Reduce risk of diabetic foot ulcers through regular foot assessment.

Perform foot assessment in people with diabetes at least once a year. Check feet more frequently for those at a higher risk of diabetic foot ulcers.

Regularly educate people with diabetes on good foot care and appropriate footwear.

Diabetes is a major global health concern. It is associated with macro- and microvascular complications, including diabetic foot ulcers (DFU). In Singapore, there is an average of four lower extremity amputations (LEA) a day in people with diabetes. About 3 in 4 LEA are preceded by DFU. In addition to LEA, DFU are associated with mobility loss, poorer quality of life, and decreased overall productivity. Regular foot assessment is recommended to identify and manage DFU risk.
Foot assessment

Components of foot assessment include risk stratification, referral, and patient education.

Risk stratification

People with diabetes should first be checked for active diabetic foot conditions. If present, patients should be immediately treated or referred (Figure 1).

Figure 1. Active diabetic foot presentation

![Active diabetic foot conditions]

<table>
<thead>
<tr>
<th>Refer to emergency department immediately</th>
<th>Treat immediately; refer as needed for timely specialist management</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Signs of inflammation, infection, or acute Charcot arthropathy, such as redness, swelling, or warmth</td>
<td></td>
</tr>
<tr>
<td>• Cellulitis or pus from wound</td>
<td></td>
</tr>
<tr>
<td>• Wet gangrene</td>
<td></td>
</tr>
<tr>
<td>• Tissue loss (ulcer or blister)</td>
<td></td>
</tr>
<tr>
<td>• Dry gangrene</td>
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</tbody>
</table>

Of the factors related to DFU risk identification and management presented in Figure 2, the following are used in risk stratification to determine the risk category:4,9

- Previous foot ulcer or amputation
- Chronic kidney disease stage 5 (estimated glomerular filtration rate <15 ml/min/1.73m²)
- Examination or test findings of:
  - Callus
  - Deformity
  - Peripheral arterial disease (PAD)
  - Neuropathy

Figure 3 describes the foot examination and tests in assessing callus, deformity, PAD, and neuropathy.

Foot assessment should be performed at least:

- Once a year for patients in the low risk category
- Every six months for patients in the moderate risk category
- Every three to four months for patients in the high risk category

Referral

Referral decisions are informed by various factors, including symptoms of deformity, PAD, or neuropathy (Figure 2). When referring for these symptoms, assign the patient a risk category as though the deformity, PAD, or neuropathy is present and follow up based on the assigned category. If cleared of the factor, reassign a risk category without that factor and manage accordingly.

Patient education

Advise patients to maintain optimal glycaemic control. Regularly educate them on good foot care and appropriate footwear (Figure 4). Encourage smokers to quit; smoking elevates LEA risk by 37%* in people with diabetes.10

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*This estimate, of low heterogeneity, was derived from a fixed effect meta-analysis of cohort studies extracted from Liu et al. (2017).10
Foot examination and tests

- Deformity, including:
  - Charcot arthropathy
  - Hallux valgus (bunion)
  - Hammer or claw toe if it increases rubbing in footwear or pressure

- Absence of any pedal pulse with either ABPI < 0.9 or toe pressure < 60 mmHg:
  - ABPI < 0.9 indicates impaired arterial blood flow.
  - Absolute systolic toe pressure < 60 mmHg is associated with impaired wound healing.
  - Work is ongoing to determine a locally-derived toe pressure value specifically for DFU risk stratification.

- Inability to feel 10 g monofilament at any of the eight tested sites. This indicates loss of protective sensation.
  - OR
  - Inability to feel vibration fully from activated 128 Hz tuning fork, as assessed by examiner. This indicates loss of vibration perception.
  - OR
  - Inability to feel vibration from neurothesiometer probe at ≤ 25 V (average). This indicates loss of vibration perception.

- Absence of any pedal pulse with either ABPI ≤ 0.9 or toe pressure < 60 mmHg:
  - Absolute systolic toe pressure < 60 mmHg is associated with impaired wound healing.

ABPI, ankle-brachial pressure index; CKD, chronic kidney disease; DFU, diabetic foot ulcers; eGFR, estimated glomerular filtration rate; PAD, peripheral arterial disease

† Diagnosis of PAD or neuropathy (if available) could also be used for DFU risk stratification. Examination and test findings of PAD and neuropathy shown here are for the purpose of DFU risk stratification, and may not be diagnostic of PAD or neuropathy.
Figure 3. Foot examination and tests in risk stratification for diabetic foot ulcers

**Deformity**
- Inspect both feet thoroughly by examining skin integrity, especially areas with callus or deformity.
- Look for deformity that increases rubbing in footwear or pressure.

**Hammer toe**
**Hallux valgus**

**Neuropathy**
- Palpate **pedal pulses** (dorsalis pedis and posterior tibial) on each foot.
- If any pedal pulse is absent:
  - Obtain **ankle-brachial pressure index (ABPI)** of each foot: measure systolic ankle pressure of each foot; measure systolic brachial pressure of each arm; divide each ankle pressure by the greater of the two brachial pressures.
  - Obtain **absolute systolic toe pressure** of each big toe.

**Hammer toe**

**Hallux valgus**

**Callus**

**Neuropathy**
- Ask patient to close both eyes.
- Apply pressure with a **10 g monofilament** on back of patient’s hand until it buckles. This will be the baseline sensation for subsequent comparison.
- Assess plantar region of first, third, and fifth metatarsal heads, and the big toe of each foot — a total of eight sites for both feet. Ask patient to inform examiner whenever pressure is felt.

**10 g monofilament (preferred test)**

**128 Hz tuning fork**

**Neurothesiometer**
- Ask patient to close both eyes.
- Place an activated **128 Hz tuning fork** over the interphalangeal joint of each big toe.
- Ask patient to inform examiner when vibration is no longer felt.

**Neurothesiometer**

**PAD, peripheral arterial disease**
Figure 4. Patient education aid on foot care and footwear
(This aid is designed to complement, and not replace, education or advice provided by a healthcare professional)

Foot care

Monitor feet every day
Watch out for:
- Blister, wound, corn, callus, or toenail abnormality
- Redness, swelling, bruise, or increased warmth

Apply simple first aid for small wound
- Clean small wound with saline before applying antiseptic and covering with a plaster
- Seek medical help if there is no improvement after two days or if there are signs of infection

Seek medical help if wound is not healing well, or worsens
If signs of infection are present, such as redness, swelling, increased pain, pus, fever, or the wound starts to smell, seek medical help as soon as possible

Maintain good foot care and hygiene
- Clean feet daily with mild soap and water
- Dry thoroughly between each toe
- Use a pumice stone or foot file to gently remove hard skin
- Avoid cutting nails too short; cut them straight across and file corners

Moisturise regularly
- Avoid using harsh soap
- Apply moisturiser daily but not between each toe
- Avoid scratching skin as it may lead to wound or bleeding

Footwear

Soft cushioning inner sole
For better comfort

Firm back (heel counter)

Low heel

Adjustable ankle fastening (lace or velcro)
To hold feet in place and reduce rubbing within shoes

Soft and breathable materials
To prevent too much moisture within shoes

Deep and wide toe box
- To let toes wiggle freely
- Make sure shoes are broad enough for feet and any deformities
- Make sure there is one thumb’s width of space between toes and tip of the shoes

Firm at back and middle sections of the sole
To support middle part of the foot (arch)

Flexible at front section of the sole
To allow natural movement of toes when walking

Watch out for:
- Blister, wound, corn, callus, or toenail abnormality
- Redness, swelling, bruise, or increased warmth

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References


About the Agency

The Agency for Care Effectiveness (ACE) is the national health technology assessment agency in Singapore residing within the Ministry of Health (MOH). ACE develops evidence-based “Appropriate Care Guides” or ACGs to guide a specific area of clinical practice. ACGs are aimed at complementing MOH Clinical Practice Guidelines when these are available, by providing additions and updates as reflected in the evidence at the time of development, and incorporating cost-effectiveness considerations where relevant. The ACGs are not exhaustive of the subject matter. When using the ACGs, the responsibility for making decisions appropriate to the circumstances of the individual patient remains with the healthcare professional. This ACG will be reviewed 3 years after publication, or earlier, if new evidence emerges that requires substantive changes to the recommendations.

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