



# Guidelines for Diabetic Foot Care

## *A Template for the Care of All Feet*

Tara L. Beuscher

The specialty of nursing foot care is growing rapidly. In 2005, the Wound Ostomy Continence Nursing Certification Board initiated the certified foot care nurse credential that provided a mechanism for this specialty to flourish, with over 1000 certified nurses. These nurses are prepared to care for individuals with numerous problems ranging from dystrophic toenails to heel fissures. Almost 50% of older individuals, and those with chronic conditions affecting the feet and functional impairments who are unable to care for their lower legs, are in dire need of foot care. However, those at highest risk for poor foot health outcomes and in greatest need are persons with diabetes. Interprofessional teams that include foot care nurses have been shown to improve outcomes by identifying high-risk individuals and targeting prevention and delivery of focused foot care and education.<sup>1</sup> The purpose of this article is 2-fold: to review the scope of diabetes-related foot conditions and complications, and describe established national and international guidelines for prevention and management; and, to introduce a comprehensive examination model designed to identify risk factors for foot complications associated with diabetes that can act as a template for examining all feet.

### DEMOGRAPHICS AND COMPLICATIONS OF DIABETES

In the United States, 1.5 million individuals are diagnosed with diabetes mellitus every year. In 2015, 30.3 million or 9.4% of the population had diabetes; however, 23.1 million were diagnosed while 7.2 million remained undiagnosed. The highest population group is older adults 65 years and older, representing 25.2% or 12 million individuals with both diagnosed and undiagnosed diabetes. Diabetes remains the seventh leading cause of death in the United States.<sup>2</sup> In 2015, the global prevalence of diabetes mellitus was reported to be 8.8%, which corresponds to 415 million individuals.<sup>3</sup>

While it is difficult to obtain accurate prevalence data on foot-related consequences of diabetes, estimates remain staggering. One of the most devastating consequences is lower extremity amputations (LEAs) that often occur as a result of neurologic and vascular changes associated with diabetes.

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The author declares no conflicts of interest.

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DOI: 10.1097/WON.0000000000000532

Seventy-five percent of LEAs are performed in patients with diabetes. Worldwide 200,000 individuals with diabetes undergo amputation each year, with an incidence ranging from 78 to 704 per 100,000 people.<sup>3</sup> In the United States, over 83,000 amputations, or 230 individuals have an amputation performed each day. These prevalence statistics are expected to rise as the population of older adults and those with diabetes increase, with a 2-fold increase expected in men.<sup>4</sup>

Foot ulcers are often precursors of LEA. It is estimated that, annually, foot ulcers develop in 9.1 million to 26.1 million people with diabetes worldwide.<sup>5</sup> The lifetime incidence of foot ulcers is between 19% and 34% of persons with diabetes.<sup>6</sup> The risk of death at 5 years for a person with a diabetic foot ulcer is 2.5 times higher than for an individual with diabetes who does not have a foot ulcer.<sup>7</sup> Ulcer infection and peripheral artery disease (PAD) increase the risk of amputation.

Peripheral artery disease is generally caused by accelerated atherosclerosis and is present in up to 50% of patients with a diabetic foot ulcer. Peripheral artery disease is an important risk factor for impaired wound healing and LEA. A small portion of foot ulcers are purely ischemic; these ulcers are usually painful and caused by minor trauma. The majority of PAD-related foot ulcers are neuro-ischemic, caused by combined neuropathy and ischemia, and induced by trauma such as friction and pressure. In these patients symptoms may be absent because of the neuropathy, despite severe pedal ischemia. Diabetic microangiopathy (so-called “small vessel disease”) is not likely to be the primary cause of an ulcer or poor wound healing in patients with PAD.<sup>5</sup>

With appropriate therapy—surgical debridement, off-loading of pressure, attention to infection, and if necessary, vascular reconstruction—diabetic foot ulcers heal in many patients, and the need for amputation is averted. Unfortunately, even after the resolution of a foot ulcer, recurrence rates are high: approximately 40% reoccur within 1 year of ulcer healing, 60% within 3 years, and 65% within 5 years. Factors associated with recurrence include peripheral neuropathy, foot deformity, increased plantar stress, and peripheral vascular disease, which are concomitant conditions and generally not resolved following ulcer healing.<sup>6</sup>

Research on prevention of foot ulcers is sparse. It is estimated that 75% of foot ulcers in persons with diabetes are preventable.<sup>8</sup> Guidelines have been developed to reduce the risk of foot ulceration both internationally<sup>9</sup> and nationally.<sup>10,11</sup> Years of guideline implementation led to a steady decline in the LEA rate in the United States between 1999 and 2009. Unfortunately, there has been a slight increase since then, particularly in younger age groups,<sup>12</sup> hence the need to continue the focus on prevention. Guidelines developed by the International Working Group on the Diabetic Foot (IWGDF) include

5 key elements that underpin prevention of foot problems: (1) identification of the at-risk foot; (2) regular inspection and examination of the at-risk foot; (3) education of patient, family, and healthcare providers; (4) routine wearing of appropriate footwear; and (5) treatment of preulcerative signs.<sup>5</sup> Foot care nurses can provide a vital service in implementing guidelines to identify the high-risk condition, and prevent the occurrence of foot ulcers and other complications.

## IDENTIFICATION OF THE AT-RISK FOOT

### History

Taking a focused history is the basis for identification of the at-risk foot. Ask the person with diabetes about the history of previous foot ulceration or LEA, PAD, foot deformity, preulcerative signs on the foot including callus, blistering, or hemorrhage, ability to perform foot hygiene by self or with assistance of other, and type and frequency of wearing footwear.<sup>5</sup> Individuals may not be aware if footwear is ill-fitting or inadequate. Persons with poor eyesight, diminished sensation of the feet, or inability to position feet for self-inspection may not be aware of skin problems.

### Skin Conditions

Callus is a thickened hyperkeratotic tissue that is a response to stress, pressure, friction, or sheering forces from ill-fitting footwear. Initially, a callus is a protective mechanism; however over time, the callus can become so thick and hard that it creates even more pressure and can ulcerate. Dark red streaks especially in the center of calluses are considered a preulcerative lesion. Fluid-filled blisters can occur with friction/sheer forces and should be investigated and managed.<sup>13</sup>

### Hygiene

Poor foot hygiene can occur when individuals are unable to physically care for their feet or do not have the environment or equipment in which to do so. Skin that is too dry or too moist can crack leading to fissures. Disrupted skin integrity can act as a portal of entry for infection. Feet should be free of dirt and debris, which helps to decrease microbial burden and allows for direct visualization of skin. Supple skin is better able to remain intact when in contact with friction forces associated with wearing shoes and ambulation. Routine application of fragrance-free lotion or cream can assist in keeping dry skin supple. Proper care of the toenails is an important aspect of hygiene. Individuals may require assistance with nail care, especially if nails are thick or hard. Fungal infections are common infections of the nails, affecting 14% to 23% of the population worldwide.<sup>14</sup>

### Inspection

Assessment of the feet is necessary to observe for conditions for which the individual may or may not be aware. Foot deformity can include toe deformities such as hammer, mallet, or claw toes (Figure 1). Hallux valgus deformity is a lateral deviation of the first toe and may be accompanied by overlapping toes. Deformities can be flexible or rigid, with rigid deformities being more likely to contribute to development of hyperkeratotic lesions (thickened calluses or corns) or skin breakdown. Prominent metatarsal heads can occur due to thinning of fat padding on the plantar surface of the feet and may accompany toe deformities. These deformities may benefit from accommodative footwear or padding to prevent skin breakdown and ulceration.<sup>15</sup>

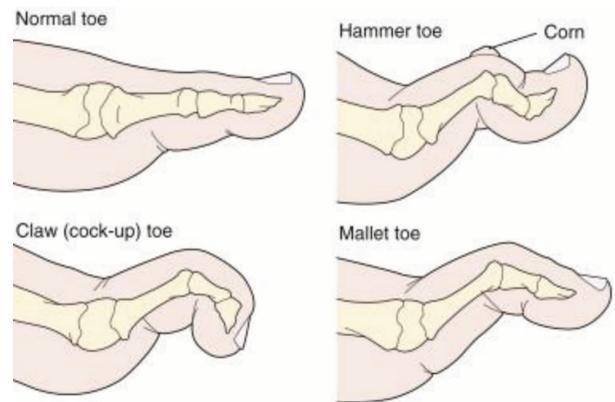


Figure 1. Toe deformities (ScienceDirect.com).

### PAD

Inspect the feet using the 6 “Ps” as a guide to detect arterial insufficiency and critical limb ischemia. The Ps include pallor (pale), pain, paresthesia (abnormal sensations), polar or poikilothermia (cold), paralysis, and pulselessness. Dry flaky or shiny skin are also signs of PAD.

### Peripheral Neuropathy

Both the IWGDF and the American Diabetes Association (ADA) recommend annual examination of the feet to identify signs or symptoms of peripheral neuropathy. The ADA<sup>10</sup> recommends the use of the 10-g monofilament along with at least one other test (pinprick, ankle reflex, and vibration) to identify peripheral neuropathy.

The monofilament is placed on the plantar surface skin in several places (Figure 2), hard enough to bend without sliding. Instruct the patient to close eyes. Then ask the patient to identify (say yes) when the monofilament touches the skin. Absence of sensation in one or more of the tested areas suggests loss of protective sensation.

Select one of the following tests to perform in addition to monofilament testing: pinprick, ankle reflexes, or vibration. The 128-Hz tuning fork can be used to test vibratory sensation. The patient is asked to close eyes. The examiner strikes

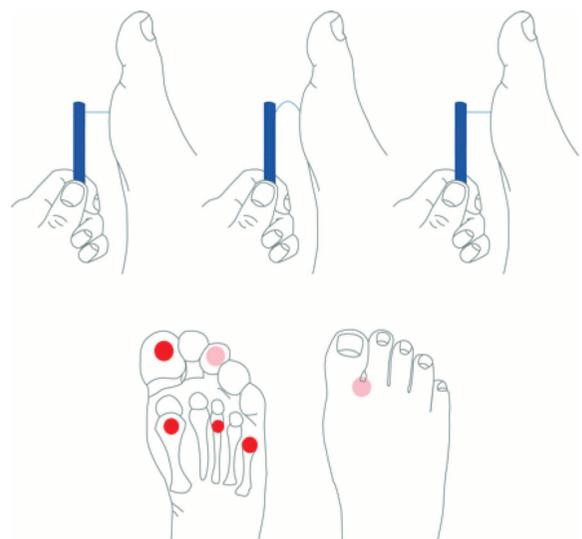


Figure 2. Monofilament testing.<sup>16</sup>

the tuning fork and places it on the tip of the first toe with pressure so that it pushes against the bone. The patient is asked to state when he or she no longer feels the vibration. An abnormal response is noted when the patient states that he or she no longer feels the vibration while the examiner still perceives it while holding the fork. A biothesiometer can also be used to test vibratory perception, if available.

Pinprick sensation is tested by utilizing a disposable safety pin applied just proximal to the toenail on the dorsal surface of the great toe (hallux) with just enough pressure to deform the skin. Inability to perceive pinprick over either hallux would be regarded as an abnormal test. Take care not to puncture the skin.

Ankle reflexes can be tested with the Achilles tendon stretched until the ankle is in a neutral position prior to striking the tendon with a tendon/reflex hammer. If a response is initially absent, the patient can be asked to hook fingers together and pull (reinforcement), with the ankle reflexes then retested with reinforcement. Total absence of ankle reflex either at rest or upon reinforcement is regarded as an abnormal result.

Peripheral pulses are palpated both at the dorsalis pedis and the posterior tibial. Pulses should be documented as either present or absent. Inability to palpate one or more pedal pulses should indicate the need to assess them with a Doppler. Inaudible pulses are a risk factor for ulceration. An ankle brachial index is an important component of the vascular assessment, should be considered when pulses are nonpalpable or inaudible, and is performed bilaterally.

**Frequency**

Persons with diabetes should have their feet examined for signs or symptoms of PAD and peripheral neuropathy at least annually. The IWGDF Risk Classification System (Figure 3) recommends the following frequency for repeat screening: annually for persons with no peripheral neuropathy; every 6 months for persons with peripheral neuropathy; every 3 to 6 months for persons with peripheral neuropathy with PAD and/or a foot deformity; and once every 1 to 3 months for persons with peripheral neuropathy and a history of foot ulcer or LEA.

**EDUCATION OF PATIENT, FAMILY, AND HEALTHCARE PROVIDERS**

Education, presented in a structured, organized, and repeated manner, plays an important role in the prevention of foot problems. There continues to be a lack of education of both people with diabetes and healthcare professionals on foot health and problem prevention strategies.<sup>17</sup> Standardized diabetes foot education programs including foot assessment,

verbal and written instructions, discussion, and follow-up sessions have been shown to help older persons with diabetes to perform foot self-care effectively.<sup>18</sup> There are many quality diabetes action plans designed for the public available on the internet for self-assessment and care.

Early in the education process, it is helpful to identify whether the individual is able to perform a daily foot inspection. Identify another person who can aid in this task if needed. Teach individuals to inspect feet, including areas between toes, looking for areas of redness or other lesions such as a blister, cut, scratch or ulcer. Individuals should wash their feet routinely (with careful drying particularly between the toes). Teach patients to avoid using chemical agents or plasters to remove calluses or corns, use emollients to lubricate dry skin, and cut toenails straight across, making sure to use a file to smooth any rough edges. Individuals should avoid walking barefoot, in socks without footwear, or in thin-soled standard slippers whether at home or outside.

Instruct patients to not wear shoes that are too tight, have rough edges, or uneven seams. Individuals should inspect or feel the inside of their shoes prior to donning. Instruction should be aimed at improving foot care knowledge and behavior as well as encouraging the patient to adhere to foot care advice. Motivational interviewing techniques can be effective to encourage foot health behavior.<sup>19</sup>

**ROUTINE WEARING OF APPROPRIATE FOOTWEAR**

At-risk patients with diabetes have elevated levels of mechanical plantar pressure during barefoot walking, which are a significant independent risk factor for foot ulceration. Walking without proper footwear also lacks protection against thermal or external trauma. Adequate footwear protects the feet from injury even when patients are nonambulatory.

The inside of the shoe should be 1 to 2 cm longer than the foot, or extending beyond the longest toe. The internal width should equal the width of the foot at the metatarsal phalangeal joints (or the widest part of the foot), and the height should allow enough room for all the toes and especially those that are deformed (hammer or claw). The insole should be sufficiently padded to avoid applying pressure to plantar bony prominences. Evaluate the fit of the shoe with the patient in the standing position, preferably at the end of the day when the feet are larger due to the dependent position. Those patients with a foot deformity or a preulcerative sign may need further adaptations to their footwear, which may include therapeutic footwear, custom-made insoles, or a toe orthosis. When a foot deformity or a preulcerative sign is present, consider referral to pedorthists/orthotists. Specific criteria are required for

Category	Characteristics	Frequency
0	No peripheral neuropathy	Once a year
1	Peripheral neuropathy	Once every 6 months
2	Peripheral neuropathy with peripheral artery disease and/or a foot deformity	Once every 3-6 months
3	Peripheral neuropathy and a history of foot ulcer or lower-extremity amputation	Once every 1-3 months

**Figure 3.** IWGDF Risk Classification System 2015 and preventative screening frequency.

therapeutic footwear with a prescription from the healthcare provider. Patients should be encouraged to wear appropriate footwear, throughout the waking hours, whether inside or out. They should also be reminded to put on shoes or supportive slippers when getting up at night.

Socks can decrease friction and sheer forces within shoes and should be clean, dry, free of holes, and seams. Tight elastic bands in socks or stockings should be avoided, as they can cause vascular constriction, edema, and pressure-related skin issues.

## TREATMENT OF PREULCERATIVE SIGNS

The IWGDF (2015) recommends treatment for any preulcerative signs on the foot of patients with diabetes. This includes removing callus, protecting blisters and draining when necessary, treating ingrown or thickened toenails, treating hematoma when necessary, and prescribing antifungal preparations for fungal infections. Depending of the nurse's level of licensure, individual state practice act, and practice setting, the nurse may perform some or all these interventions; for other conditions there may be the need to refer to the appropriate healthcare provider such as podiatrists.

### Blisters

Blisters can be caused by ill-fitting shoes or other friction source and can be especially problematic in the neuropathic foot. Small blisters can be protected from repeat injury with small gel or silicon pads and will likely reabsorb. Larger blisters can be lanced, allowed to drain and bandaged with the covering skin intact to remain over the dermis. Relieving or redistributing pressure to the affected area is essential to prevent recurrence. Appropriately supportive footwear should be worn by ambulatory individuals to avoid pressure to the area. Off-loading shoes and boots may be required to substantially reduce pressure for areas at high risk of ulceration for individuals who are minimally ambulatory.

### Calluses

Callus debridement can be performed with a scalpel (sharp debridement) or with a rotary tool or a manual file. The goal is to remove small, thin slivers of hyperkeratotic tissue, leaving a thin layer remaining for ongoing protection. Avoid debriding too deeply into vascular tissue. Offloading areas of the foot can alleviate pressure and be helpful in slowing callus recurrence. Avoid the use of commercial over-the-counter callus remover products, which can cause damage to normal skin.

### Toenails

Toenail debridement is a frequent request of individuals who are unable to trim thickened nails. Older individuals may have difficulty visualizing or reaching their feet or lack sufficient strength to safely provide the needed self-care. Reducing the nail in length and girth may be accomplished with a specialized nail nipper or rotary tool designed for this purpose. Take small nips of nail and avoid debriding through the nail or otherwise cutting into vascular tissue. Be aware of infection control to prevent the spread of fungus to other toes or through aerosolization during debridement, especially with a rotary tool.

## THE ADA FOOT CARE GUIDELINES

The ADA publishes foot care recommendations in their annual standards of medical care in diabetes and recommendations are similar to those of the IWGDF. The Wound Ostomy and Continence Society also publishes guidelines for lower extremity neuropathic disease that incorporates many of these recommendations.<sup>10</sup> The current ADA (2019) recommendations<sup>11</sup> include the following:

- Perform a comprehensive foot evaluation at least annually to identify risk factors for ulcers and amputations. Patients with evidence of sensory loss or prior ulceration or amputation should have their feet inspected at every visit.
- Obtain a history of prior ulceration, amputation, Charcot arthropathy, angioplasty or vascular surgery, cigarette smoking, retinopathy, and renal disease and assess current symptoms of neuropathy (pain, burning, and numbness) and vascular disease (leg fatigue and claudication).
- The examination should include inspection of the skin, assessment of foot deformities, neurological assessment conducted with a 10-g monofilament testing, and at least one other assessment: pinprick, temperature, vibration, and vascular assessment including checking pulses in the legs and feet.
- Patients with symptoms of claudication or decreased or absent pedal pulses should be referred for ankle-brachial index and for further vascular assessment as appropriate.
- A multidisciplinary approach is recommended for individuals with foot ulcers and high-risk feet such as those undergoing dialysis or have Charcot arthropathy or a history of previous ulcers or amputation.
- Refer patients who smoke or who have histories of prior lower extremity complications, loss of protective sensation, structural abnormalities, or peripheral arterial disease to foot care specialists for ongoing preventive care and lifelong surveillance.
- Provide general preventive foot self-care education to all patients with diabetes.
- The use of specialized therapeutic footwear is recommended for high-risk patients with diabetes including those with severe neuropathy, foot deformities, or a history of amputation.

Preventing foot complications in individuals with diabetes is just one aspect of the range of care required. Tight glycemic control is the cornerstone for preventing systemic diabetes-related complications.

## CONCLUSION

With the large number of individuals worldwide with diabetes and who suffer with the devastating complications of LEA, foot ulcerations, and neuropathy, prevention is key to reducing the enormous burden of this condition. As foot/wound/skin care nurses, we are in a unique position to assess, educate, and intervene early to prevent ulcers and amputations. Unfortunately, many individuals have diabetes and are yet to be diagnosed, placing them at high risk of developing early complications. Implementing these well-established foot care guidelines

as a standardized template for foot examination is a critical component of evidence-based foot care for persons with diabetes.

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