WHITE PAPER

Diabetic Foot

Solsius

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Preamble

This white paper is not intended to replace scientific references, official recommendations or specialist publications relating to the diabetic foot. These sources are indispensable pillars and remain the foundation of all evidence-based medical care.

Our approach takes a complementary perspective. The objective is to provide a structured synthesis of essential knowledge, with an emphasis on prevention, monitoring and awareness. The aim is to offer practical insights, while respecting the standards established by the scientific and medical community.

In this sense, this document should be seen not as an exhaustive reference, but as a tool for reflection and dissemination of best practice, designed to foster a better understanding and better management of the diabetic foot and its complications.

Introduction

The diabetic foot is one of the most feared complications of diabetes. Silent in its early stages, it can rapidly progress to serious, sometimes irreversible lesions, leading to loss of mobility, prolonged hospitalisations and, in the most severe cases, amputation. Yet this dramatic outcome is not inevitable.

The majority of ulcers and serious complications can be avoided through active, structured and patient-specific prevention. This prevention is based on an understanding of the mechanisms involved, recognition of warning signs, and the adoption of simple but regular practices.

This white paper has been written to support both diabetic patients and healthcare professionals in this preventive approach. Its aim is twofold:

- To provide clear and precise information on risks, early symptoms and monitoring methods.
- To promote prevention and patient therapeutic education for better knowledge and management of possible complications.
- To propose concrete solutions, validated by clinical practice, to durably protect foot health.

One of the most promising recent advances in this field is the integration of temperature sensors directly into smart insoles or connected shoes. These devices continuously measure plantar thermal variations and can signal inflammation before it becomes visible to the naked eye. Coupled with a mobile application or remote monitoring system, this technology enables rapid alerting of the patient and their medical team, significantly reducing the time between the onset of a problem and its management.

By adopting the advice and recommendations in this guide, and by making use of modern tools such as connected thermal monitoring, each patient can become an active participant in their own prevention. In the case of the diabetic foot, prevention through daily monitoring using new technologies is the best insurance against complications.

Chapter 1: Understanding the Risks

Effective prevention of the diabetic foot is based first and foremost on a clear understanding of the specific risks to which people with diabetes are exposed. These risks are neither anecdotal nor rare: on the contrary, they are well documented, frequent and often preventable. This chapter aims to explain the pathophysiological mechanisms that make the foot more vulnerable in diabetic patients.

1.1 Pathophysiology of diabetes and foot involvement

Diabetes, whether type 1 or type 2, progressively damages blood vessels and nerves. This phenomenon particularly affects the extremities, especially the feet. Three major interconnected complications explain the increased vulnerability of the foot in diabetic patients: neuropathy, arteriopathy and immune disorders [1,2,3].

Chronic hyperglycaemia leads to an accumulation of metabolic waste products (such as advanced glycation end products) that deteriorate nerve tissue and vessel walls. This leads to a progressive weakening of sensory perception, poor regulation of temperature and perspiration, and a reduced capacity for healing [1,2,3].

1.2 Peripheral neuropathy

Neuropathy is one of the most important risk factors in the development of diabetic foot lesions. It manifests in several forms [1,3]:

- Sensory neuropathy: partial or total loss of sensitivity to pain, temperature and pressure. The patient does not feel injuries, heat or foreign bodies in their shoes.
- Motor neuropathy: weakening of the small muscles of the foot, leading to deformities (claw toes, collapse of the plantar arch), which alter the distribution of pressures and promote friction points.
- Autonomic neuropathy: impairment of perspiration regulation and skin vascularisation. This causes skin dryness, cracks, and reduces the natural capacity for healing.

The combination of these three forms of neuropathy creates a high-risk context for the formation of painless but progressive wounds.

1.3 Peripheral arterial disease of the lower limbs (PAD)

PAD is a condition of the leg arteries, often silent. In diabetic patients, it is frequently distal (affecting the small arteries below the knee) and symmetrical. It reduces blood supply to plantar tissues, which has two major consequences [1,2,3]:

- Local hypoxia (oxygen deficiency), which prevents proper healing.
- A reduction in local immune defences, making the area more vulnerable to infections.

PAD can go unnoticed, particularly in cases of concurrent neuropathy. The patient does not feel the typical pain of intermittent claudication (pain during walking). This makes diagnosis more difficult, but its impact is major on the prognosis of wounds [1,2,3].

1.4 Infection risks

The diabetic foot is particularly susceptible to infections. A simple wound, even superficial, can rapidly progress to a deep infection, due to several factors [1,2]:

- Impaired immune response (linked to diabetes).
- Frequent presence of polymicrobial flora, often resistant.
- Humid or enclosed environment (shoes, socks), conducive to microbial growth.
- Delayed consultation, often related to the absence of pain.

An untreated infection can lead to osteitis (bone infection), requiring heavy treatments or even partial or total amputation of the foot. Prevention therefore relies on daily vigilance, rapid treatment of lesions, and rigorous medical follow-up [1,2].

By understanding these mechanisms, the patient and their carers can better anticipate at-risk situations, adjust behaviours, and implement targeted prevention measures. The following chapter will address warning signs that should never be ignored.

Sources

[1] The International Working Group on the Diabetic Foot. IWGDF guidelines on the prevention and management of diabetes-related foot disease (2023 update). IWGDF; 2023.

[2] French Health Insurance (Ameli). Complications of diabetes affecting the feet. 2025.

[3] Société Francophone du Diabète (SFD). Diabetic Foot Reference Guide 2024.

Chapter 2: Warning Signs

Early detection of warning signs of the diabetic foot is a crucial step in preventing progression to serious complications. These signals, often subtle at first, can easily be overlooked by the patient, particularly in cases of neuropathy. Yet their prompt recognition enables effective and preventive management [1,2,3,4].

2.1 Loss of sensitivity

Loss of sensitivity (or hypoaesthesia) is one of the first symptoms of peripheral neuropathy. The patient may no longer feel pain, heat, cold or even certain injuries. This functional anaesthesia makes the foot vulnerable to repeated trauma and progressive wounds, often not immediately detected [1,2,3,4].

2.2 Appearance of wounds, blisters or cracks

The presence of any skin lesion, however minor, must be considered a warning sign. Blisters, cracks, scratches or poorly healing wounds can rapidly become infected, especially in cases of poor circulation or chronic hyperglycaemia. Daily vigilance is essential [1,2,3,4,5].

2.3 Discolouration, redness, abnormal warmth

An area of the foot showing abnormal colouration (persistent redness, unusual pallor, bluish tint) or localised warmth may indicate a developing inflammatory or infectious process. These signs should prompt immediate consultation [1,2,3,4,5].

2.4 Foot deformities

The progressive or sudden appearance of deformities (claw toes, collapse of the plantar arch, hallux valgus, etc.) alters the distribution of plantar pressures. These changes increase the risk of hyperpressure zones, promoting the appearance of ulcers. Any deformity must be assessed by a professional [1,2,3,4].

2.5 Ingrown toenails and fungal infections

Ingrown toenails can cause painful microtraumas or become infected if not properly treated. Fungal infections, common in diabetic patients, weaken the interdigital skin and facilitate the entry of bacterial infections. Their rapid treatment is essential to prevent complications [1,2,3,4,5].

Recognising these warning signs makes it possible to trigger an early response. Daily foot inspection, self-monitoring, and regular visits to healthcare professionals are the essential pillars of active and lasting prevention.

Sources

[1] IWGDF. IWGDF Guidelines on the prevention and management of diabetes-related foot disease. 2023.

[2] French Diabetes Society (SFD). Best practice guidelines. 2015.

[3] IWGDF. Guidelines 2019.

[4] French Health Insurance (Ameli). Monitoring diabetic feet. 2025.

Chapter 3: Daily Hygiene

Daily foot hygiene is a simple but essential measure in preventing the diabetic foot. It limits infectious risks, enables early identification of warning signs, and maintains skin integrity. In the context of diabetes, where skin is more fragile and healing is slowed, a rigorous routine is indispensable [1,2,3].

3.1 Foot washing: frequency, temperature and suitable products

Daily washing is recommended, preferably in the evening, to remove impurities, perspiration residue and infectious agents. It should be carried out with warm water (between 32°C and 37°C), never hot, as diabetic patients may not be able to perceive the actual temperature and risk burns [1,5].

The use of a mild, pH-neutral soap is recommended. Overly harsh or antiseptic soaps can damage the skin's natural hydrolipidic film and worsen skin dryness.

3.2 Thorough drying, especially between the toes

After washing, drying must be thorough, patting gently without rubbing. Particular attention must be paid to the interdigital spaces: residual moisture promotes maceration and the proliferation of fungi, which can lead to fungal infections [1].

The use of a hair dryer is not recommended, as heat can cause burns if sensitivity is impaired. A clean, soft towel is sufficient.

3.3 Daily skin moisturisation

The skin of the diabetic foot is often dry, thin and prone to cracking. Daily moisturisation strengthens the skin barrier and prevents fissures, which are potential entry points for infections [1,2].

Specific foot moisturising creams, without fragrance or alcohol, are recommended. It is essential not to apply cream between the toes, to avoid maceration. A small amount applied to the top of the foot, the sole and the heels is sufficient [1,2].

3.4 Daily visual inspection

Each day, the patient must inspect all of their feet, including the sole and areas difficult to see such as the spaces between the toes. In cases of reduced mobility or visual problems, a long-handled mirror or the help of a relative can facilitate this examination.

Signs to look for include: wounds or ulcers, redness or irritation, blisters, cuts, cracks, corns, calluses, hard skin, fissures, fungal infections, ingrown or discoloured nails, or any deformity of the foot. This inspection enables early detection of anomalies and action before they worsen [2,3].

3.5 Nail care and precautions

Nails should be cut regularly, in a straight line (never rounded), with a soft file to avoid sharp edges. Cuticles should never be torn and ingrown nails should never be removed at home [2,4].

If in doubt or if difficulties arise, consultation with a podiatrist is recommended, especially if deformities or a history of wounds are present [2,4].

Rigorous, simple and adapted hygiene is a fundamental pillar of diabetic foot prevention. It not only protects the skin but also helps to quickly identify warning signs. This routine, when well integrated into daily life, is an essential act of therapeutic autonomy that can prevent severe complications and preserve the patient's quality of life.

Sources

[1] IWGDF guidelines 2023.
[2] French Health Authority (HAS). Podological treatment of the diabetic patient's foot. 2020.
[3] French Health Insurance (Ameli). Monitoring diabetic feet. 2025.
[4] HAS. Podiatrist: an essential role in patient education. 2020.
[5] HAS. Care pathway for the adult patient with type 2 diabetes. 2023.

Chapter 4: The Role of Footwear

The choice of shoes plays a central role in preventing diabetic foot lesions. Inappropriate footwear is one of the primary risk factors for injuries, ulcerations and, ultimately, amputations. Conversely, appropriate footwear reduces plantar pressures, protects fragile skin and ensures daily functional comfort [1,2].

4.1 Characteristics of appropriate footwear

A good shoe for a diabetic patient must meet several strict criteria [1,2,3]:

- Appropriate size: the shoe must neither compress the foot nor leave it floating. It must provide sufficient space at the forefoot, including in cases of deformity (hallux valgus, claw toes, etc.).
- No internal seams: poorly positioned internal seams can create friction or pressure points responsible for blisters or irritation.
- Rigid and stable sole: a semi-rigid sole limits microtraumas while ensuring a good foot roll. The outer sole must be non-slip to prevent falls.
- Solid heel counter: good support at the back of the foot prevents extraneous movements, stabilises the ankle and limits the risk of friction.
- Breathable material: the material should allow good ventilation to limit moisture and maceration.

4.2 The importance of socks

Socks play a complementary role to footwear. They should be chosen with equal care [1]:

- Seamless, to avoid friction.
- Made of cotton or natural fibres, which absorb perspiration well.
- Without tight elastic, which can impede circulation or mark the skin.
- Changed daily, or even twice a day in cases of excessive perspiration.

4.3 Orthopaedic or custom-made shoes

In cases of foot deformity, a history of ulceration or significant loss of sensitivity, standard footwear may no longer be sufficient. It is then recommended to use [1,2,3]:

- Custom-made orthopaedic insoles, designed to distribute pressure and protect at-risk areas.

- Therapeutic off-the-shelf (CHTS) or custom-made (CHUP) shoes, prescribed by a healthcare professional and sometimes reimbursed by the national health insurance.

A podiatrist or orthopaedist can adapt footwear according to the specific features of the foot, in collaboration with the general practitioner or diabetologist.

4.4 Practical day-to-day advice

For appropriate footwear, the patient should [1,2]:

- Try on shoes at the end of the day, when the feet are slightly swollen, to ensure they remain comfortable.
- Inspect the inside of shoes before putting them on (presence of pebbles, folds, objects, etc.).
- Avoid wearing new shoes for a full day: wear them gradually.
- Alternate pairs daily to allow airing.
- Never walk barefoot, even indoors: domestic injuries are common.

Inappropriate footwear can turn a simple chafe into an ulcer that is difficult to heal. Conversely, rigorously chosen and well-maintained footwear constitutes an effective protective barrier against diabetic foot lesions. The role of shoes is not limited to comfort: it is a prevention device in its own right, often underestimated but essential.

Sources

[1] HAS. Podological treatment of the diabetic patient's foot. 2020.

[2] IWGDF guidelines 2023.

[3] SFD. Diabetic Foot Reference Guide 2024.

Chapter 5: Medical Monitoring

Regular medical monitoring is a central pillar in preventing complications of the diabetic foot. Even in the absence of symptoms, patients must benefit from structured, multidisciplinary and personalised follow-up. A proactive approach enables early detection of neurological, vascular or cutaneous changes and prevents progression to serious lesions [1,2,3,4].

5.1 Regular visits to the podiatrist

In diabetic patients, consultation with a podiatrist is recommended at least once a year, and more frequently if the foot is considered at risk (history of ulcer, neuropathy, arteriopathy, deformity, etc.) according to the podological grade [3]. This monitoring enables:

- Assessment of podological risk according to HAS recommendations (level 0 to 3), also known as the 'grade'.
- Thorough clinical examination of the foot (skin, nails, posture, footwear).
- Active prevention (chiropody care, advice, footwear adaptation).

For patients recognised with a Long-Term Condition (ALD) for diabetes, these consultations can be covered 100% upon medical prescription [3,4].

5.2 Peripheral sensitivity assessment

Loss of sensitivity is one of the earliest markers of the at-risk foot. It is assessed through various simple and reproducible tests performed during consultation:

- 10g monofilament test (Semmes-Weinstein): used to identify anaesthetised zones.
- Tuning fork test (128 Hz): measures vibration sensitivity.
- Osteotendinous reflexes: assessment of Achilles reflexes.
- Thermal perception test (less common in routine practice).

These tests allow the detection of peripheral neuropathy, which is often silent, and adjustment of monitoring accordingly [1,2,3,5].

5.3 Vascular assessment of the lower limbs

Diabetes is a major factor in peripheral arterial disease of the lower limbs (PAD). Regular monitoring of arterial perfusion is therefore essential [1,2]:

- Palpation of peripheral pulses (dorsalis pedis and posterior tibial).

- Measurement of the ankle-brachial index (ABI): compares pressure at the ankle and the arm.
- Arterial Doppler (if doubt or absence of manually perceived pulse).

A vascular deficit must be addressed rapidly to avoid critical ischaemia or poor wound healing.

5.4 Strict glycaemic monitoring

Metabolic control remains a fundamental foundation for preventing complications. Poorly controlled blood sugar promotes neuropathy, impairs healing, weakens immunity and aggravates the risk of infection.

Monitoring includes:

- Quarterly HbA1c to evaluate overall balance.
- Regular self-blood glucose monitoring, especially in cases of insulin treatment.
- Adjustment of antidiabetic treatments in liaison with the general practitioner or diabetologist.

Good glycaemic control significantly reduces the risk of podological complications [1].

5.5 Coordination among healthcare professionals

Management of the diabetic foot relies on a multidisciplinary approach. Depending on the level of risk and the patient's situation, several professionals may be involved:

- General practitioner: pivot of monitoring and referral.
- Diabetologist: treatment adjustment and coordination of metabolic monitoring.
- Podiatrist: preventive care, footwear adaptation, monitoring.
- Nurse: education, dressings, home follow-up.
- Vascular surgeon or orthopaedist: in case of complications.

This coordination enables comprehensive, coherent and responsive management, and thus helps to reduce the number of lower limb amputations caused by diabetes [1,2,3,5].

Regular, structured and multidisciplinary medical monitoring can considerably reduce the risk of serious complications of the diabetic foot. By combining early screening, therapeutic education and metabolic monitoring, it is possible to avoid the majority of ulcers and amputations. The patient remains at the centre of this process, supported by a trained and vigilant team of professionals.

Sources

[1] IWGDF guidelines 2023.
[2] IWGDF guidelines 2019.
[3] HAS. Podological condition & diabetes: multi-professional follow-up. 2020.
[4] French Health Insurance (Ameli). Diabetes: preventing foot complications. 2025.
[5] HAS. Podological treatment of the diabetic patient's foot. 2020.

Chapter 6: In Case of a Lesion

Despite good prevention, a lesion may appear. In this case, the speed and rigour of management are essential to prevent worsening, deep infections or amputation. A wound should never be underestimated, even if it seems superficial or painless.

6.1 Never treat a wound yourself

One of the most dangerous reflexes is to try to disinfect and dress a foot injury yourself. In diabetic patients, pain perception is often impaired, which can mask the real severity of a wound.

Even a small lesion can become infected rapidly or worsen in the absence of appropriate care. It is therefore crucial to:

- Not apply aggressive products (alcohol, eosin, excessive Betadine, etc.).
- Not cut away dead skin yourself.
- Not ignore a wound that does not heal within 48 hours.

The only correct course of action: consult a healthcare professional immediately.

6.2 Medical consultation without delay

The occurrence of any foot anomaly must lead to a prompt consultation. The following situations require immediate medical advice [1]:

- Fever, chills or shivering.
- Wound or skin lesion.
- Suspicious redness, warm area or swelling.
- Appearance or worsening of pain.
- Unpleasant odour from the wound.
- Discharge from the wound (blood, pus, clear fluid).
- Signs of arteritis worsening lesions: cold feet, absence of dorsalis pedis and posterior tibial pulses, violaceous macules.
- Change in colour: appearance of cyanotic, violaceous or necrotic areas.

In the presence of any of these signs, consult without delay: general practitioner or nurse for initial assessment, referring diabetologist, or hospital department (diabetology or emergency) if the lesion is serious, infected or associated with fever. A delay in consultation is one of the main factors in complications. It is better to consult for a false alarm than too late.

6.3 Care protocol for ulcers

Once the lesion is identified, an appropriate care protocol is implemented. It includes several essential steps:

- Gentle wound debridement (removal of dead tissue).
- Appropriate disinfection, without damaging healthy skin.
- Specific dressings (foam dressings, alginates, silver-based dressings, etc.).
- Offloading: completely relieving the injured area (with orthopaedic insoles, boots, offloading casts, etc.).
- Regular follow-up (ideally 1 to 2 times per week).

In cases of infectious signs, antibiotic therapy may be prescribed. Hospitalisation is sometimes necessary if there is a risk of deep tissue involvement.

6.4 Infection warning signs to watch for

Once the wound has healed, preventive work must resume with even greater rigour. A foot that has already had an ulcer is considered to be at very high risk, and requires [2]:

- Closer podiatric consultations.
- Custom-made or therapeutic footwear.
- Enhanced daily inspection by the patient or a third party.
- Sometimes, long-term offloading insoles.

6.5 Preparing follow-up after healing

Follow-up helps prevent recurrence, which is common if preventive measures are relaxed.

In the event of a lesion, the watchword is responsiveness. The earlier management is initiated, the greater the chances of recovery without complications. The patient should never hesitate to consult at the slightest doubt. This chapter serves as a reminder that prevention does not stop when a wound appears: it continues during and after healing, with the help of healthcare professionals and available preventive tools such as connected insoles that provide thermal monitoring of your feet.

Sources

[1] HAS. Podological treatment of the diabetic patient's foot. 2020.

[2] SFD. Best practice guidelines. 2015.

Chapter 7: Patient Therapeutic Education

Therapeutic education and access to reliable resources play a key role in the prevention of the diabetic foot. It is not enough to give instructions: patients must be equipped, trained to recognise risks, and enabled to become active participants in their own health. Good information, clear and repeated, enables good reflexes to become established over time [1,2].

7.1 Patient therapeutic education (PTE) programmes

Patient Therapeutic Education (PTE) programmes are overseen by Regional Health Agencies (ARS) and offered in many hospitals, health centres or care networks.

They enable patients to:

- Understand their illness (diabetes, its complications).
- Acquire practical skills: foot inspection, wound management, shoe choice, etc.
- Identify warning signs not to be overlooked.
- Share experiences with other patients in a safe environment.

These programmes are often free, accessible on prescription, and run by trained professionals (nurses, podiatrists, doctors, dietitians, etc.).

7.2 Useful resources: brochures, videos, infographics

Many educational resources exist to support patients:

- Illustrated brochures: often available in medical practices or on the websites of health authorities (HAS, French Health Insurance).
- Explanatory videos: demonstrating correct hygiene practices, mistakes to avoid, or how to use equipment (mirror, dressing, thermal sensor, etc.).
- Infographics: useful for visually highlighting key points (to display in a bathroom, for example).
- Interactive quizzes: to test knowledge and reinforce memorisation.

Some resources are specifically designed for non-French-speaking patients or those with disabilities.

7.3 Mobile applications and digital tools

Digitalisation has led to the emergence of mobile monitoring and prevention tools. Some applications are specially designed for diabetic patients, with adapted features:

- Glycaemic monitoring: recording of readings, personalised alerts, history.
- Care reminders: daily alert for foot inspection, hygiene care, or appointments.
- Foot photo diary: to monitor the development of a suspicious area.
- Connection with caregivers: possibility of sharing data or photos with their podiatrist or doctor.

7.4 Patient associations and support networks

Joining a diabetic patient association provides moral support, the opportunity to share concrete experiences and to stay informed. These organisations offer:

- Practical workshops.
- Conferences with healthcare professionals.
- Moderated online forums or groups.

Among the most active associations: French Diabetes Federation (FFD), French-speaking Diabetes Society (SFD), National Centre for Precision Diabetes Medicine, French Union for Foot Health (UFSP).

These networks play an essential role in combating isolation and maintaining daily motivation.

Access to clear, validated and adapted information enables the diabetic patient to become an autonomous and informed participant in preventing podological complications. Education is not limited to occasional discourse: it must be ongoing, based on concrete tools, and adapted to each individual profile. By mobilising available resources, patients can genuinely prevent ulcers, preserve their mobility and improve their quality of life.

Sources

[1] SFD. Best practice guidelines. 2015.

[2] HAS. Podological treatment of the diabetic patient's foot. 2020.

Chapter 8: Enhanced Prevention Protocols

In some diabetic patients, the risk of foot complications is particularly high. In these situations, standard monitoring, while necessary, is not sufficient. An enhanced prevention protocol must be implemented, designed to anticipate problems, act earlier and prevent minor lesions from developing into serious ulcers or amputations. This chapter details the key steps in this approach, which is based on careful observation, rigorous organisation and active patient involvement.

8.1 Identifying high-risk patients

The first step is to determine which patients need enhanced monitoring. The criteria are well established:

- People who have already had an ulcer or who have undergone partial or total foot amputation.
- Patients in whom the monofilament test shows a loss of protective sensitivity.
- Those with peripheral arterial disease confirmed by clinical examination or Doppler.
- Patients with significant foot deformities, such as claw toes or hallux valgus, causing hyperpressure zones.
- People who have recently recovered from a wound, as the risk of recurrence is particularly high in the year that follows.

8.2 Increased frequency of consultations

In high podological risk diabetic patients, it is essential to increase the frequency of podiatric consultations to prevent the appearance of serious lesions.

According to the IWGDF, the recommended consultation frequencies, corresponding to foot lesion screening actions to be performed, are as follows [1]:

- Grade 0: a screening consultation is recommended every year.
- Grade 1 (low risk – PSP or AP*): a screening consultation is recommended every 6 to 12 months.
- Grade 2 (moderate risk – PSP + AP, or PSP + foot deformity, or AP + foot deformity): a screening consultation every 3 to 6 months is necessary.
- Grade 3 (high risk – PSP or AP associated with one or more aggravating factors): follow-up should be close, with a screening consultation every 1 to 3 months.

**PSP: Loss of Protective Sensitivity; AP: Peripheral Arteriopathy.*

At each visit, the professional carefully examines the skin, looks for areas of redness, swelling or hyperkeratosis, assesses the condition of the nails and checks the suitability of shoes and insoles. Vascular risk and sensitivity must also be regularly reassessed.

In France, there are different prevention packages covered by the French Health Insurance according to the grade [2]:

- For patients with grade 0 or 1 podological risk: a grading assessment is covered once a year.
- For grade 2 patients: an annual package of 5 preventive care sessions is provided.
- For grade 3 patients: 8 annual sessions if a foot wound is in the process of healing; 6 annual sessions if no wound is present.

8.3 Daily monitoring by the patient

The patient plays a central role in the success of the enhanced protocol. Each day, they should [1]:

- Inspect their feet in their entirety, including the sole and the spaces between the toes, using a mirror or the help of a relative if necessary.
- Look for any redness, blister, crack, unusually warm or cold zone.
- Use a portable device to compare the temperature of both feet. A difference of more than 2.2°C can signal early inflammation.

This self-monitoring must become a daily reflex, just like brushing teeth, and any suspicious change must be reported immediately.

8.4 Adaptation of footwear and orthoses

The choice of shoes and insoles is a key element. In an enhanced protocol [3]:

- Shoes must often be custom orthopaedic, with sufficient space for the toes, no troublesome internal seams, and a stable outer sole.
- Insoles must be thermoformed to uniformly distribute pressure and reduce at-risk zones.
- Any sign of wear or deformation should lead to rapid replacement, as damaged equipment loses its protective effectiveness.

Regular checks by a podiatrist ensure that the devices are still appropriate.

8.5 Enhanced education

Enhanced prevention involves training the patient and their entourage in the correct practices [3]:

- Knowing how to recognise the first warning signs (persistent redness, localised warmth, blister).
- Mastering appropriate daily hygiene techniques: gentle washing, thorough drying, controlled moisturisation (not between the toes).
- Avoiding risky behaviours, such as walking barefoot, using hot water bottles or directly heating the feet.

These reminders must be renewed regularly to prevent lapses or negligence.

8.6 Post-ulcer prevention

After an ulcer has healed, the foot remains vulnerable. The first six months are particularly critical, with a high risk of recurrence. During this period:

- Medical follow-up should be monthly.
- Offloading devices must be worn strictly, even if the foot appears healed.
- Daily monitoring must be even more attentive, possibly with the help of connected tools to continuously measure pressure and temperature.

8.7 Multidisciplinary coordination

The enhanced protocol must rely on a coordinated care team [3]:

- The general practitioner supervises overall management.
- The diabetologist ensures optimal glycaemic control.
- The podiatrist provides technical monitoring of the feet and footwear.
- The nurse can intervene at home for monitoring and local care if needed.

Smooth communication between these professionals allows rapid action in the event of an alert.

Enhanced prevention of the diabetic foot is based on heightened vigilance, daily patient involvement, and close collaboration between healthcare professionals. Applied consistently, it significantly reduces the number of new wounds and prevents amputations that could be avoided. In practice, it transforms care into a proactive strategy, where every small sign is taken seriously and treated before it becomes an emergency.

Sources

[1] IWGDF guidelines 2023.

[2] French Health Insurance (Ameli). Monitoring diabetic feet. 2025.

[3] HAS. Podological treatment of the diabetic patient's foot. 2020.

Chapter 9: Thermal Monitoring of the Diabetic Foot

9.1 Introduction to thermal monitoring

Thermal monitoring of the diabetic foot is an emerging preventive strategy aimed at early detection of areas at risk of ulceration by measuring skin temperature variations. This approach is based on a well-documented clinical observation: a localised increase in temperature can precede the formation of a visible lesion by several days.

It therefore constitutes an early warning tool, making it possible to implement corrective measures before the appearance of visible complications. The objective is to prevent ulcerations by acting at the very first signs of tissue inflammation.

The development of this method is linked to the limitations of conventional approaches (visual inspection, podiatric care, appropriate footwear). These techniques are essential, but do not detect internal microtraumas or early inflammation. Thermal monitoring adds a physiological dimension, directly measuring metabolic or vascular dysregulation.

With the arrival of embedded sensors, smart insoles, the Internet of Things (IoT) and other connected tools, thermal monitoring is becoming accessible in an outpatient setting, at the patient's home. Its non-invasive character, ease of use and potential for self-monitoring make it a major advance in personalised prevention of the diabetic foot.

9.2 Pathophysiology of skin temperature in the diabetic foot

In diabetic patients, several pathophysiological mechanisms contribute to modifying the thermal regulation of the foot. Peripheral neuropathy, in particular the autonomic component, impairs local vasomotor control, which affects the normal distribution of surface heat. This dysregulation makes it difficult to subjectively detect at-risk areas and promotes the appearance of painless but progressive lesions.

In cases of repeated plantar hyperpressure, mechanical irritation or microtraumas, an inflammatory reaction is triggered. This inflammation induces local vasodilation with increased blood flow, responsible for a discrete but significant rise in skin temperature. This rise can precede the visible lesion by 1 to 2 weeks, making it a reliable early indicator.

The thermal gradient between symmetrical areas of both feet is often used as a reference: a difference greater than 2.2°C is generally considered a clinical alert threshold. However, this value must be interpreted taking into account the individual context (physical activity, vascularisation, ambient temperature).

9.3 Methods for measuring plantar temperature

Measurement of plantar temperature is a central element of thermal monitoring of the diabetic foot. Several methods exist, each with their advantages, technical constraints and specific indications. The main approaches can be classified into two broad categories: manual point devices and continuous monitoring devices.

Non-contact infrared thermometers are the most widely used tools in outpatient settings. They allow rapid measurement of the skin temperature of different areas of the foot. The user, often the patient themselves or a carer, measures temperature at key points such as the metatarsal heads, the heel and the hallux. These measurements should ideally be taken at a fixed time, in a stable environment, and compared to symmetrical areas of the other foot. A difference of more than 2.2°C between two corresponding sites is considered clinically significant [1,2].

Other devices, such as liquid crystal thermal plates, allow rapid assessment by direct application of the foot to a heat-reactive surface. These systems offer immediate visual representation but lack quantitative precision.

Infrared thermographic cameras allow detailed thermal mapping of the foot. They are used in specialist centres and hospital departments. However, their cost and bulk limit their use at home. They are useful for monitoring high-risk patients or in the context of clinical trials.

The most recent technologies include sensors embedded in connected insoles or socks. These devices measure temperature continuously or semi-continuously, at multiple plantar points. The data is then transmitted to a mobile application or remote monitoring platform. These systems enable early detection of anomalies, even in the absence of symptoms, and encourage the patient's active involvement in managing their risk of ulceration.

9.4 Modern thermosurveillance technologies

Technological evolution has profoundly changed the thermal monitoring tools available to diabetic patients. Modern devices aim to make monitoring more accessible, more continuous and more intelligent, while facilitating the integration of data into the care pathway.

Among the notable innovations are smart insoles, equipped with multipoint sensors enabling real-time monitoring of plantar temperature or pressure. These insoles are

connected to mobile applications that alert the patient or healthcare professionals in the event of an anomaly. This type of device is particularly indicated for high-risk patients or those with a history of plantar ulcer.

Thermosensitive socks are another emerging solution. Designed using technical textiles incorporating microsensors, they allow extended wear whilst recording temperature at regular intervals. Some versions include geolocation functions or physical activity detection to contextualise thermal data.

Finally, the integration of artificial intelligence today allows the collected data to be processed to identify risk profiles, detect abnormal trends or suggest targeted interventions. These algorithms can be trained from patient history and adjusted according to individual variables. The aim is to provide personalised, predictive and preventive monitoring.

9.5 Role of thermal monitoring in ulcer prevention

The prevention of diabetic foot ulcers relies on the early identification of risk factors, the limitation of excessive plantar pressures and the rapid detection of warning signs of inflammation. Thermal monitoring, as a non-invasive tool, plays a central role in this strategy.

Several clinical studies have demonstrated that regular monitoring of plantar temperature, combined with self-management measures, reduces the incidence of foot ulcers in high-risk diabetic patients. A local rise in temperature is often the first sign of tissue stress, preceding the visible appearance of a lesion. A simple thermal alert then enables rapid intervention: reduction of physical activity, rest, footwear adaptation or early medical consultation.

In practice, patients equipped with thermal monitoring devices such as smart insoles with sensors can monitor several key foot areas daily. In the event of an anomaly, they are invited to modify their behaviours and/or alert their care team. This approach therefore relies as much on technology as on patient therapeutic education.

Thermal monitoring is particularly useful for patients with a history of ulcers, severe neuropathy or significant plantar deformity. In these cases, the natural warning mechanisms (pain, discomfort) are absent or ineffective. Thermal monitoring then acts as a substitute alarm, objectifying an invisible risk that visual examination alone cannot reveal.

Integrated into an overall care pathway, thermal monitoring complements podiatric interventions, orthopaedic footwear, and preventive care. It allows a proactive rather than reactive approach, reducing complications, hospitalisations and the costs associated with managing the diabetic foot.

9.6 Clinical protocols integrating thermography

For thermal monitoring to be effective in preventing ulcers, it must be part of standardised, reproducible clinical protocols that can be integrated into the diabetic patient's daily care pathway.

One of the best-documented protocols consists of daily measurements, at a fixed time, at specific points on the foot, generally 6 areas per foot: hallux, heads of the 1st, 3rd and 5th metatarsals, the lateral border and the heel. These measurements must be compared to symmetrical areas of the other foot. If a temperature differential ≥ 2.2°C persists for two consecutive days, an alert is triggered.

In this protocol, the patient is recommended to:

- Reduce walking activities for 5 to 7 days.
- Carry out a daily visual inspection.
- Consult a specialist healthcare professional if the elevated temperature persists or if clinical signs appear.

Specialist centres can integrate these measurements into a monthly or bimonthly clinical routine, particularly for high-risk patients. The infrared thermal camera is sometimes used in consultation to complement the visual and podiatric assessment.

Other protocol models rely on connected devices capable of carrying out monitoring automatically and sending data to carers. These tools allow a remote monitoring approach, in which alerts are transmitted in real time to a medical platform, which can then contact the patient to organise a consultation or care adaptation.

The success of these protocols largely depends on patient adherence, staff training, and the smooth integration of data into clinical tools (shared medical records, secure messaging, etc.). The aim is to make thermal monitoring a preventive routine, just like measuring blood glucose or taking blood pressure.

9.7 International recommendations

According to the recommendations of the International Working Group on the Diabetic Foot (IWGDF), diabetic patients at moderate to high risk of ulceration (risk 2-3) should monitor the temperature of their feet daily. A difference >2.2°C over two consecutive days should lead to limiting ambulatory activity and rapidly consulting a healthcare professional [3].

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Consider teaching a person with diabetes who is at moderate or high risk of foot ulceration (IWGDF risk 2-3) to self-monitor the skin temperature of their feet once a day, to identify any early signs of foot inflammation and help prevent a first plantar foot ulcer or an ulcer recurrence. If the temperature difference between corresponding regions of the left and

right foot is greater than a threshold of 2.2°C for two consecutive days, advise the person to reduce their ambulatory activity and to consult an appropriately trained health professional for further diagnosis and treatment.

9.8 Remote monitoring and telemedicine applied to thermosurveillance

The evolution of communication technologies and connected sensors has enabled the development of effective remote monitoring solutions for diabetic patients at risk of plantar ulceration. The integration of thermal monitoring into telemedicine devices represents an important turning point in the proactive and personalised management of the diabetic foot.

When anomalies are detected — such as a persistent local rise in temperature — alerts are generated and transmitted to the care team or the patient themselves.

This model enables medical follow-up to be opened up, actively involving the patient in their self-management while ensuring clinical oversight from a distance. The carer can intervene rapidly in the event of an alert: telephone call, teleconsultation, treatment modification or referral to an urgent face-to-face consultation. In this way, targeted preventive actions can be taken even before visible symptoms appear.

Remote monitoring also presents an organisational advantage: it reduces the frequency of in-person consultations, optimises medical resources, and extends monitoring to under-served areas. Specialist nurses can remotely supervise several dozen patients simultaneously, with automatic alert triage tools and prioritisations based on risk level.

Some platforms also allow the integration of thermal data into a shared medical record, offering an overall view of the foot's condition, combining plantar pressures, history of ulcers, podiatric status, photos and biological results. This promotes a multidisciplinary approach to care, bringing together general practitioners, diabetologists, podiatrists, orthopaedists and specialist nurses in coordinated management.

However, the effectiveness of remote monitoring rests on several conditions:

- The quality and reliability of the devices used.
- Patient training in taking measurements and interpreting alerts.
- The responsiveness of the care system to manage detected anomalies.
- The confidentiality and security of medical data transmitted online.

Recent studies have shown that remote monitoring of at-risk feet, when well structured, significantly reduces the rate of ulceration, hospitalisations and

amputations. It integrates perfectly into secondary prevention programmes and chronic care models oriented towards patient autonomy.

Thus, the coupling of thermal monitoring and telemedicine is not simply a technological evolution: it constitutes a new paradigm for monitoring, based on connectivity, personalisation and anticipation.

Sources

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[3] IWGDF guidelines 2023.

Conclusion

The prevention of the diabetic foot is a major public health challenge and a pillar of quality of life for patients with diabetes. Each year, thousands of ulcers and amputations could be avoided through simple measures, regular monitoring and shared vigilance between the patient and healthcare professionals.

The protection of the diabetic foot rests on three inseparable pillars:

- Knowledge of risks and identification of warning signs – understanding how diabetes weakens nerves, vessels and skin, and knowing at-risk situations, allows earlier and more effective action.
- Prevention and continuous monitoring – whether visual, tactile or assisted by connected tools, daily monitoring, especially thermal monitoring of the foot, is the best way to detect an anomaly before it becomes serious.
- Close collaboration – between the patient, their entourage and a multidisciplinary team involved in prevention, treatment and education.

Technological advances, the development of remote monitoring and the emergence of new therapeutic strategies now consolidate these foundations. They constitute a major lever for improving the monitoring of the diabetic patient, provided they are integrated into personalised protocols, adapted to the needs and specific features of each patient.

But beyond tools and techniques, the key remains the patient's commitment to their own prevention. It is by making foot care a daily reflex, in the same way as glycaemic monitoring and thermal foot monitoring, that the patient can genuinely avoid complications.

In sum, prevention is better than cure. In the case of the diabetic foot, this maxim takes on its full meaning: a few minutes each day to examine, protect and care for the feet can prevent months of heavy treatments and preserve precious autonomy. Prevention is not just a medical act — it is an investment for life.

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