**Ms Johlene Sander**, Head of Advanced Wound Care, South African Military Health Service, 2 Military Hospital, Wynberg, Cape Town, South Africa

**Luinio S Tongson**, MD, FPCS, CWSP, MPH, DEd, Head, Diabetic Foot and Wound Healing Center, Chinese General Hospital and Medical Center; Head, Diabetic Foot and Wound Center, Hyperbaric Oxygen Treatment, Capitol Medical Center, Philippines

**Prof. Fran Game**, MB BCh, FRCP, Clinical Director R&D, University Hospitals of Derby and Burton NHS Foundation Trust, Derby, UK

**Dr. Ana Lamza**, General and Vascular Surgeon, Department of Surgery, Clinical Hospital Sveti Duh, Zagreb, Croatia

**Prof. Dr. Ewa Klara Stuermer**, MD, PhD, Head of Comprehensive Wound Centre, Head of Translational Research, Department of Vascular Medicine, University Medical Centre Hamburg-Eppendorf, Hamburg, Germany, European Wound Management Association (EWMA) Council Member

# Foreword

Diabetes-related foot disease remains one of the most severe, costly and life-altering complications of diabetes worldwide. It encompasses a spectrum of interrelated conditions, including peripheral neuropathy, peripheral arterial disease, ulceration, infection and Charcot neuro-osteoarthropathy, that together drive high rates of hospitalisation, disability and premature mortality. Despite advances in clinical knowledge and the availability of evidence-based guidelines, diabetes-related foot disease continues to account for the majority of non-traumatic lower limb amputations globally.

The global burden of diabetes is rising rapidly and unevenly. Current projections indicate a 45% increase in the number of adults living with diabetes worldwide between 2024 and 2050, with the largest relative increases expected in Africa (142%), the Middle East and North Africa (92%), Southeast Asia (73%) and South and Central America (45%). These trends are closely mirrored by rising rates of foot complications, particularly in low- and middle-income countries, where access to screening, specialist care and coordinated treatment remains limited (International Diabetes Federation, 2025).

Even in high-income countries, where multidisciplinary foot services and advanced diagnostics are available, health systems face growing challenges. Rising obesity and earlier onset of diabetes increase risk, while inconsistent access to structured patient education and healthcare professional training limits awareness of the relationship between glycaemic control, neuropathy, vascular disease and limb health. Across settings, the problem is not a lack of evidence, but a failure to implement that evidence consistently and at scale.

In October 2025, a multidisciplinary group of international experts convened in person and online in Kuala Lumpur, Malaysia, to address this persistent implementation gap. The meeting brought together clinicians, researchers and health system leaders from diverse regions to focus on practical, context-sensitive strategies for the prevention and management of diabetes-related foot disease across low-, middle- and high-income settings.

The aim of this document is not to restate existing guidelines, but to support their translation into routine practice. By consolidating expert consensus into practical frameworks, decision tools and implementation strategies, it seeks to help clinicians, health systems and policymakers reduce avoidable foot complications and preventable amputations.

**Prof. Dr. Harikrishna KR Nair (Chair)**
**Prof. Dr. Zulfiqarali G Abbas (Co-Chair)**

# Global burden, epidemiology and pathophysiology of diabetes-related foot disease

Diabetes-related foot disease represents a major and growing global health burden. The rising prevalence of diabetes worldwide is accompanied by a parallel increase in foot complications, including diabetic peripheral neuropathy (DPN), peripheral artery disease (PAD), diabetic foot ulceration (DFU), diabetic foot infection (DFI) and lower limb amputation.

It is estimated that 19–34% of people living with diabetes are at risk of developing a DFU within their lifetime and that approximately 20% of those affected may subsequently require lower extremity amputation. This may include minor amputation (resection through or distal to the ankle), major amputation (resection proximal to the ankle) or both (McDermott et al, 2023; Armstrong et al, 2017; IWGDF, 2023). These outcomes are associated with considerable morbidity, increased healthcare utilisation and long-term disability.

Globally, an estimated 589 million adults aged 20–79 years were living with diabetes in 2024, corresponding to approximately one in nine adults. This number is projected to rise to over 850 million by 2050, or one in eight adults, reflecting a sustained increase in disease burden (International Diabetes Federation, 2025).

The projected increase in diabetes prevalence is unevenly distributed, with the greatest relative growth anticipated in low- and middle-income countries (LMICs), particularly in Africa, the Middle East and North Africa and Southeast Asia [**Table 1**; International Diabetes Federation, 2025]. In these settings, constrained healthcare resources, delayed presentation and limited access to multidisciplinary foot care are expected to amplify the clinical impact of diabetes, resulting in a disproportionate burden of morbidity and mortality over the coming decades (International Diabetes Federation, 2025; Abbas and Nair, 2025).

These epidemiological trends translate into increasing absolute numbers of individuals at risk of DPN, PAD, DFU, DFI and lower limb amputation. Estimates indicate that diabetes-related lower limb amputation occurred approximately every 30 seconds worldwide in 2005 (International Diabetes Federation, 2005), with subsequent analyses suggesting a rise to one amputation every

**Table 1. Projected regional increases in diabetes prevalence by 2050 (International Diabetes Federation, 2025).**

| Region | Adults with diabetes (2024) | Adults with diabetes (2050, projected) | Percentage increase (%) |
|---|---|---|---|
| Africa | 24.6 million | 59.5 million | 142 |
| Middle East and North Africa | 84.7 million | 162.6 million | 92 |
| Southeast Asia | 106.9 million | 184.5 million | 73 |
| South and Central America | 35.4 million | 51.5 million | 45 |
| Western Pacific | 215.4 million | 253.8 million | 18 |
| North America and Caribbean | 56.2 million | 68.1 million | 21 |
| Europe | 65.6 million | 72.4 million | 10 |
| Global | 588.7 million | 852.5 million | 45 |

20 seconds. A substantial proportion of these amputations, estimated to be up to 85%, may be preventable through relatively simple, low-cost interventions supported by basic education and structured foot care programmes (Abbas and Morbach, 2005; Bakker et al, 2006; Pendsey and Abbas, 2007; Abbas and Archibald, 2007a, 2007b; Abbas et al, 2011; Abbas, 2013; 2014; 2015; Baker et al, 2017; Schaper et al, 2024; International Diabetes Federation, 2025).

**Pathophysiology of diabetes-related foot disease**

Diabetes-related foot disease develops through the interaction of neurological, vascular, mechanical and infectious processes. Although clinical presentation varies across individuals and regions, the biological pathways leading to tissue breakdown and ulceration are largely consistent (Schaper et al, 2024).

The condition encompasses a spectrum of foot pathology in people with diabetes, including DPN, PAD, DFU, DFI, CN (Charcot neuroarthropathy), gangrene and lower limb amputation. Ulcer formation typically occurs in individuals with one or more predisposing factors, most commonly DPN and/or PAD combined with a mechanical or external precipitating event.

DPN plays a key role in this process. Sensory neuropathy [**Figure 1a and 1b**] results in loss of protective sensation, reducing the ability to perceive pain, pressure or injury. Motor neuropathy [**Figure 2**] contributes to intrinsic muscle weakness and imbalance, leading to foot deformities and restricted joint mobility. These changes alter normal gait and plantar pressure distribution, producing focal areas of repetitive mechanical overloading. The skin responds by forming callus, which further concentrates pressure. Repetitive loading may result in subcutaneous haemorrhage beneath the callus and subsequent breakdown of the overlying skin, resulting in ulceration (Schaper et al, 2023).

Neuropathy also increases vulnerability to minor trauma from ill-fitting footwear, friction or thermal injury, which may go unnoticed and perpetuated by continued ambulation. Autonomic neuropathy of the foot [**Figure 3**], most commonly caused by diabetes, damages the nerves that control involuntary functions. This leads to severely dry, cracked and inelastic skin. The condition results in reduced sweating (anhidrosis), distended veins, bounding pulses and an increased risk of infection due to skin breakdown.

PAD [**Figure 4**] most commonly due to atherosclerosis, is present in a substantial proportion of individuals with DFU and contributes to impaired tissue perfusion, delayed healing and progression to necrosis, gangrene or amputation. While a small proportion of ulcers in severe PAD are purely ischaemic and painful, most are neuroischaemic. In neuroischaemic ulcers, neuropathy may mask symptoms of arterial insufficiency, even in the presence of advanced disease.

Although diabetes-related microangiopathy can be demonstrated histologically in the foot, available evidence suggests that it is not the primary driver of ulcer formation or impaired wound healing (Schaper et al, 2023).

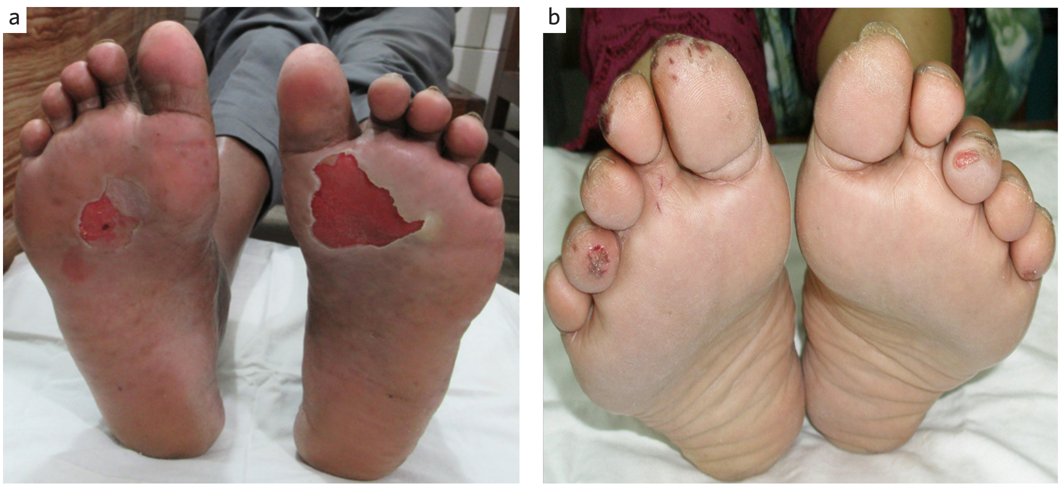


**Figure 1.** (a) Bilateral diabetic peripheral sensory neuropathy with plantar thermal ulcers following exposure to a hot surface. (b) Bilateral diabetic peripheral sensory neuropathy with ulceration secondary to rodent bites. Images courtesy of Prof. Dr. Zulfiqarali G. Abbas.

**Figure 2.** Bilateral diabetic peripheral motor neuropathy demonstrating intrinsic muscle wasting, prominent superficial vasculature and foot deformity. Image courtesy of Prof. Dr. Zulfiqarali G. Abbas.

**Figure 3.** Bilateral diabetic foot autonomic neuropathy demonstrating xerosis, with associated skin cracks and fissures. Image courtesy of Prof. Dr. Zulfiqarali G. Abbas.

**Figure 4.** Peripheral arterial disease affecting the lower extremities. Image courtesy of Prof. Dr. Zulfiqarali G. Abbas.




**Box 1. Pathophysiology of diabetes-related foot disease: at a glance**

Diabetes-related foot disease arises from the interaction of neurological, vascular, mechanical and infectious processes. While clinical presentation varies, the underlying mechanisms are consistent across populations.

**Diabetic peripheral neuropathy (DPN)**
- Loss of protective sensation to pain, pressure and injury
- Motor neuropathy contributes to muscle imbalance, foot deformity and altered gait
- Autonomic neuropathy leads to dry skin and fissuring, increasing susceptibility to breakdown.

**Altered biomechanics and pressure loading**
- Deformity and limited joint mobility result in focal areas of increased plantar pressure
- Repetitive, localised loading promotes callus formation
- Callus further increases local pressure, predisposing to subcutaneous haemorrhage and skin breakdown.

**Peripheral artery disease (PAD)**
- Present in up to half of patients with diabetes-related foot ulcers
- Impairs tissue perfusion and oxygen delivery
- Contributes to delayed healing, tissue necrosis and risk of amputation
- May be clinically silent in the presence of neuropathy.

**Trauma**
- Minor mechanical or thermal injury often precipitates ulceration
- Common sources include ill-fitting footwear, repetitive friction or burns
- Injury frequently goes unrecognised due to sensory loss.

**Infection**
- Skin breakdown allows microbial entry
- Impaired host response and reduced perfusion facilitate infection
- Infection accelerates tissue destruction and increases amputation risk.

**Ulcer phenotypes**
- Neuropathic ulcers: preserved perfusion, sensory loss, pressure-related
- Ischaemic ulcers: reduced perfusion, often painful, less common
- Neuroischaemic ulcers: combined neuropathy and PAD; symptoms may be masked.

**Microangiopathy**
- Commonly observed in diabetes
- Does not appear to be the primary driver of ulcer formation or impaired healing.

# Identifying the person with an at-risk foot

Early identification of individuals at risk of diabetes-related foot disease allows timely intervention and reduces progression to foot ulceration and amputation (Basir et al, 2020; Purwanti et al, 2024). Risk assessment should occur across all levels of care – primary, secondary and tertiary care settings – and should not be limited to specialist services. Identification should be systematic and embedded within routine diabetes care rather than triggered only by symptoms or complications.

Delayed recognition of neuropathy is associated with increased ulcer risk and greater disease severity (Purwanti et al, 2024). Although timely referral following detection improves outcomes and reduces healthcare costs, uncertainty regarding referral thresholds and limited training in foot assessment continue to contribute to delayed escalation of care (Guest et al, 2017; Pankhurst et al, 2018; Musgrove and Bowskill, 2019).

### Assessment across care settings

Identification of the at-risk foot relies on consistent clinical assessment adapted to the care setting. While tools and referral pathways differ across health systems, routine foot examination remains the foundation of risk detection.

**Primary care**

Primary care is often the first point of contact for people with diabetes and, for many, the only setting in which routine foot assessment occurs. As such, it plays a central role in early risk identification.

Recommended core practices include:

- A foot check at every diabetes-related visit, supported by a simple screening protocol
- Use of basic, scalable tools such as monofilaments and tuning forks, with Doppler assessment where available
- Direct inspection and palpation of the foot, even when equipment is limited.

Simple examination can identify changes in temperature, swelling, deformity or loss of sensation. These findings often provide the earliest indication of risk.

**Secondary and tertiary care**

Hospitals and specialist services should support rapid identification and escalation of risk through clear pathways.

Key components include:

- Screening for neuropathy, infection, ischaemia and Charcot-related red flags in emergency and outpatient settings
- Clear fast-track referral pathways to vascular and specialist foot services for abnormal findings
- Multidisciplinary management in tertiary centres, with these services acting as regional referral hubs.

### Physical examination of the foot as a screening tool

Touching and examining the foot remains one of the most effective screening approaches in diabetes care. Direct inspection and palpation [**Figure 5a and b**] provide information that is unable to be inferred from history alone and support early identification of neuropathy, ischaemia, infection and structural change.

Despite this, removal of footwear and systematic examination of both feet are frequently omitted in clinical practice. In a cross-sectional study of nurses working across primary care, hospital and residential care settings, only 36.3% reported performing barefoot foot examinations at every patient visit. Others reported examining feet only when symptoms were present (14.0%) or when risk was perceived during assessment (8.3%), while a small proportion reported never performing barefoot foot examinations (Hidalgo-Ruiz et al, 2023).

A brief, structured bedside assessment can support consistent risk identification across care settings [**Table 2**]. Screening

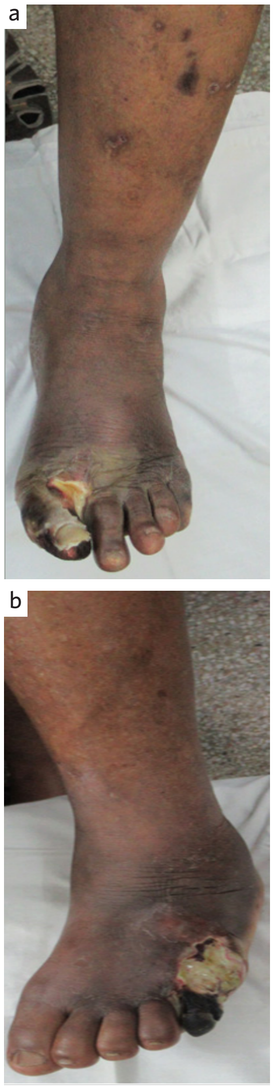


**Figure 5.** (a) The left diabetic foot, in a patient with dark skin, shows no obvious erythema. However, palpation reveals characteristic swelling and increased warmth, which support the diagnosis. The great toe is gangrenous and infected. (b) The fifth toe is gangrenous and infected. Images courtesy of Prof. Dr. Zulfiqarali G. Abbas.

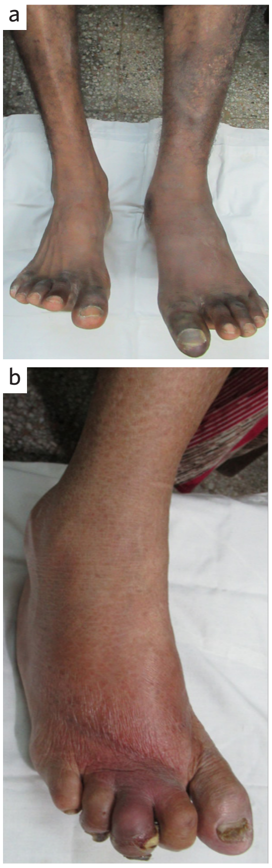


**Figure 6.** (a) The right diabetic foot, with dark skin, shows no visible erythema, but exhibits clinically appreciable swelling and increased warmth. In contrast, the left foot demonstrates intrinsic muscle wasting consistent with an atrophic diabetic foot, without swelling, erythema or increased temperature. (b) The right diabetic foot shows erythema, with an infected ulcer on the third toe. Images courtesy of Prof. Dr. Zulfiqarali G. Abbas.

should always include both feet, even when pathology appears unilateral.

**Skin tone considerations**

Variation in skin tone can influence visual assessment of the foot and may lead to misinterpretation of early pathological changes. In light skin tones, erythema typically appears red or pink, whereas in dark skin tones it may present as subtle or deeper discolouration, including purple, maroon or dark red (Dhoonmoon et al, 2023; Harte and Marshall, 2025; **Figure 6a and 6b**). Similarly, early ischaemic changes in darker skin may manifest as paler or darker areas than baseline or as purple discolouration, rather than the classical blue hues seen in lighter skin (Fletcher et al, 2025).

Clinical assessment should therefore not rely on colour alone. Comparison of both feet, combined with palpation, temperature assessment and evaluation of capillary refill, supports more accurate detection of ischaemia and other abnormalities across diverse populations.

Educational and training materials should reflect this variability by including images across a range of skin tones. Where available, alternative modalities such as thermographic imaging may further assist assessment and reduce the risk of missed or delayed diagnosis.

## Ulcer classification: matching the system to the setting

Ulcer classification supports communication and treatment planning. While no classification system can reliably predict outcomes, their usefulness depends on consistent application and whether they provide information that meaningfully guides management decisions (IWGDF, 2023). No single system is suitable for all settings.

For instance, early systems like the Wagner classification focus exclusively on ulcer depth. In contrast, the University of Texas classification incorporates depth, ischaemia and infection. Their straightforward approaches have facilitated widespread adoption, especially in primary care settings. However, whether considering only depth, or depth alongside ischaemia and infection, these methods overlook important factors such as the area and site of the ulcer (Zhang et al, 2025).

**Table 2. Bedside screening checklist.**

| Item | How to perform | Abnormal › action |
|---|---|---|
| **Remove socks and shoes; expose both feet** | Ensure the patient is seated or lying comfortably | Patient refuses › provide education and document the reason |
| **Visual inspection of both feet** | Look for wounds, discolouration, swelling, callus, deformity and nail changes | Any wound/discolouration › urgent clinical assessment |
| **Temperature and swelling** | Palpate dorsal and plantar surfaces, and compare both feet | Unilateral warmth/swelling › consider Charcot arthropathy or infection › urgent review |
| **Pedal pulses** | Palpate dorsalis pedis and posterior tibial pulses | Absent or weak pulses › obtain Doppler assessment or refer for vascular review |
| **Sensation** | Assess using a 10-g monofilament at plantar sites or a 128-Hz tuning fork (where available) | Loss of protective sensation › follow Grade ≥1 risk pathway |
| **Footwear check** | Inspect footwear for appropriate fit and abnormal wear patterns | Inappropriate footwear › provide education and consider footwear referral |
| **Prior history** | Ask about and document previous foot ulcers or amputations | Previous ulcer or amputation › follow Grade 3 risk pathway |

More comprehensive classification systems incorporate additional clinical domains and are better suited to secondary and tertiary care. An overview of commonly used ulcer classification systems is presented in **Table 3**. Systems such as SINBAD [**Table 4**] and WIfI (Wound, Ischaemia, foot Infection) integrate ischaemia and infection, providing more clinically meaningful stratification and aligning with international guideline recommendations (IWGDF, 2023).

**Table 3. Overview of ulcer classification systems.**

| System | What it captures | Practical use and where it fits best | Implementation notes |
|---|---|---|---|
| Wagner (1981) | Mainly depth | Simple, visual; outpatient use | Limited as it does not capture ischaemia, infection, neuropathy |
| University of Texas | Depth, infection, ischaemia | Specialist/tertiary care | Lacks neuropathy assessment; not recommended as sole tool |
| SINBAD (2003) | Site (forefoot vs. hindfoot), ischaemia, neuropathy, bacterial infection, area, depth | Comprehensive, widely used for audits | Recommended in tertiary and secondary care; allows standardised audits |
| WIfI (Wound, Ischaemia, foot Infection) | Wound, ischaemia, infection | Specialist/ multidisciplinary team | Supports risk-based revascularisation decisions |

**Table 4. Overview of SINBAD classification system. The SINBAD system scores six components of a wound, assigning 0 or 1 point to each.**

| Category | Definition | Score |
|---|---|---|
| Site | Forefoot | 0 |
| | Midfoot or hindfoot | 1 |
| Ischaemia | Pedal blood flow intact (≥1 palpable pulse) | 0 |
| | Clinical evidence of reduced pedal perfusion | 1 |
| Neuropathy | Protective sensation intact | 0 |
| | Loss of protective sensation | 1 |
| Bacterial infection | Absent | 0 |
| | Present | 1 |
| Area | Ulcer <1cm² | 0 |
| | Ulcer ≥1cm² | 1 |
| Depth | Ulcer confined to skin and subcutaneous tissue | 0 |
| | Ulcer reaching muscle, tendon or deeper structures | 1 |
| Total score range | | 0–6 |

**Best Practice Statement:**
Classification should become more detailed as care escalates. Depth is a starting point, not a conclusion.

- Primary care and community settings benefit from simple visual, tactile and manual examination-based systems that prompt referral
- Secondary and tertiary care require multidimensional systems that guide intervention and audit.

### Risk stratification across care levels

Structured risk stratification enables timely review and appropriate escalation of care. Risk categories should align with established international frameworks while remaining practical and feasible to implement across diverse healthcare systems, including in resource-limited centres.

The International Working Group on the Diabetic Foot (IWGDF) risk stratification system is based on clinical history and findings from physical examination [**Table 5**]. Within this framework, individuals classified as moderate or high risk are recommended for referral to podiatrists, foot surgeons or diabetes specialists, depending on national healthcare structures and service availability (IWGDF, 2019).

In addition, people with diabetes who present with any foot pathology, including callus, ingrown or thickened toenails or fungal infection should also be referred for specialist foot assessment to reduce the risk of ulcer development (IWGDF, 2016). In settings where podiatry services are not available, referral to a specialised foot centre or multidisciplinary foot care service is recommended.

Symptoms suggestive of PAD, such as exertional calf pain, as well as clinical signs including absent or diminished foot pulses, warrant referral for non-invasive vascular assessment.

Risk assessment should always include both feet, even when ulceration or amputation has occurred on one side only.

### Patient and caregiver education for foot self-examination

Education on foot self-examination is a key component of diabetes-related foot disease prevention. Both people with diabetes and their caregivers should be provided with clear, practical knowledge that supports early recognition of change and timely reporting to healthcare professionals.

People with diabetes should understand that:

- Diabetes increases the risk of foot complications, even in the absence of symptoms
- Early changes are often subtle and painless
- Regular follow-up and attendance at scheduled appointments are essential to prevention.

Education should actively include caregivers and family members. Partners or household members are often better positioned to notice changes that develop gradually and should be encouraged to report concerns to healthcare professionals as part of a shared "circle of care."

### What patients and caregivers should look for

Foot self-examination should be simple, visual and hands-on, and ideally performed daily. Patients and caregivers should be encouraged to compare both feet and to assess changes relative to the individual's usual appearance and sensation, rather than relying on pain or overt injury. See **Box 2** for practical guidance on daily foot assessment for patients and caregivers.

**Table 5. The International Working Group on the Diabetic Foot (IWGDF, 2019) risk stratification system and recommended foot screening and examination frequency.**

| IWGDF grade | Ulcer risk | Clinical description | Recommended review interval | Notes |
|---|---|---|---|---|
| Grade 0 | Very low | ■ No neuropathy<br>■ No deformity<br>■ No PAD | Once a year | Reinforce lifestyle measures and basic foot care |
| Grade 1 | Low | ■ Neuropathy or deformity | Once every 6–12 months | Early review is essential to prevent late presentation |
| Grade 2 | Moderate | ■ Loss of protective sensation and PAD, or<br>■ Loss of protective sensation and foot deformity, or PAD and foot deformity | Once every 3–6 months | Increase frequency of monitoring and education |

**Box 2. Daily foot assessment: guidance for patients and caregivers.**

**VISUAL INSPECTION** →

Look at the top, sole, sides, heel and between the toes for:

- Breaks in the skin
- Ulceration
- Callus
- Colour changes
- Swelling
- Nail changes
- Loss of hair
- Structural deformity

↓

**TOUCH AND SENSATION** →

Notice areas that feel:

- Numb
- Overly sensitive
- Painful
- Unusually warm or cold

*Remember, temperature can change with the room or weather, so compare both feet and look for other changes too*

↓

**CHECK FROM BASELINE** →

- Ask: "Does this foot look or feel different from before?"
- Any new or unexplained change should be reported, even if it seems minor
- Symptoms such as tingling, burning, reduced sensation or absence of sensation may indicate neuropathy and should prompt clinical review

**Promoting a preventive mindset**

Education should aim to support a proactive patient mindset. Key messages include:

- "I have diabetes, which places me at higher risk of foot problems"
- "Foot complications are not inevitable if I act early"
- "Keeping my appointments and reporting changes early can protect my feet."

Patients should be advised not to self-treat foot problems. Even minor lesions, colour changes or sensory disturbances may indicate early disease and should be assessed by an appropriately trained healthcare professional, including in community or primary care settings.

**Self-examination is for everyone**

Foot self-examination should be promoted as a routine health behaviour, similar to breast or testicular self-examination. It should not be limited to people with existing complications; it is relevant to anyone at risk.

**Best Practice Statement:**

Patient and family education should consistently emphasise the following key principles to support foot health and prevent complications:

- Perform daily foot inspection, noting changes in temperature, swelling, discolouration, deformity, callus, nail condition or hair distribution
- Avoid walking barefoot, both indoors and outdoors
- Wash and dry feet carefully, ensuring thorough drying between toes; avoid prolonged soaking
- Wear well-fitting footwear and prescribed orthoses, where indicated
- Engage actively in care; prevention relies on sustained patient–clinician collaboration
- Report minor changes early rather than waiting for pain, infection or ulceration to develop.

**Clinical pearls**

- Risk stratification should be routine for all people with diabetes. Clear risk categories and review intervals help ensure timely follow-up at every level of care
- Foot self-examination is a core prevention tool. Education should be provided to people with and without diabetes, as foot risk and neuropathy are not limited to those with established disease
- Hands-on examination matters. Clinicians must physically examine the feet. Limited access to equipment should never replace looking at and touching the foot
- Primary care is the front line. Routine screening should be embedded in primary care, with clear and fast referral pathways for abnormal findings
- Education should be visual and culturally appropriate. Simple images and locally adapted materials are essential, particularly in low-literacy settings
- Caregivers and communities are part of the solution. Engaging family members and community networks supports earlier detection, especially in low- and middle-income countries.

# Core principles of ulcer treatment

1 **Restore perfusion** ▶ 2 **Control infection with antimicrobial stewardship in mind** ▶ 3 **Offload pressure** ▶ 4 **Provide local wound care**

Regardless of geography or resource availability, management of diabetes-related foot ulcers follows a consistent clinical sequence: restore perfusion, control infection with antimicrobial stewardship in mind, offload pressure and provide local wound care.

Failure to address any component of this sequence compromises healing and increases the likelihood of ulcer progression and limb loss.

### 1) Restore perfusion

Assessment of vascular status is required in all patients with foot ulcers. Ischaemia should be identified early through clinical examination and, where available, non-invasive vascular assessment. Local wound care alone is insufficient when significant perfusion impairment is present.

Where PAD is identified, timely referral for vascular assessment and consideration of revascularisation should occur, as inadequate or impaired perfusion is associated with delayed healing, tissue loss and increased amputation risk.

Common signs and symptoms of impaired peripheral perfusion include: (Wagner, 2025)

**Objective: (nurse assesses)**

- Weak or absent peripheral pulses
- Cool skin temperature
- Thickened nails
- Skin discolouration: pallor when legs are raised and rubor when dependent
- Loss of hair to legs
- Delayed wound healing.

**Subjective: (patient reports)**

- Altered skin sensations
- Claudication (muscle pain, cramping or fatigue)
- Peripheral pain
- Numbness and tingling.

### 2) Control infection with antimicrobial stewardship in mind

Infection management requires balancing prompt treatment with responsible antimicrobial use. Antibiotics are indicated for clinically infected wounds, particularly when infection is spreading or systemic features are present [**Figure 7**]. They should not be used to prevent infection or for clean, non-infected wounds [**Table 6**] (Abbas et al, 2024).

Antibiotics support wound healing by treating infection, but they do not directly heal wounds, as not all wounds are infected (de Souza et al, 2014). All open wounds contain microorganisms; however, colonisation, the replication of bacteria without tissue invasion or damage, does not warrant antibiotic use. Inappropriate antibiotic use can be harmful, weakening wound tensile strength and interfering with collagen cross-linking (Kanoh and Rubin, 2010).

Given the global burden of antimicrobial resistance, topical antibiotics should be reserved for specific infected wounds and used only by experienced clinicians in clearly defined circumstances (Wolcott, 2015; Tong et al, 2018, International Wound Infection Institute [IWII] 2022; 2025), such as topical metronidazole gel for treating malodour in fungating wounds (Marson et al, 2018). For most local wound infections, topical antiseptics are preferred, as they reduce microbial burden without contributing to antibiotic resistance.

**Figure 7.** A clinically infected wound with cellulitis involving the foot and extending into the leg. Image courtesy of Prof. Dr. Zulfiqarali G. Abbas.

**Best Practice Statement:**
Do not delay vascular assessment while providing local care.

**Best Practice Statement:**
Classification systems that include ischaemia should trigger escalation.

| Table 6. The classification system for defining the presence and severity of an infection of the foot in a person with diabetes[a] | |
|---|---|
| **Clinical classification of infection, definitions** | **IWGDF/IDSA classification** |
| No systemic or local symptoms or signs of infection | 1/Uninfected |
| Infected: At least two of these items are present:<br>■ Local swelling or induration<br>■ Erythema >0.5 but <2cm[b] around the wound<br>■ Local tenderness or pain<br>■ Local increased warmth<br>■ Purulent discharge<br>And, no other cause of an inflammatory response of the skin (e.g. trauma, gout, acute Charcot neuroarthropathy, fracture, thrombosis or venous stasis) | 2/Mild |
| Infection with no systemic manifestations and involving:<br>■ Erythema extending ≥2cm[b] from the wound margin, and/or<br>■ Tissue deeper than skin and subcutaneous tissues (e.g. tendon, muscle, joint and bone)<br>Infection involving bone (osteomyelitis) | 3/Moderate<br><br><br>Add "(O)" |
| Any foot infection with associated systemic manifestations (of the systemic inflammatory response syndrome [SIRS]), as manifested by ≥2 of the following:<br>■ Temperature: >38°C or <36°C<br>■ Heart rate: >90 beats/min<br>■ Respiratory rate: >20 breaths/min, or $PaCO_2$ <4.3kPa (32mmHg)<br>■ White blood cell count >12,000/mm³, or <4,000/mm³, or >10% immature (band) forms<br>Infection involving bone (osteomyelitis) | 4/Severe<br><br><br><br><br>Add "(O)" |

Note: The presence of clinically significant foot ischaemia makes both diagnosis and treatment of infection considerably more difficult

[a] infection refers to any part of the foot, not just of a wound or an ulcer
[b] in any direction, from the rim of the wound
[c] if osteomyelitis is demonstrated in the absence of ≥ 2 signs/symptoms of local or systemic inflammation, classify the foot as either grade 3(O) (if <2 SIRS criteria) or grade 4(O) if ≥ 2 SIRS criteria)

**Antimicrobial resistance and wound care**
The World Health Organization (2019) recognises antimicrobial resistance (AMR), the reduced efficacy of antivirals, antifungals, antibacterials and antiparasitics, as a global health crisis. In wound care, antimicrobial overuse is a significant concern. Lipsky et al (2016) highlighted global studies showing that 80% of antibiotic courses and 20% of all antibiotics are prescribed in community or ambulatory settings. Reducing AMR is therefore a shared responsibility across all healthcare providers [**Box 3**].

**Microbiology as a support tool**
Microbiological sampling should be performed:
- After thorough cleansing with a non-antimicrobial irrigation solution (e.g. saline) and any necessary debridement
- Using deep tissue specimens, such as tissue obtained during debridement, rather than superficial swabs, in order to more accurately identify the infecting organisms (IWGDF, 2023). Punch biopsies may also be used where appropriate; however, these procedures carry inherent risks and should therefore be performed judiciously.

**Box 3. Antibiotics: key clinical considerations.**

- Antibiotics are primarily used to treat established infections, but they may also be used prophylactically in specific situations, such as prior to surgery, to prevent surgical site infections
- Choice, dose and duration should follow national or local guidelines
- Broad-spectrum antibiotics should be avoided whenever possible. Where empirical therapy is required due to clinical severity or diagnostic uncertainty, treatment should be reviewed promptly and narrowed where possible
- Antibiotic use should be informed by local antibiograms whenever available.

| Technique | Feasibility | Notes |
|---|---|---|
| Total contact casting | ■ HIC: feasible<br>■ LMIC: limited | ■ Labour-intensive<br>■ High skill required |
| Custom orthotics | ■ HIC: widespread<br>■ LMIC: limited | ■ Essential for pressure redistribution |
| Boots/removable devices | ■ Both | ■ Effective for acute ulcer management |
| Felt padding | ■ LMIC: practical | ■ Low-cost, redistributes pressure<br>■ Consider using in combination with appropriately fitting footwear |

Table 7. Offloading techniques across care settings.

**Best Practice Statement:** Some cleansing solutions can be warmed to body temperature before use, in accordance with the manufacturer's instructions for use.

**Figure 8.** Charcot neuroarthropathy (CN) without appropriate offloading has led to callus formation. Ongoing mechanical stress prevents epithelialisation of the ulcer. Image courtesy of Prof. Dr. Zulfiqarali G. Abbas.

Where culture and sensitivity testing are unavailable, alternative approaches such as Gram staining may provide useful guidance and have shown reasonable concordance with tissue culture in some settings with limited microbiology resources (Abbas et al, 2012).

Advanced diagnostic tools, such as fluorescence imaging, may support assessment in high-income settings but do not replace clinical judgement and are not widely accessible in LMICs.

### 3) Offload pressure

Pressure redistribution is a key component of ulcer management (IWGDF, 2023). Without adequate offloading, even well-perfused and uninfected ulcers are unlikely to heal. Continued mechanical loading perpetuates tissue injury and delays epithelialisation [**Figure 8**].

Offloading strategies should be:
- Tailored to ulcer location and underlying pathology
- Adapted to patient mobility and tolerance
- Feasible within available resources.

Several techniques are available and selection should balance biomechanical effectiveness with practicality to support adherence and continuity of care [**Table 7**].

Options used across care settings include total contact casting, removable devices, custom orthoses and felt padding. Where specialist expertise and resources permit, total contact casting provides effective pressure redistribution. However, its use may be limited by staff workload, training requirements and material availability. In these situations, removable devices (which can be made non-removable if required), orthotic solutions and felt padding offer practical alternatives. When appropriately monitored, these approaches can be used effectively in both high- and low-resource environments.

The principles of offloading apply across multiple diabetes-related foot conditions, including ulceration and acute CN, where protection from further mechanical stress is required.

### 4) Provide local wound care

Local wound care aims to reduce bioburden, support tissue repair and protect the surrounding skin. Cleansing should be performed following wound bed assessment and repeated after debridement as part of ongoing wound management.

Undetected biofilms, even in the absence of overt infection, represent a significant barrier to healing in chronic wounds. Studies suggest that between 60% and 100% of chronic wounds contain biofilm, with the 'true' prevalence likely approaching 100%, indicating that all chronic wounds may have biofilm on at least part of the wound bed (Bjarnsholt et al, 2017; Malone et al, 2017).

Biofilms consist of microbial communities embedded in a highly immunogenic protective matrix. This matrix, known as extracellular polymeric substance (EPS), is composed of polysaccharides, proteins, metal (calcium, magnesium, iron) ions and extracellular DNA, and can constitute over

80% of the biofilm mass (Flemming et al, 2016). Both the microbes and the EPS that make up the biofilm are major barriers to healing (Percival et al, 2012). Biofilms are highly recalcitrant to antimicrobials because the EPS protect the microbes from the host immune response and conventional antimicrobial treatments, resulting in persistent wounds and an increased risk of systemic infections (Percival et al, 2012).

**Wound cleansing approaches**

A variety of wound cleansing solutions are available, each with different purposes and properties (IWII, 2025). An overview of common approaches is provided in **Table 8**.

**Octenidine in local wound care**

Octenidine is a bipyridine-based antimicrobial and antiseptic agent available in liquid and hydrogel formulations. It has been used for more than 35 years for skin, mucosal and wound antisepsis, as well as microbial decolonisation, across a wide range of inpatient and outpatient clinical settings in Europe, Asia and Australia (Dettenkofer et al, 2010; Vanscheidt et al, 2012; Eisenbeiß et al, 2012; Spencer et al, 2013; Mikić and Stojic, 2015; Gastmeier et al, 2016; Lutz et al, 2016; Jeans et al, 2018; Matiasek and Gmelch, 2018; Pichler et al, 2018; Böhle et al, 2022; Schaumburg et al, 2024; Dhoonmoon et al, 2025).

Its antimicrobial activity is mediated through disruption of microbial cell membranes, leading to rapid cell damage and death, without inducing resistance (Malanovic et al, 2020; 2022, Vejzovic et al, 2022). Octenidine has also demonstrated activity against biofilm formation and established biofilms, particularly when used following debridement (Krasowski et al, 2021; Stuermer et al, 2021; Severing et al, 2022; Dhoonmoon et al, 2025).

**Table 8. Wound cleansing approaches and clinical considerations.**

| Cleansing type | Examples | Key properties | When to use | Limitations |
|---|---|---|---|---|
| Inert solutions | ■ Sterile saline<br>■ Sterile water<br>■ Drinking-quality tap water | ■ Neutral rinsing agents without active chemical ingredients or antimicrobial activity | ■ Cleansing healthy wounds without visible contamination; cleansing surrounding skin | ■ Do not loosen debris or remove non-viable tissue; no antimicrobial activity; generally not suitable for heavily contaminated or infected wounds |
| Antiseptics | ■ Acetic acid<br>■ Aluminium acetate<br>■ Povidone-iodine (PVP-I)<br>■ Polyhexamethylene biguanide (PHMB)<br>■ Octenidine dihydrochloride (OCT) | ■ Antimicrobial solutions active against bacteria, fungi, viruses and protozoa | ■ Prevention and management of wound infection and biofilm, particularly when combined with debridement and antimicrobial dressings (IWII, 2025) | ■ Routine use not required for clean wounds without infection risk; appropriate use is important for antimicrobial stewardship |
| Surfactant solutions | ■ Betaine | ■ Reduce surface tension, allowing solutions to spread across the wound and loosen debris (Bellingeri et al, 2016; Percival et al, 2018) | ■ Useful for removing dirt, dead tissue and debris from the wound bed | ■ Limited direct antimicrobial activity unless combined with antiseptics |
| Combination solutions | ■ Octenidine dihydrochloride (OCT) combinations<br>■ Polyhexamethylene biguanide (PHMB)<br>■ Hypochlorous acid (HOCl) | ■ Combine surfactants and antimicrobials for both cleansing and antimicrobial protection | ■ Particularly useful for wounds with high infection risk or suspected biofilm, such as diabetes-related foot ulcers | ■ Selection should consider wound status and clinical context |

Octenidine is a broad-spectrum antimicrobial active against a wide range of clinically relevant Gram-positive and Gram-negative bacteria, as well as fungi, including multidrug-resistant organisms commonly encountered in chronic wounds [see **Table 9**] (Alvarez-Marin et al, 2017; Ponnachan et al, 2019; Spettel et al, 2022; Dhoonmoon et al, 2025).

When used selectively and in alignment with antimicrobial stewardship principles, octenidine may support local infection control in diabetes-related foot ulcers, particularly before and after debridement or in wounds with high bioburden or suspected biofilm.

**Table 9. Bacterial and fungal species susceptible to octenidine dihydrochloride (OCT; Alvarez-Marin et al, 2017; Ponnachan et al, 2019; Spettel et al, 2022; Dhoonmoon et al, 2025).**

| Category | Example species |
|---|---|
| **Gram-positive bacteria** | ■ *Staphylococcus aureus* (including mupirocin-resistant *S. aureus*)<br>■ *Enterococcus spp.* (including vancomycin-resistant *enterococci*) |
| **Gram-negative bacteria** | ■ *Escherichia coli*<br>■ *Pseudomonas aeruginosa*<br>■ *Acinetobacter baumannii*<br>■ *Klebsiella pneumoniae* |

**Clinical integration across settings**
Management strategies should be adapted to the level of care [**Table 10**]. Primary care and outpatient settings may initiate simple assessment and early management, while inpatient and tertiary services should apply comprehensive classification, vascular assessment and multidisciplinary treatment.

**Table 10. Context-specific considerations for the management of ulcers.**

| Setting | Wound cleansing | Antibiotics | Notes |
|---|---|---|---|
| LMIC | ■ Clean water<br>■ Low-cost antiseptics | ■ Avoid broad-spectrum antibiotics where possible<br>■ Empirical therapy may be required for severe or spreading infection and should be reviewed and de-escalated when feasible | ■ Culture facilities may be limited<br>■ Avoid prophylactic antibiotic use |
| HIC | ■ Evidence-based antiseptics<br>■ No topical antibiotics for clean wounds | ■ Targeted therapy based on culture and susceptibility results | ■ Routine tissue culture is recommended<br>■ Fluorescence imaging may be used as an adjunct, if available<br>■ Clinicians should be aware of the most likely local pathogens. In the UK, mild-to-moderate infections are usually caused by Gram-positive cocci (*staphylococci* and *streptococci*) |
| All | Debride before culture | Avoid unnecessary antibiotics | ■ Educate clinicians on the polymicrobial nature of DFUs |

# Implementation strategies for people with an at-risk foot in low- and high-income settings

**Best Practice Statement:** Routine, systematic foot examination should be a core component of diabetes care across all healthcare settings and levels of the health system.

Disparities exist between LMICs and high-income countries (HICs) in access to care, timeliness of intervention and clinical outcomes for diabetes-related foot disease.

In many LMICs, large segments of the population live in rural or remote areas, often far from specialist services. Common structural and system-level barriers include limited access to podiatry and multidisciplinary foot services, shortages of trained vascular specialists and restricted availability of diagnostic tools for PAD.
In contrast, HICs generally have greater access to specialist services and advanced diagnostics, yet continue to face challenges related to implementation and coordination of care. These challenges include increased severity of diabetes-related complications at younger ages and lifestyle-driven disease progression. Despite differences in healthcare structures, delays in referral to specialist foot care teams appear to be a common theme (Manu et al, 2018) and assessment pathways are often fragmented, with insufficient integration of vascular, neurological and wound assessments. Across all income settings, delayed identification and intervention remain major contributors to preventable morbidity and limb loss.

### From evidence to practice: the implementation gap

Preventive strategies for diabetes-related foot disease are well described in international guidelines (IWGDF, 2023; International Diabetes Federation, 2025). However, outcomes are largely determined by whether these strategies are applied consistently in routine care. Across both LMICs and HICs, failures in implementation, rather than lack of evidence, remain a major driver of preventable ulceration and amputation.

Successful implementation requires coordinated action across multiple levels, including the health system, the healthcare workforce, patients, caregivers and the wider community.

To translate evidence into practice, several key implementation principles should guide diabetes-related foot care across settings [**Figure 9**].

**Implementation principle 1: early identification should be routine**
Identification of foot risk should be embedded within routine diabetes care rather than triggered only by symptoms or complications. Regular foot screening, performed alongside structured risk stratification, supports timely review and escalation of care. Screening and risk assessment should be conducted together using simple, reproducible approaches applicable across care settings.
Fast-track referral pathways are a key component of early identification. Clear referral criteria and defined timelines for specialist review reduce delays once abnormalities are detected. Delayed referral


**Figure 9.** Implementation principles for improving prevention and management of diabetes-related foot disease.

continues to contribute to poor outcomes in both LMICs and HICs, despite differences in resource availability.

**Implementation principle 2: systems must support action**

Prevention is most effective when foot care is integrated into existing healthcare systems rather than delivered as a standalone activity. Integration across primary care, diabetes services, endocrinology, dermatology, emergency departments and surgical teams improves continuity, accountability and follow-through.

System-level enablers include clearly defined referral pathways, delineated roles and responsibilities across services and routine data collection to monitor outcomes and guide resource allocation.
While HICs generally have greater resources, fragmented care pathways remain common. In LMICs, limited resources amplify the impact of system inefficiencies, making coordination particularly important.

**Implementation principle 3: workforce capacity determines reach**

The effectiveness of preventive strategies depends on workforce capacity. Healthcare professionals should be equipped to perform foot assessments, provide patient education and make appropriate referral decisions.

In many LMICs, nurses form the backbone of healthcare delivery and play a central role in screening and education. Where available, podiatrists, diabetes specialists and community health workers further strengthen care models. Training programmes should be practical, culturally appropriate and aligned with the local scope of practice, rather than relying on highly specialised skills that are not widely available.

Evidence suggests that gaps in training remain a significant barrier to implementation. In a cross-sectional study, 66% of nurses reported having no formal training in diabetic foot care, 80.9% did not provide education to patients with diabetic foot problems and 77.5% did not routinely perform foot examinations in people with diabetes (Kaya and Karaca, 2018). These findings highlight the need to increase general awareness of DFU, alongside targeted workforce development to support consistent screening, patient education and early intervention.

Multidisciplinary team-based care has been associated with reduced rates of foot ulceration and amputation, lower healthcare costs and improved quality of life among people at risk of diabetes-related foot disease (Aydin et al, 2010; Aalaa et al, 2012). Diabetic foot care teams commonly include general practitioners, nurses, diabetes educators, podiatrists, orthotists, vascular surgeons, infectious disease specialists, dermatologists, endocrinologists, dietitians and orthopaedic surgeons (Abbott et al, 2002; Clarke and Tsubane, 2008; Yazdanpanah et al, 2015). While all team members contribute to patient education, nurses and podiatrists are often the primary sources of ongoing information and support for patients (Aalaa et al, 2012).

**Implementation principle 4: patients are active partners**

Patient engagement is central to prevention. Strategies work best when patients understand their risk, feel confident to care for their feet and are supported to attend follow-up appointments. Dressing changes provide a practical opportunity to teach patients about foot care, helping them manage their condition effectively.

Education should focus on practical skills, including basic daily foot care, appropriate footwear, blood glucose monitoring and early reporting of change. Messages should be repeated over time and reinforced across multiple encounters. Education delivered in shared or public clinical spaces, such as waiting areas, may increase reach and normalise preventive behaviours.
Mindset change is often required. Patients should be supported to move from passive acceptance of complications to an understanding that early action can reduce risk.

**Implementation principle 5: prevention extends beyond the clinic**

Community-based approaches play an important role, particularly in LMICs. Mobile clinics, outreach caravans and outreach services can reduce access barriers by bringing screening, education and referral directly into communities and villages. These models support engagement with individuals who may not otherwise access formal healthcare services.

Caregiver involvement further strengthens prevention. Family members are often well placed to notice changes and support early reporting, particularly for individuals with vision impairment, mobility limitations or neuropathy.

Responsibility for prevention is shared across stakeholders. Local multidisciplinary teams deliver care, health systems provide structure and coordination, and national and international organisations support prevention through policy development, guideline production and advocacy. Diabetes-related foot disease prevention should be approached as a shared public health responsibility rather than the remit of any single profession or organisation.

**Implementation principle 6: delivery methods must match context**

Educational content should be delivered in ways that fit the local context. In HICs, digital tools such as mobile apps, e-learning modules and social media can help provide consistent education at scale. In LMICs, materials may need to be translated into local languages and include visual aids to address language and literacy barriers. Face-to-face contact with healthcare professionals remains an important part of education and should be used during wound care sessions whenever possible.

No single delivery method is sufficient. Combining clinical encounters, community outreach and visual messaging improves reach, reinforcement and retention of key preventive messages [**Box 4**].

**Box 4. The four important prevention messages.**

Across all settings, effective prevention depends on a small number of consistent messages being delivered repeatedly. While delivery methods may vary, the content of prevention messaging should remain stable and recognisable to patients, caregivers and healthcare professionals. These messages form the foundation of diabetes-related foot disease prevention.

1. **Daily basic foot care matters**

People with diabetes should be taught simple, practical foot care from the outset. This includes daily washing, careful drying (particularly between the toes), appropriate nail care and use of moisturisers to prevent skin breakdown. These basic actions reduce risk and should not be reserved for those with established complications.

2. **Footwear is part of treatment, not an afterthought**

Appropriate footwear is an important part of preventing trauma and pressure-related injury. Open shoes or flip-flops provide limited protection and may increase risk in some situations. Footwear advice should be personalised, taking into account orthoses or protective shoes where needed. Patients should be clearly informed that walking barefoot or in socks can be harmful. Cultural and environmental factors should also be considered when making recommendations.

3. **Monitoring and professional review cannot be separated**

Self-care does not replace professional care. Patients should be reminded to monitor blood glucose levels, attend regular reviews and report changes early. Poor glycaemic control is common globally and remains a major contributor to complications, particularly in resource-limited settings.

4. **Prevention requires collaboration**

Consistent prevention messaging is most effective when delivered collaboratively. Primary care, endocrinology, diabetes services, dermatology, nursing, podiatry (where available) and community health workers should reinforce the same messages. Alignment with national and international organisations (e.g. diabetes associations, public health agencies) supports consistency and reach.

# Active Charcot Neuro-Osteoarthropathy (CN)

Active Charcot neuro-osteoarthropathy (CN) [**Figure 10**] should be considered in any person with diabetes and peripheral neuropathy who presents with a red, warm and swollen foot, particularly in the absence of pain. CN is a sterile inflammatory process affecting bone, joints and surrounding soft tissues in the insensate foot. Without timely recognition and management, ongoing inflammation and mechanical loading may result in progressive fractures, joint dislocation and irreversible deformity.

### Diagnosis of Charcot foot

Diagnosis is primarily clinical, based on signs of inflammation after exclusion of alternative causes such as infection, gout or deep vein thrombosis. Imaging supports diagnosis and staging. **Figure 11** shows the recommended diagnostic and management pathway for suspected or confirmed CN.

Plain radiographs may be normal in early disease; magnetic resonance imaging (MRI) is therefore recommended where available. If MRI is not feasible, computed tomography or radionuclide imaging may be used. In settings where advanced imaging is unavailable, individuals with compatible clinical presentation should be managed as having probable active CN.

### Surgical management of CN

#### Overview and primary goal

The primary objective of surgery in CN is limb salvage. In this context, limb salvage refers to achieving a stable, plantigrade and ulcer-free foot that can accommodate therapeutic footwear or bracing (Wukich and Kavarthapu, 2023).

Surgical intervention is not necessarily aimed at restoring normal anatomy, but rather at creating a durable foot architecture that permits safe mobilisation, reduces the risk of recurrent ulceration and helps preserve patient independence (Khan et al, 2023).

This distinction is important when counselling patients and guiding referral pathways. The goals of surgery in CN differ substantially from those of elective reconstructive procedures, where restoration of anatomical alignment may be the primary objective. In Charcot reconstruction, functional stability and ulcer prevention typically take priority over anatomical correction. **Table 11** summarises the key differences between limb salvage surgery and anatomical reconstruction in this context.

#### Indications for surgical intervention

Surgical referral should be considered when optimal non-operative management is unsuccessful or no longer feasible (Rhon and Tucker, 2022).

Common indications include:

- Unbraceable deformity preventing effective offloading or ambulation
- Recurrent or non-healing ulceration despite appropriate wound care and offloading
- Unstable deformity or joint dislocation that compromises mobility or limb integrity
- Progressive deformity placing the patient at high risk for skin breakdown or infection (Khan et al, 2023).

#### Surgical strategy

Surgical approaches for CN vary in complexity. The choice of procedure depends on the:

- Stage of disease
- Severity and chronicity of deformity
- Patient's comorbidities
- Local surgical expertise (Hurst and Shin, 2025).

#### Early or acute phase

Surgical intervention is uncommon in the acute phase and is usually limited and targeted. Procedures aim to reduce focal pressure or stabilise specific joints. Examples include exostectomy to remove bony prominences causing pressure and targeted arthrodesis in selected cases (Schade and Andersen, 2015).

#### Chronic or established deformity

In patients with longstanding deformity,

**Figure 10.** Charcot neuro-osteoarthropathy (CN) of the foot. Image courtesy of Prof. Dr. Zulfiqarali G. Abbas.

surgery may be required to restore a plantigrade foot and improve stability.

Procedures range from moderate corrective interventions to complex reconstructions and may involve internal fixation, external fixation (e.g. circular frames) and multilevel reconstruction. These procedures are typically performed in specialist centres (Khan et al, 2023).

### Offloading and immobilisation in active CN

Offloading was consistently identified by the expert panel as the main therapeutic intervention for acute CN. Some clinicians favour the term "joint rest," reflecting the primary aim of limiting destructive mechanical forces acting on destabilised joints, while others prefer "offloading" to maintain consistency with ulcer management terminology. The panel agreed that, regardless of terminology, the principle is the same: the affected foot should be immobilised and protected to prevent future damage, while supporting the patient's overall mobility and daily function as much as possible.

Management should begin as soon as CN is suspected and should not be delayed while awaiting definitive imaging. Early protection of the foot is critical to promote remission and limit structural collapse, with imaging and specialist review arranged as capacity allows.

In high-income settings, first-line management typically involves a non-removable, knee-high offloading device, most commonly a total contact cast (TCC). However, its use may be constrained by labour intensity, staff training requirements, material availability and time. As a result, removable knee-high devices that can be secured or rendered functionally non-removable are widely used alternatives.
In low-resource settings, clinicians may rely on pragmatic measures such as wheelchairs, crutches or prolonged bed rest. While suboptimal, these approaches are preferable to continued ambulation, which accelerates joint destruction and deformity. Below-ankle offloading devices are not recommended for active CN.

**Table 11. Goals of surgery: limb salvage vs anatomical reconstruction (Steinberg et al, 2023; Ha et al, 2020).**

| Limb salvage surgery | Anatomical reconstruction |
|---|---|
| Stable, plantigrade foot | Restoration of normal anatomy |
| Focus on ulcer prevention | Focus on alignment and form |
| Compatible with bracing or therapeutic footwear | May require prolonged non-weight-bearing |
| Prioritises function and durability | Prioritises structural correction |
| Appropriate for high-risk patients | Selected cases in specialist centres |

Offloading and immobilisation should continue until clinical remission is achieved, defined by resolution of local inflammation and radiographic consolidation where fractures are present. This process frequently requires several months. Given the risks associated with prolonged immobilisation, including ulceration, muscle atrophy and overload of the contralateral limb, patients should be followed closely.

### Monitoring and post-remission care

Following remission, individuals should transition to custom footwear and/or orthoses designed to accommodate residual deformity and optimise plantar pressure distribution. Where joint instability or significant deformity persists, below-knee customised devices may be required. Ambulation and loading should be reintroduced gradually, with prompt reassessment if signs of recurrence occur.
At present, no pharmacological therapy has been shown to shorten disease duration or prevent deformity in active CNO, and such interventions are not recommended. Vitamin D and calcium supplementation should be provided in accordance with local guidelines for individuals at risk of deficiency.

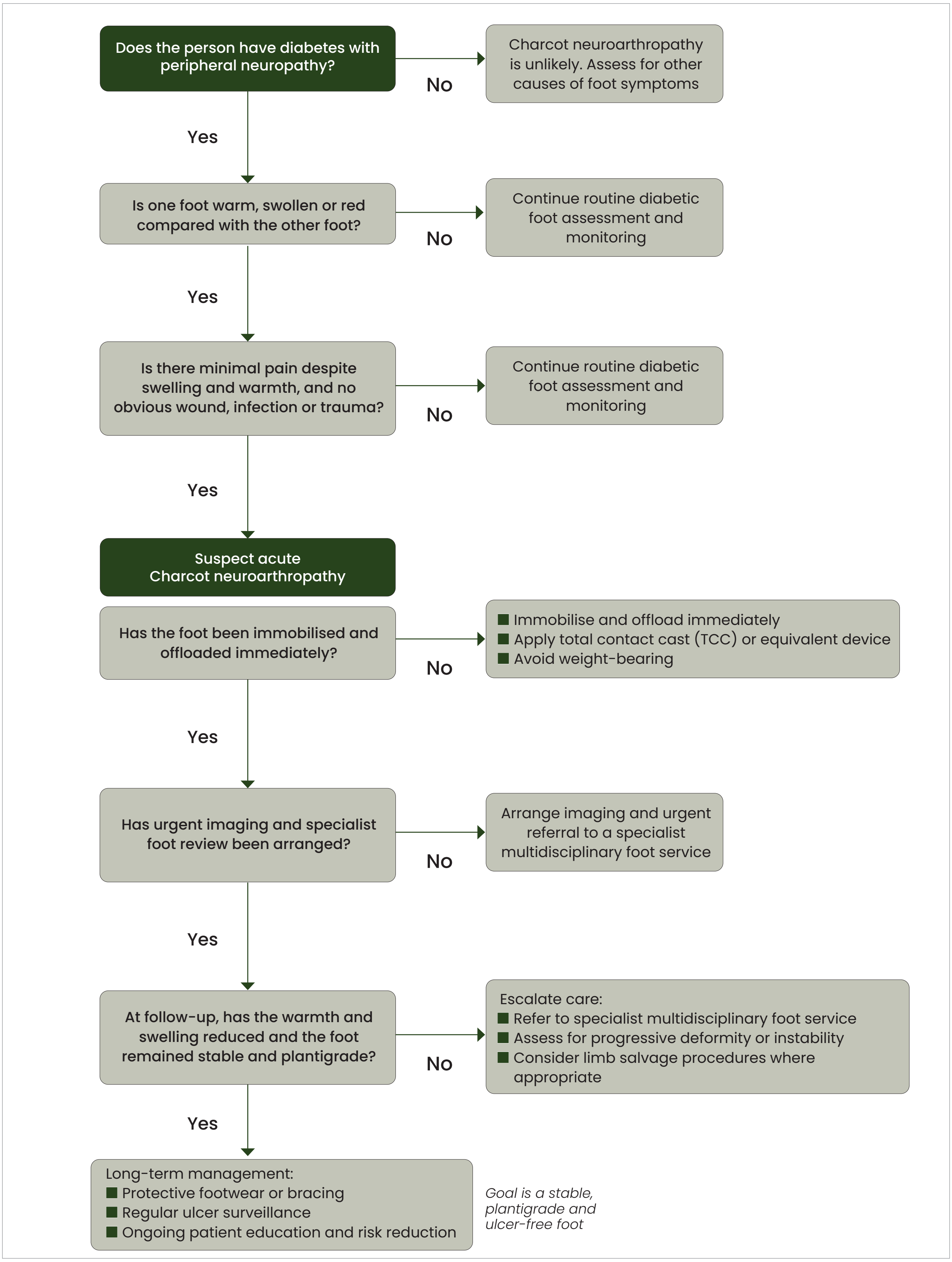


**Figure 11.** Clinical pathway for suspected or confirmed Charcot neuroarthropathy.

# Conclusion

Diabetes-related foot disease remains a major and growing cause of preventable morbidity, disability and health system burden worldwide. Despite well-established evidence on prevention, assessment and treatment, outcomes continue to be shaped less by the availability of guidelines than by how consistently they are implemented in daily practice. This document highlights that the pathways to foot ulceration, infection, acute CN and amputation are largely shared across regions, while the barriers to effective care differ by context, resources and system design.

Early identification of risk, routine foot examination and structured risk stratification are foundational interventions across all care settings. These measures require minimal technology yet remain inconsistently applied. Embedding screening into routine diabetes care, supported by clear referral pathways and defined escalation timelines, is central to reducing delayed presentation and avoidable progression.

The management of established disease depends on coordinated, multidisciplinary care guided by severity, vascular status and infection risk. Ulcer classification systems should be selected pragmatically to support action rather than documentation alone. Restoration of perfusion, infection control aligned with antimicrobial stewardship, pressure offloading and local wound care remain the core components of treatment, regardless of geography. In acute CN, early recognition and immediate immobilisation of the foot are critical to preventing irreversible deformity.

Implementation success is strongly influenced by system design and workforce capacity. Fragmented pathways, limited training and unclear roles undermine prevention in both high- and low-income settings. Nurses, podiatrists and community health workers play a central role in screening, education and early intervention, particularly where specialist access is limited. Training should be practical, context-specific and aligned with the local scope of practice. There is no need to set aside any extra time or space for this; it can be incorporated into the routine local therapy.

Patient and caregiver engagement is integral to prevention. Education should emphasise early recognition of change, routine self-examination and timely reporting, supported by culturally appropriate and accessible materials. Community-based approaches and outreach models extend reach beyond formal healthcare settings and are particularly important in underserved populations.

Responsibility for prevention is shared. Clinicians, health systems, policymakers and international organisations all contribute to reducing avoidable ulceration and amputation through coordinated action. Translating evidence into practice requires sustained commitment to system integration, workforce development and patient partnership.

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