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Screening for the High-Risk Diabetic Foot: A 60-Second Tool (2012)[©]



1 AMA PRA

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To earn CME credit, you must read the CME article and complete the quiz and evaluation on the enclosed answer form, answering at least 13 of the 18 questions correctly.

This continuing educational activity will expire for physicians on October 31, 2013.

PURPOSE:

To enhance the learner's competence with knowledge of screening for the high-risk diabetic foot.

TARGET AUDIENCE:

This continuing education activity is intended for physicians and nurses with an interest in skin and wound care.

OBJECTIVES:

After participating in this educational activity, the participant should be better able to:

1. Demonstrate use of the 60-second tool and other foot assessment strategies to identify risk in the diabetic foot.
2. Apply the 60-second tool positive screen recommendations and accepted evidence-based treatment guidelines in patient care situations.

ABSTRACT

People with diabetes mellitus will develop lower-limb complications, such as neuropathy, peripheral vascular disease, foot ulcers, and lower-leg amputations. Resources to control elevated hemoglobin A_{1c} and blood pressure, along with the standardized approach using the 60-second tool (2012)[©], can detect the high-risk diabetic foot and help prevent complications.

KEYWORDS: Diabetes mellitus, high-risk foot neuropathy, peripheral vascular disease, nontraumatic lower limb amputation, diabetic foot ulcer, 60-second tool

ADV SKIN WOUND CARE 2012;25:465-76; quiz 477-8.

DIABETES AND FOOT ULCERS

Diabetes and its complications have become a pandemic affecting 346 million people worldwide.¹ As Americans have become more overweight and even obese, the incidence and prevalence of diabetes have increased. In the United States, the latest 2011 figures from the Centers for Disease Control and Prevention (CDC) report that 25.8 million people or 8.3% of the population (18.8 million diagnosed and 7.0 million undiagnosed) are affected by diabetes.² Diabetes is the seventh leading cause of death in the United States. This significant incidence and prevalence of diabetes have had an even greater impact on the developing world, as the World Health Organization reports that "more than 80% of people with diabetes live in low- and middle-income countries."¹

A person with diabetes has a 15% to 25% lifetime chance of developing a foot ulcer and a 50% to 70% recurrence rate over the ensuing 5 years.³ A foot ulcer precedes lower-limb amputation in 85% of cases.^{3,4} The 1-year amputation rate of a person with diabetes and a foot ulcer is 15%.⁵ The presence of diabetes increases the risk of a nontraumatic lower-limb amputation 20-fold, and worldwide 25% to 90% of amputations, especially nontraumatic lower-limb loss, are associated with diabetes.^{6,7} The annual incidence of lower-extremity amputations in persons with diabetes has been documented to be as low as 181 per 100,000 population in Brazil annually and as high as 936 per 100,000 population in Barbados (Table 1).

HIGH RISK FOR SECONDARY AMPUTATION

Statistically, 5 years after the first amputation, 50% of the individuals will have a second amputation.⁵ Lower limb loss is also associated with a 50% death rate, carrying a worse prognosis than breast or prostate cancer.⁸ The CDC reports that "in 2006, about 65,700 nontraumatic lower-limb amputations were performed in people with diabetes."²

According to the 2011 CDC fact sheet, total direct and indirect diabetes costs in the United States as of 2007 is \$174 billion, with \$116 billion for direct medical costs and \$58 billion for indirect costs.² The cost of diabetes care and complications to the US healthcare system is estimated to be \$10.9 billion annually, with \$16,488 to \$66,215 per amputation⁹ (Table 1).¹⁰⁻¹⁵

Narayan et al,¹⁶ in a 2006 World Bank publication, identified 3 key interventions for developing countries. Similar recommendations have been made by the Pan American Health Organization¹⁷ that would apply to resource-challenged systems everywhere, including North America. The key element in these recommendations is that they are cost savings to the healthcare system and highly feasible to implement. The interventions include foot care for persons at high risk, glycemic control to hemoglobin A_{1c} (HbA_{1c}) less than 9%, and blood pressure control to less than 160/95 mm Hg.¹⁷

The HbA_{1c} correlates with the average blood glucose over 90 days. In type 2 diabetes, each 1% drop in HbA_{1c} is associated with a 37% reduction in the risk of microvascular disease (including peripheral neuropathy),¹⁸ and aggressive management of high blood pressure is associated with a reduction in diabetic complications, including heart and kidney disease.¹⁸ In developed countries, an even tighter control of these 2 measures would be feasible. For example, guidelines from both the Canadian Diabetes Association and American Diabetes Association suggest

Table 1.
ANNUAL INCIDENCE OF LOWER-EXTREMITY AMPUTATIONS

Region	Country	Data Used	Incidence per 100,000 Diabetic Population
Europe	Denmark	Holstein et al, 2000	430
	UK	Rayman et al, 2004	285
North America	USA	Lavery et al, 2003	590
Africa		NA	NA
Asia		NA	NA
South America	Brazil	Spichler et al, 2001	181
Caribbean	Barbados	Hennis et al, 2004	936
	Guyana	Newark et al, 2007	478

that persons with diabetes maintain an HbA_{1c} of 7% or less and a blood pressure of less than 130/80 mm Hg.^{19,20}

THE IMPORTANCE OF FOOT CARE AND SCREENING FOR THE HIGH-RISK FOOT

Previous studies of persons with diabetes have identified neuropathy (loss of protective sensation), peripheral vascular disease, prior foot ulcer, or previous amputation as risk factors for developing a foot ulcer (Table 2). Lavery et al^{21,22} and the International Working Group on the Diabetic Foot (IWGDF) identified the yearly incidence rate of ulceration. If a person has diabetes and no other complication, he/she has a 2% risk of developing a foot ulcer. Annually, this incidence increases to 4.5% with neuropathy and to 13.8% with peripheral vascular disease. When any 2 of 4 criteria are present: previous ulcer, previous amputation, peripheral vascular disease, and neuropathy, the incidence of developing a foot ulcer increases to 32.2%.²²

HIGH-RISK FACTORS FOR DEVELOPING A DIABETIC FOOT ULCER

Flores-Rivera²³ published a case-control study in 1998 that examined risk factors for diabetic foot amputations. The subjects included men aged 30 to 90 years with a diagnosis of diabetes for an average of 10 years. Included in the study were 80 cases that required an above-the-knee supracondylar amputation and 240 control subjects without lower-extremity amputation. A statistically significant increased risk of amputation was evidenced with

- neuropathy as measured by absent vibratory perception (odds ratio [OR], 14.9; 95% confidence interval [CI], 8.2–27.9);

- peripheral vascular disease (OR, 8.9; 95% CI, 5.3–15.9);
- cracks or fissures in feet (OR, 3.45; 95% CI, 1.33–8.82);
- feet soaked in water (OR, 1.8; 95% CI, 1.07–2.93); and
- ingrown toenails (OR, 2.0; 95% CI, 0.6–5.3).

The study also emphasized the need for persons with diabetes to have diabetes education, glycemic control, careful daily foot hygiene, and appropriate footwear. The National Institute for Health and Clinical Excellence guidelines recommend the foot examination include inspection for foot abnormalities, palpation of the pulse, and the use of a 10-g monofilament test.²⁴

These scientific publications, along with many other guidelines, including the IWGDF, have come to similar conclusions. These publications serve as an evidence base for the criteria in the 60-second tool (2012)[©]. This screen is based on the literature evidence along with the pilot site from Guyana that may serve as a model for “reverse innovation” to developed countries and other healthcare systems.

DEVELOPMENT AND VALIDATION OF THE 60-SECOND TOOL (2012)[©]

Guyana is the second poorest country in South America. Infected diabetic foot ulcers were the most common reason for admission to a surgical ward at the country’s Georgetown Public Hospital Corporation, the national referral and teaching hospital. In a 2007 study from the surgical ward,¹⁵ almost half of the admitted patients with foot complications underwent a lower-limb amputation, with half of these being major amputations.

Although it was generally agreed that there was a need to screen the feet of persons with diabetes, this was challenging because of time restraint, and lack of standardized diabetic foot examination. A generalized documentation form was difficult to complete with 180 patients processed over a daylong clinic and only 2 to 5 medical personnel available. There was major resistance to yet another task without proof that this could be performed within the 60-second time frame. As part of the comprehensive amputation prevention program introduced in 2008,²⁵ there was a need to develop a simplified tool that did not require a calculation for risk status and that could be administered in less than 1 minute. One minute was chosen as a reasonable time interval that was convenient and easy to remember. The authors also realized that many patients with diabetes had open foot ulcers, blisters, fissures, or ingrown toenails, which increase the risk of secondary bacterial infections, but that patients were often not aware of these foot abnormalities. Callus formation is a direct result of localized pressure. This 60-second screening tool was administered to 1266 individuals at the weekly medical diabetes clinic. The profiles of these patients are outlined in Table 3.²⁶

Table 2.
HIGH-RISK FACTORS FOR DEVELOPING A DIABETIC FOOT ULCER

Screening for High-Risk Status	Ulcer Yearly Incidence/Rate, %	OR (95% CI)
Group 0 (no PN, no PVD)	2%	
Group 1 (PN, no PVD or deformity)	4.5%	2.4 (1.1–5)
Group 2B (PVD)	13.8%	9.3 (5.7–15.2)
Group 3 PN/PVD (history of ulcer or amputation)	32.2%	52.7 (27.2–109.8)

Source: Lavery et al.²⁴ classification system of the International Working Group on the Diabetic Foot. *Diabetes Care* 31(1):154–6, 2008.

Abbreviations: PN, peripheral neuropathy; PVD, peripheral vascular disease.

Table 3.
RESULTS OF 60-SECOND SCREEN ON 1266 PATIENTS
WITH DIABETES IN GUYANA, SOUTH AMERICA

Item	No, %	Yes, %
Previous ulcer	91	9
Previous amputation	96	4
Absent pulse	88	12
Stiffness	98.7	1.3
Active diabetic foot ulcer	91	9
Ingrown toenail	81.7	18.3
Callus	77.7	22.3
Fissure	89.5	10.5
Neuropathy	76.6	23.4
Referred diabetic foot center	52	48

Although a fixed large toe or limited ankle motion can increase the risk of ulceration, these criteria were difficult to standardize and were positive in only 1% of subjects. The 60-second tool (2012)[®] was created and revised in 2012 (Figure 1). This screening tool was adopted by the Guyana Ministry of Health and is currently in widespread use throughout the country. A reliability study was subsequently undertaken.²⁷

OVERVIEW OF THE 60-SECOND TOOL (2012)[®]

This screening test identifies the high-risk diabetic foot status. It has been designed to identify any “yes” item on both feet for this high-risk foot status. If a high-risk foot is identified, there is a need for a referral or treatment as outlined in the chart at the bottom of the instructions page in Figure 1. The higher the risk status, the shorter the suggested follow-up period is for rescreening and follow-up of treatment. This may include the need for diabetes and foot care education, professional care of nails, orthopedic shoes, orthotics, and restrictions on activities. Each item will be discussed in detail to define the criteria for a positive response.

There is also a video of the 60-second tool (2012)[®] with a screen-timer and a sequential examination that can be viewed to illustrate the components of the foot examination. This video with audio explanation was clocked with a complete exam demo in 59 seconds. The screening test form and the video of the 60-second tool (2012)[®] are available for free at <http://diabeticfootscreen.com>. Healthcare professionals are asked to register on the site so they may be contacted if any changes from this ongoing research result in updates to the form or video. After registering, the video will be available free of charge via yousendit.com.

COMPONENTS OF THE 60-SECOND TOOL (FOR THE HIGH-RISK DIABETIC FOOT) (2012)[®]

The top of the form includes patient demographic information and the date of the examination. The ethnic origin of the patient is important because of different prevalence of diabetes in various racial groups. The terms in this generic form are chosen based on the categories approved for US government grant funding.

History

The first section of the actual examination addresses historical information concerns, such as a previous ulcer or amputation, by both patient history and observing the foot.

Question 1: Previous Ulcer

The patient should recall if he/she has had a previous ulcer (Figure 2). Not all patients are aware of the presence of a foot ulcer or the previous history of an ulcer. They may not have received professional care. As a prompt for this question, look for atrophic scars on the plantar forefoot where the metatarsal head region is the foot ulcer site in 80% of individuals. However, ulcer site scars may be present in the mid-foot or heel area and less often on the dorsum of the foot.

Question 2: Previous Amputation

On history, patients with diabetes who are being screened should be asked if they have a previous history of an amputation. On inspection, the clinician will often observe evidence of amputation, such as 4 instead of 5 toes.

Physical Examination

There are 3 items included in this section of the physical examination: deformity, ingrown toenail, and absent pedal pulses.

Question 3: Deformity

This part of the examination refers to an abnormal shape of the foot beyond the uniform curled toes that may be seen with neuropathy. These abnormalities include the hammer toe, claw toe, and Charcot foot. The hammer toe has a bend in the proximal interphalangeal joint, so that the end of the toe points downward, and the proximal toe is raised secondarily above the dorsal surface of the other toes. The claw toe is created when the toe is bent upward from the metatarsal phalangeal joint or the metatarsal head area, and it is subsequently flexed (bent down) at the proximal and distal interphalangeal joint. Both of these deformities result in abnormal thickening of the keratin over the tip of the toe. Any excess pressure can result in the development of corns, calluses, blisters, or ulcerations on the dorsal and plantar surface of the foot.

The Charcot foot presents insidiously with warmth (increased skin temperature), redness, and swelling. It may or may not be

Figure 1.

DOCUMENTS FOR 60-SECOND TOOL

Screening for the High-Risk Diabetic Foot: A 60-Second Tool (2012) © Sibbald						
Name: _____ ID#: _____ Phone #: _____ Facility: _____ DOB (dd/mm/yy): ____/____/_____ Gender: M <input type="checkbox"/> F <input type="checkbox"/> Years with diabetes: _____ Ethnicity: Black <input type="checkbox"/> Asian <input type="checkbox"/> Caucasian <input type="checkbox"/> Mixed <input type="checkbox"/> Other <input type="checkbox"/> Date of Exam (dd/mm/yy): ____/____/_____ 		<u>CHECK BOTH FEET</u> (Circle correct response) “YES” on either foot = HIGH RISK <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; text-align: center; border: none;">LEFT</td> <td style="width: 50%; text-align: center; border: none;">RIGHT</td> </tr> </table>			LEFT	RIGHT
LEFT	RIGHT					
HISTORY	1. Previous ulcer	NO	YES	NO	YES	
	2. Previous amputation	NO	YES	NO	YES	
PHYSICAL EXAM	3. Deformity	NO	YES	NO	YES	
	4. Ingrown toenail (thickened nail fold)	NO	YES	NO	YES	
	5. Absent pedal pulses (dorsalis pedis and/or posterior tibial)	NO	YES	NO	YES	
FOOT LESIONS <i>Remember to check 4th and 5th web spaces/nails for fungal infection and check for inappropriate footwear.</i>	6. Active ulcer	NO	YES	NO	YES	
	7. Blisters	NO	YES	NO	YES	
	8. Calluses (thick scale on plantar skin)	NO	YES	NO	YES	
	9. Fissure (linear crack)	NO	YES	NO	YES	
NEUROPATHY <i>MORE THAN 4/10 SITES LACKING FEELING = “YES”</i>	10. Monofilament exam (record negative reaction): a) Right ____/10 negatives (≥ 4 negatives = Yes) b) Left ____/10 negatives (≥ 4 negatives = Yes)	NO	YES	NO	YES	
		Total # of YES: _____		Total # of YES: _____		
PLAN a) POSITIVE SCREEN- Results when there are one or more “Yes” responses. <u>Refer to a foot specialist or team for prevention, treatment, and follow up.</u> (Bony deformity, current ulcer, absent pulse are most urgent.) These individuals are at increased risk of a foot ulcer and/or infection. Patients should be educated on what changes to observe and report, while waiting for the specialist appointment. Referral to: _____ Appointment time: _____ b) NEGATIVE SCREEN- Results when there are all “No” responses. <u>No referral required.</u> Educate patients to report any new changes to their healthcare provider and re-examine in 1 year. One Year Date for Re-Examination (dd/mm/yy): ____/____/_____ Completed By: _____ Date: _____						
Additional Note: For POSITIVE SCREEN , in addition to referral plan above, positive risk factors can be linked to the care recommendations in “Root Risk Classification and Follow-Up Guide” table on the bottom of reverse side. Local referral patterns may vary depending on expertise and available resources.						

**Screening for the High-Risk Diabetic Foot:
A 60-Second Tool (2012) © Sibbald**

General Instructions:

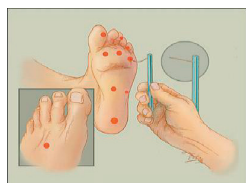
This diabetic foot screening tool is designed to identify individuals with high-risk diabetic feet. This screening tool is a simplified 60-second assessment for each foot, to be implemented by any healthcare provider. Preparation involves having a 5.07 g monofilament available and asking the patient to remove his/her shoes and socks.

Normal screening findings are indicated as “No” (not requiring referral) and abnormal screening findings are indicated as “Yes” (requiring referral). Generation of a list of local reputable foot specialists and/or teams for referring is recommended.

Screening involves:

- Inform patient about the simplified 60-second screening and explain the reason for the examination.
- Fill in patient’s demographic data in top left section of screening tool.
- Assess both feet. Circle either a “Yes” or “No” response for questions 1-10.
- **Any “Yes” response requires follow-up or a referral to a foot specialist and/or team.**

Question	“Yes” Response
1	“Yes”, if previous ulcer from history is observed : Ask the patient and assess both lower legs and feet for the presence of a healed ulcer as evidenced by scar tissue.
2	“Yes”, if previous amputation of digit(s), foot, or limb is observed.
3	“Yes”, if deformity and/or abnormality in shape or structure of either foot is observed (bony prominences/hammer toes).
4	“Yes”, if ingrown toenail present . Inspect distal corners for embedded nail and/or thickened nail fold skin. if absent pedal pulses (palpate dorsalis pedis and if absent check posterior tibial). A yes answer requires absence of both pulses.
5	“Yes”, if absent pedal pulses (palpate dorsalis pedis and if absent check posterior tibial). A yes answer requires absence of both pulses.
6	“Yes”, if active ulcer(s) present : Openings in the skin with a dermal or deeper base.
7	“Yes”, if blister(s) present : Observe for fluid (serum, blood, or pus) under intact skin surface.
8	“Yes”, if callus present (thick scale on plantar skin) : Assess and inspect for presence of thick areas of keratin on the bottom or sides of feet and toes.
9	“Yes”, if fissure (linear crack) : Observe for a linear break with dermal or deeper base.
10	“Yes”, if Monofilament Exam identified 4 or more negative reactions (lack of feeling) : Follow the monofilament exam instructions below. Each foot is examined separately.



Steps for Monofilament Exam for Neuropathy:

- Show and touch monofilament to patient’s arm or upper leg.
- Ask the patient to close his/her eyes and say “yes” when they feel the monofilament.
- Touch monofilament until filament bends in a letter “c” shape, assessing all 10 areas on diagram (do not test over calluses, scars, or ulcers).
- **Lack of feeling (4 or more out of 10) - indicates a negative reaction = Neuropathy = “YES” on screening tool.**

Foot Risk Classification and Follow-up Guide						
Assessment Findings ↓	RISK	Follow Up (mths)	Prof. Nail Care	Orthopaedic Shoes	Orthotics + Diabetic Socks	Activity
No Neuropathy	0	12	-	Well fitting	Well fitting shoes	As able
Neuropathy	1	6	+/-	Professional fit	Custom full contact	As able, monitor, guided by foot exam
Deformity	2a	3-4	+/-	+/- custom fit	Custom full contact	Avoid excessive walking, √ non-impact exercises
Peripheral Vascular Disease	2b	3-4	+	Professional fit	Soft full contact	Dependent on ischemic pain, √ non-impact exercises, or as recommended by vascular team consult
Ulcer Hx or Active ulcer	3a	1-2	+	Professional fit	Custom fitted	Activity dependant on exam, √ non-impact exercises
Hx Amputation	3b	1-2	+	Special clinic (assessment) Modified footwear	Specialized clinic: amputation/prostheses, +/- walking aid	Based on tissue tolerance, √ non-impact exercises

Constructed from: International Diabetes Federation-IWGDF 2008, CAWC Best Practice Guidelines DFU 2010, and other sources.

Figure 2.
10 STEPS OF EXAMINATION



associated with pain. This disorder starts with edema, and as the joints are distended, the bones collapse and fragment, leaving behind debris as they dislocate. The foot is distorted with this process of healing over 6 to 9 months. The resultant fixed deformity may include a rocker bottom foot. The clinician should examine the foot for abnormal contours. The contralateral foot, if normal, may be used for a comparison. The changes can be present in the forefoot, midfoot, hindfoot, or heel area, as well as the ankle. In the acute stage, there needs to be immobilization and

non-weight bearing, along with modification of activities. Chronically, these deformities lead to an increased susceptibility to ulceration. Prevention requires downloading the affected joint with bracing above and below the joint if possible.

Question 4: Ingrown Toenail

An ingrown toenail results when the distal toenail is trapped in the nail fold, and a tissue reaction leads to an enlargement of the nail fold skin. This acute bacterial infection may be called acute

bacterial paronychia and needs to be distinguished from chronic paronychia that may be associated with yeast. This allows bacteria to enter locally and invade the tissue around the nail. It is more common for this type of localized infection to spread to deeper tissue if the person is immunocompromised or if repeated trauma occurs locally. Persons with diabetes are more susceptible because they may have poor glucose control that will decrease the host resistance and repeated injury from tight shoes or undetected local trauma associated with neuropathy. Infection in the nail bed can easily spread to the phalangeal bone in the underlying bone, leading to osteomyelitis.

Toenails should be cut straight across, and they should be longer than the distal nail fold. Temporary removal of the nail border may not solve the problem. The permanent removal of the nail border (ingrown side) with local chemical destruction of any remaining matrix (phenolization) is more likely to prevent recurrences but is associated with a slight risk of infection.²⁸ Phenol destruction is contraindicated if peripheral vascular disease is present. There is generally no benefit for the prophylactic use of systemic antibiotics without signs and symptoms of infection.

Question 5: Presence of Pedal Pulses

Peripheral vascular disease is more common in persons with diabetes and even more common if they smoke. The presence of the dorsalis pedis or posterior tibial pulse is a good indicator in most patients that there is adequate circulation to the foot. Pulses are best palpated by placing the fingers lightly on the dorsal surface of the foot and waiting for the pulse to connect with the examiner's fingertips. The navicular bone is just below the anterior bend of the ankle, and this region may be a convenient location to palpate the dorsalis pedis pulse.²⁹ Occasionally, there is an absent dorsalis pedis pulse, and the posterior tibial pulse can be palpated in the groove between the medial malleolus and the Achilles tendon. Pulses are more difficult to palpate if there is local edema or if there is weak pulse amplitude. An arterial Doppler is a more accurate test, especially for those without a palpable pulse.

Foot Lesions

There are 4 types of foot lesions to identify in this section: active ulcer, blisters, calluses, and fissures.

Question 6: Active Ulcer

Persons with diabetes and neuropathy are prone to develop foot ulcers (loss of epidermis with a dermal or deeper base). The loss of protective sensation makes many of these ulcers asymptomatic, and unless the affected individual can visualize the ulcer, they may not be aware of its presence and potential danger. As stated earlier, about 80% of the ulcers are over the area of the metatarsal heads, but they can be localized anywhere on the foot.³⁰

Question 7: Blisters

A blister is a fluid-filled sack. In dermatological terminology, if it is larger than a centimeter, it is a *bulla*, and if it is smaller than a centimeter, it is a *vesicle*. Blisters can be filled with 3 kinds of fluid: blood, pus, or serum, and they often have more than 1 component (eg, serosanguineous). A blister indicates friction and/or shear between the foot and footwear, often on the plantar surface. Any opening of the skin is a source of entry for infection and potential deeper ulceration.

Question 8: Callus (Thick Scale on the Plantar Surface of the Foot)

A callus is due to excess local pressure with a loss of sensation in a stocking and glove distribution. The atrophy of the intrinsic muscles combined with the imbalance between the atrophic extensors and the over-pull of the flexural muscles result in clawing of the toes and prominent metatarsal heads. This needs to be distinguished from the deformity associated with hammer toes, claw toes, or the Charcot foot. The turned-up toes are associated with the distal migration of the protective fat pads normally under the metatarsal heads to the space at the base of the toes. The pressure with walking and repeated trauma leads to the production of a compensatory callus over the metatarsal heads. The presence of callus indicates an increased pressure and the risk of associated ulceration.

Callus is usually treated with regular debridement and appropriate orthotic inserts. If the callus continues to form, the orthotic may need adjustment, or the patient is not wearing the therapeutic footwear consistently. An additional problem is the use of slippers, socks alone, or barefoot in the home without appropriate support or orthotics.

Common features of supportive shoes include³¹ the following:

- fits well
- made out of breathable material (eg, leather)
- has a firm heel
- has self-fasteners or shoelaces
- has good shock absorption
- cannot be bent or twisted in the center
- has no seams in the toe box.

Question 9: Fissure or Linear Crack

A fissure is a linear crack or defect in the skin with a dermal or deeper base. It is most common when the skin moisture content falls below 10%, and the thick skin on the heel is most susceptible to this type of change. Persons with diabetes may have dry skin on the plantar surface of the skin due to the autonomic component of the neuropathy, but they can also have fungal infections that will give a dry, scaly appearance to the plantar skin.³¹

A fungal infection can have 3 components. The dry skin has a white powdery texture to the surface skin markings, and this

change extends around the side of the foot in a distribution that may be covered by a moccasin style of footwear. The second component is the breakdown of the keratin in the toe webs, with the tightest space between the fourth and fifth toes being most susceptible to fungal changes. The toe webs can become macerated with excess moisture and sweating, leading to the local secondary proliferation of bacteria that causes a superficial critical colonization and potential subsequent lymphadenitis or cellulitis. Control of fungus in the toe webs or plantar aspect of the feet is best accomplished by using topical antifungal agents including terbinafine once daily or an azole antifungal agent, such as clotrimazole, miconazole, ketoconazole, or econazole twice daily. The third component is involvement of the nails. The changes often start asymmetrically and involve distal streaking of the nails that eventually leads to whole-plate involvement and finally nail destruction. The LION (Lamisil Itraconazole ONychomycosis) study demonstrated 75% effectiveness for terbinafine 250 mg daily for 12 weeks and 38% effectiveness for itraconazole 400 mg a day for 1 week per month for 12 weeks or 3 cycles.³² Fissures can also occur if access to proper footwear use is a problem encountered in resource-restricted environments. There are also cultural differences concerning the use of footwear, including the wearing of open flip-flop sandals with the strap between the first and second toes. This type of shoe is commonly found in developing countries, and patients are often reluctant to change. The popularity of the open shoe is partly due to heat and humidity issues and partly due to the low cost. The same applies to walking barefoot with the development of calluses and fissures. Cultural habits and future costs to be incurred for footwear are valid patient-centered issues that require appropriate attention and educational intervention in managing the high-risk diabetic foot successfully in resource-challenged communities.³³

If fungus is not present, the dry skin associated with autonomic neuropathy can be treated with 2 types of moisturizers. Humectants increase stratum corneum skin moisture content by binding water to the surface of the skin. These agents include urea and lactic acid as water-attracting components that are part of the stratum corneum's natural moisturizing factor. Lubricating moisturizers include petrolatum, silicone, dimethicone, and ceramides as examples. The fissure identifies a positive increased risk factor, but the presence of fungus is a clinical and laboratory diagnosis that should be treated to avoid other complications or transmitting to other individuals via the bathroom floor or other community spaces.

Neuropathy

The sensory component can be easily measured with a 10-g monofilament or previously with a neurological pin. The Semmes-Weinstein monofilament test can measure a loss of protective

sensation to predict subsequent foot ulceration, with the efficacy confirmed in the Seattle Diabetic Foot Study.⁴ There are 3 components to the neuropathy associated with diabetes, represented by the mnemonic SAM: sensory, autonomic, and motor.

Question 10: Monofilament Examination

Many studies have utilized a 10-g nylon monofilament with either the shorter 4-point test on each foot or the longer 10-point test. However, the authors have confirmed the interrater reliability utilizing the longer 10-point scale, which may provide fewer errors for individuals who are less familiar with the use of the monofilament. Ideally, areas of callus should be avoided.

To perform the test, the subject is asked to close his/her eyes, and the monofilament is placed on a proximal location on the arm or leg. The pressure should be applied to bend the nylon monofilament from the perpendicular position to produce an arch-shaped bend and held in place for 1 second. When a proximal test is felt by the patient, the 10 points on each foot are examined, asking the patient to indicate when he/she feels the sensation. This is faster than asking the patient if he/she feels the monofilament every time the examiner applies it to the foot. The 10 points include 9 on the plantar aspect of the first, third, and fifth toes; the first, third, and fifth metatarsal heads; the 2 sides of the midfoot, and the heel. The tenth point is on the mid-dorsum of the foot, (see diagram on p. 470). If 4 or more of the 10 points are not felt, the test is positive for loss of protective sensation.³⁴⁻³⁶

The same monofilament should not be used more than 10 times in a 24-hour period because of fatigue of the monofilament nylon fibers and a less accurate result.²⁴ It may be ideal to have a monofilament for each patient, and this can be facilitated by constructing a monofilament from scratch, as outlined by Ayello et al.³⁷

The 60-second tool (2012)[©] can be completed within a 60-second period.

DISCUSSION

Identification of the high-risk foot is an essential component of diabetes care. It focuses attention and directs limited resources to those patients most at risk for developing a foot ulcer. The IWGDF risk classification allows the authors to be more specific about follow-up recommendations for different levels of risk.³⁸ Patients with a negative screen and diabetes should be reassessed in a year or sooner if a foot problem develops. Those patients who fall into IWGDF group 1 (loss of protective sensation) can be assigned to more frequent (monthly checks for 6 months) foot checks, including education, review of the appropriateness of their footwear, and detailed foot care education. Those who also have a foot deformity will need adaptive footwear and regular professional foot care.

Patients with peripheral vascular disease will need scrupulous attention to cardiovascular risk management, including lipid management advice about appropriate exercise, and smoking cessation.

Patients who have peripheral arterial disease in addition to 1 or more of the risks previously discussed will need a vascular consultation and review every 3 to 6 months. Consultant suggestions for referrals should be managed by the clinician most responsible for the patient's care, which may be the primary care physician or a specialist. Finally, the highest-risk group, those with a previous ulcer or amputation, should be seen every 6 to 12 weeks and receive all of the interventions that are appropriate (see "Instructions for Use" and "Foot Risk Classification and Follow-up Guide" in Figure 1; Table 4).

The high-risk diabetic foot can be identified with a simplified screening, and subsequent foot ulcers can be prevented. Many specialists, including wound care clinicians, frequently encounter patients with diabetes mellitus and should screen these individuals during a routine visit. This screen can identify 40% to 50% of persons with diabetes who have a high risk of foot ulceration and subsequent preventable lower-limb amputation.²⁵⁻²⁷

The evaluation of the cutaneous changes associated with diabetes can be optimized when professionals use a standardized approach. Several studies demonstrated that amputation can be reduced 40% to 85% through the detection of high-risk patients and a multiprofessional approach that focuses on preventive measures.^{39,40} The importance of routine foot examination in persons with diabetes mellitus, the identification of the high-risk foot, and subsequent treatment of detected diabetic foot ulcers are underestimated. There are many preventable foot complications that go undetected because of the asymptomatic nature of the disease and time restraints in clinical practice.

The earlier recognition of the high-risk foot and the timely treatment will save limbs and improve patient quality of life. There is often a gap between primary care and the interprofessional diabetic team. Some of the communication barriers can be overcome with enhanced clinical systems of care and tools to facilitate integrated care models.

There are other diabetic foot screenings that are reported to be 60 seconds in length.^{41,42} The complete Inlow examination for the high-risk foot and the subsequent screening tool⁴¹ requires 5 to 7 minutes for most examiners to complete. Calculation of the risk status requires the tabulation of 12 subscales and 4 anchors for each subscale, along with a cumulative scoring system that assumes all risk factors are equal. This comprehensive examination was too time-consuming for everyday clinical practice and the average clinician.⁴¹

Many healthcare systems have limited resources for preventive foot care. This screening tool was developed to focus these resources on those patients at greater risk for developing an ulcer.

Table 4.
INTERVENTIONS FOR DIABETIC PATIENTS BASED ON FOOT STATUS

Screening for High-Risk Status	Intervention		
	Screening Interval	Diabetes and Hypertension	Specialist Referral
Group 0 (no LOPS or PVD or history of ulcer/ amputation)	Screen again in 12 mo	Individualized targets but ideal HbA _{1c} <7%; BP <130/80	
Group 1 (LOPS, no PVD/ deformity)	Screen again in 6/12	HbA _{1c} <7%; BP <130/80	May need podiatry/ chiropody
Group 2A (LOPS + deformity)	Screen again in 3-6/12	HbA _{1c} <7%; BP <130/80	Specialist foot wear; podiatry/ chiropody; may need diabetes specialist
Group 2B (PVD)		HbA _{1c} <7%; BP 130/80; cardiovascular risk management	Specialist foot wear; podiatry/ chiropody; vascular assessment; may need diabetes specialist
Group 3 (LOPS + PVD or previous ulcer or amputation)	Screen every 6/52-3/12	Individualized; HbA _{1c} <7%; BP <130/80	As above

Abbreviations: BP, blood pressure; LOPS, loss of protective sensation; PVD, peripheral vascular disease.

This tool will potentially utilize the available expertise in the most effective way. The 60-second tool (2012)[®] has a demonstrated utility to identify the high-risk foot. Simultaneously, there should be an increased focus on optimizing glycemic control and optimizing blood pressure to achieve a target HbA_{1c} of less than 7% and a blood pressure of less than 130/80 mm Hg. The high-risk person with diabetes mellitus should be referred to a diabetes education center or interprofessional team. It is important to communicate and coordinate the care between all disciplines, the patient, and his/her circle of care.

SUMMARY

Screening persons with diabetes to prevent foot ulcers can lead to a decreased incidence of lower-extremity amputation. The identification of 48% of the Guyanese diabetes mellitus outpatient medical clinic population is a high yield for a screening test and agrees with the 37% to 38% demonstrated by Abbas et al⁴² in Tanzania on a much larger cohort of subjects. Training in the principles of screening, the appropriate referral and treatment of the identified foot problems, and documentation of outcomes should be included in basic diabetes education for all healthcare professionals. Interprofessional centers of excellence should not only provide care for the high-risk patients, but also offer opportunities for the team to learn more about diabetes foot care. This can be accomplished by spending time working with the expert team through clinical rotation in the diabetes center, which should include mentorships and preceptorships. The International Interprofessional Wound Care Course students from Stellenbosch University, Cape Town, South Africa; Sheikh Khalifa Medical City in Abu Dhabi, United Arab Emirates, Saudi Arabia; and the University of Toronto have embraced this 60-second tool (2012)[©] and are currently collecting data for the further utility of the screening tool in diverse clinical settings.

Screening for the high-risk foot is an important component of diabetic care. Given cost restraints and healthcare professionals' time, there is a need to rationalize diabetic foot screening and resource allocation to the high-risk foot. The authors have developed and tested a screening tool that can be completed in less than 1 minute. The 60-second tool (2012)[©] can identify the high-risk patient and provide guidance for appropriate interprofessional care.

PRACTICE PEARLS

- The high-risk diabetic foot (for future ulceration) can be identified with a 60-second tool 2012[©].
- Screening of feet for persons with diabetes mellitus coupled with management of hemoglobin A1c levels and blood pressure are important components of the plan of care.
- Foot screening has identified 37% to 48% of persons with diabetes have a high risk of developing an ulcer.
- Increased foot ulcer risk is associated with previous amputations, previous ulcers, peripheral vascular disease or neuropathy.
- A 10-g monofilament examination (4 or more out of 10 negative responses) can determine a loss of protective sensation.
- Inspection of the foot can detect bone or skin abnormalities
 - Bony changes: claw or hammer toes, Charcot changes
 - Skin changes: ingrown toenail, callus, blister, ulcer, fissure.

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