

# MODULE 6:

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Diabetic Foot Ulcers  
(Approx 30 minutes)

# Learning Objectives

At the end of this module, learners will be able to:



Assess severity of diabetic foot ulcers and wound infections



Implement recommended antimicrobial management for infected wounds



Describe the role of debridement and offloading in management of diabetic feet

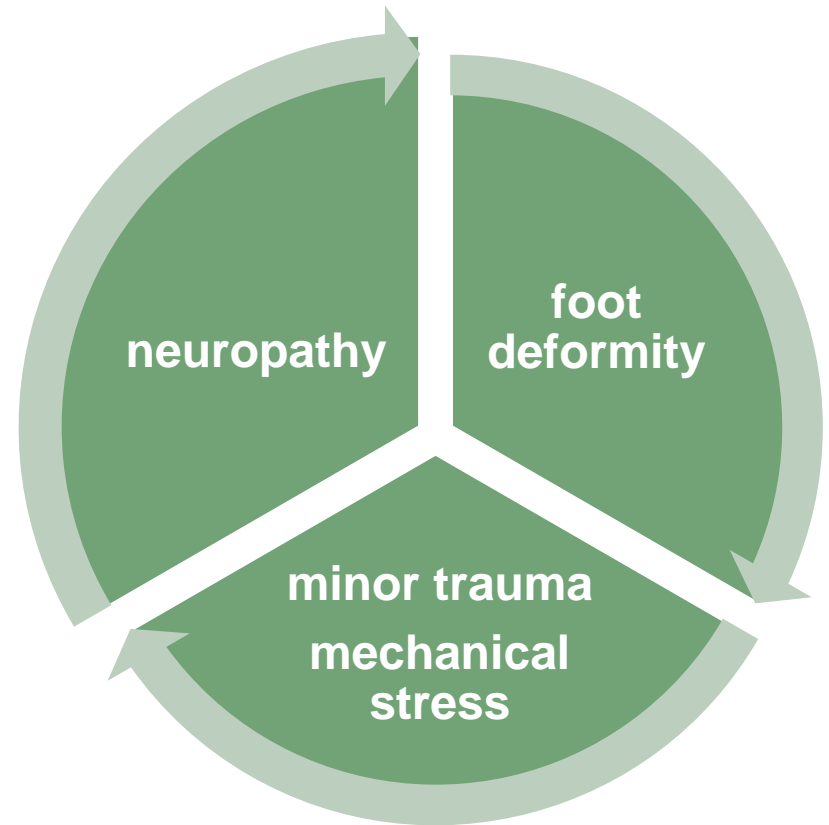
## **TRIAGE DECISION:**

- URGENT REFERRAL (red flags) –
- NON-URGENT REFERRAL to hospital swab in referring physician / NI
- NON-URGENT REFERRAL for vascular diabetic foot ulcers should also

Use pathway tools to support recommended management of diabetic foot ulcers

# Etiology of Diabetic Foot Ulcers (DFU)

- More than 60% of DFU result from critical triad of
  - Neuropathy
  - Deformity
  - Minor trauma
- Diabetic Neuropathy most important etiologic component
- Minor trauma (usually caused by footwear) is often preventable



# Risk factors for DFU

- Diabetic neuropathy
- Peripheral Arterial Disease or other CVD
- Foot deformity
- Past history of foot ulcer
- Prior amputation
- Poor glycemic control
- Smoking
- Diabetic nephropathy – particularly end-stage CKD on dialysis (4x increased risk of DFU compared to CKD not on dialysis)

# Characteristics of DFU

- Skin ulceration occurs over bony prominence or on callus
- Ulcer typically deep with distinct borders
- Surrounding skin atrophic
- Associated diabetic foot complications
  - neuropathy, signs of chronic ischemia/PAD
- Ulceration may be obscured by
  - callus
  - boggy slough (yellow, green, brown)
  - dry eschar (black, brown)
  - blister

Ulcer covered by eschar



Ulcer covered by blister





Suspect underlying tissue ulceration/necrosis if adjacent area is purple, painful, fluctuant, hotter or colder than surrounding skin.



Blister formed under callus and extending onto medial foot



Relatively innocent-looking ulcer in callus but significant subcutaneous tissue involvement

# Stages of DFU



1. Skin intact; localized erythema over bony prominence, pressure point or callus



2. Shallow wound or ruptured blister



3. Full tissue loss, but no tendon or bone exposure



4. Deep tissue loss with bone, tendon or muscle exposure



# Principles of DFU Management

## Wound dressings:

- maintain moist wound healing environment

## Offloading:

- redistribution of pressure away from ulcerated skin

## Treat infection:

- oral or systemic antibiotics – use LEW pathway antibiotic protocol as a guide
- there is no role for topical antibiotics if suspicion of infection

**Mainstay of wound healing is offloading pressure from wound.** “It is not what one puts on a wound that heals it, but what one takes off.”



# Principles of DFU Management

## Debridement:

- done by surgeons and wound care specialists

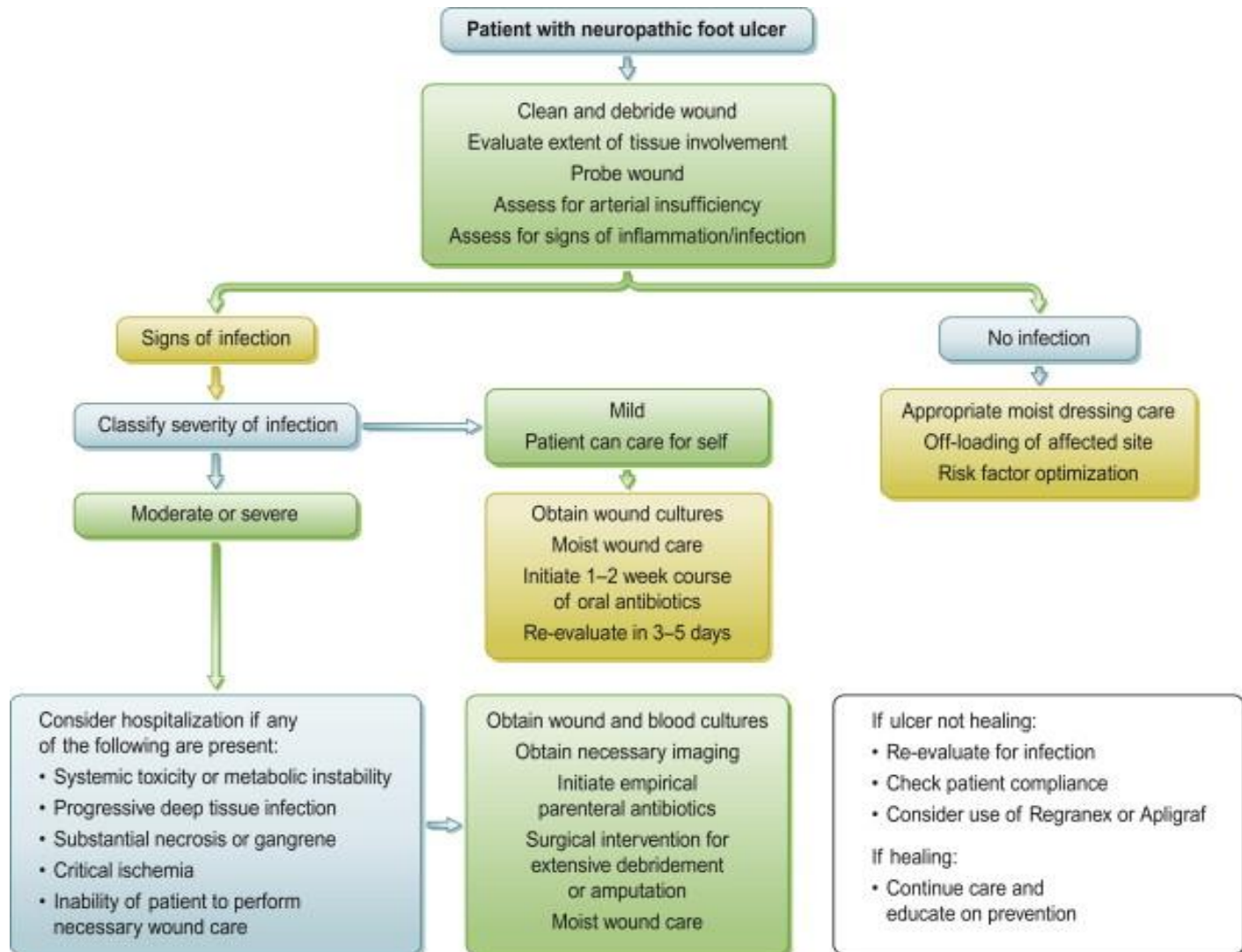
## Improve blood supply:

- endovascular intervention/surgery if large vessel PAD (This requires assessment by vascular surgery, hence rationale for specialist referral of all DFU)

## Optimal glycemic control:

- blood sugars higher than 11mmol/L impair immune response and wound healing

# Principles of DFU Management



# LEW referral for DFU management

- For most DFU, use the **LEW Pathway referral form** to make a non-urgent referral to both the homecare team and a vascular specialist.
- Homecare can initiate appropriate wound care while waiting for specialist consult.
- Medical leaders for the LEW Pathway recommend that ALL diabetic foot ulcers are referred to vascular surgery for an initial assessment to determine if vascular investigations /interventions are required.
- Once the LEW Pathway is fully established, and there are adequately trained and experienced nurses throughout the province, this early specialist referral may not be required for non-severe DFUs.

# LEW Pathway referral form

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## SIGNS OF INFECTION (IF ANY):

### 2 OR MORE SIGNS OF SEVERE INFECTION INDICATE URGENT SPECIALIST REFERRAL

Mild – moderate	<input type="checkbox"/> purulent exudate <input type="checkbox"/> skin erythema <2cm surrounding ulcer
Severe	<input type="checkbox"/> systemic signs/toxicity <input type="checkbox"/> cellulitis (skin erythema >2cm surrounding ulcer) <input type="checkbox"/> odor <input type="checkbox"/> deep tissue involvement (bone, joint, abscess) <input type="checkbox"/> increasing pain

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## RECENT LAB TESTS:

A1C \_\_\_\_\_ (DD/MMM/YYYY)     Creatinine \_\_\_\_\_ (DD/MMM/YYYY)     eGFR \_\_\_\_\_

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## TRIAGE DECISION:

- URGENT REFERRAL (red flags) – send patient to ER, or page on-call vascular surgeon and fax this form
- NON-URGENT REFERRAL to homecare for treatment according to pathway protocols (*home care nurse may order a wound swab in referring physician / NP name if required*) – fax this form to nearest homecare team
- NON-URGENT REFERRAL for vascular assessment of diabetic foot ulcer – fax this form to vascular specialist. Non-urgent diabetic foot ulcers should also be referred to homecare for initiation of treatment.

To open a PDF of *Referral Form-Lower Extremity Wound Pathway*, click on the link in the sidebar.



# Diabetic Foot Ulcer

Clinical pearls – suggested by wound care nurses and surgeons:

- >2 cm of skin erythema around a diabetic lower limb ulcer may be indicative of limb-threatening infection (need to admit for IV antibiotics, limb elevation, wound care).
- Presence of pain in a previously insensate foot can be the first and most important indicator of severe infection or underlying osteomyelitis.
- Need to consider other diabetic complications such as CKD before selection and dosing of antibiotics for diabetic foot infections.
- Selection of antibiotic must be guided by previous/recent antibiotics used by patient.
- Poor glycemic control delays ulcer healing.

# Signs of Wound Infection in DFU

Increased bacterial burden in wound results in:

- Friable or hyper-granulation tissue in wound bed (raised, deep/bright red, bleeds readily)
- Increased amount of exudate
- Purulent exudate (greenish or yellow)
- Necrotic slough on wound base
- Odour persistent after wound cleansing
- Increased surrounding skin erythema

# Severe Diabetic Foot Infection



# Antibiotic therapy for infected DFU

Key principles to consider and guide selection:

## Duration of wound and probable bacteria

- short duration – mostly Staph and Strep
- duration greater than 4 weeks – likelihood of anaerobic bacteria

## Severity of infection

- moderate or severe infection/cellulitis – need to consider both Gram negative and positive bacteria

## Renal function

- need to adjust antibiotic dose if eGFR <30 ml/min

## If high risk for CA-MRSA

- sulfamethoxazole/trimethoprim or doxycycline mild infections;
- vancomycin moderate-severe infections

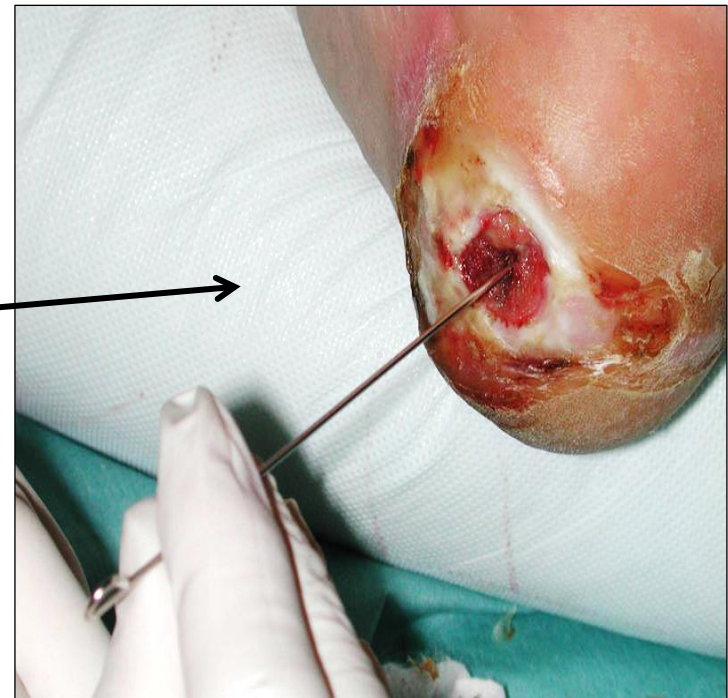


# Antibiotic therapy for infected DFU

## Suspected Osteomyelitis

- Probe-to-bone test (metal probe inserted into wound; positive test if probe contacts bone – increased likelihood of osteomyelitis)
- MRI (MRI best imaging test; nuclear medicine bone scan lacks specificity)

Probe-to-  
bone test



# Antibiotic therapy for infected DFU

- Use LEW Pathway Antimicrobial Therapy chart to guide antibiotic selection.

To open a PDF of *Antimicrobial therapy for diabetic foot infection*,  
click on the link in the sidebar.



- **If severe infection, refer to vascular surgery.**  
Tertiary care is recommended.
  - Complex antibiotic regimens; imaging may be required.
  - Not infrequently these patients develop acute-on-chronic renal failure.

Infection Severity	Preferred Empiric Regimens	Alternative Regimens	Comments
<p><b>Mild</b></p> <ul style="list-style-type: none"> <li>Cellulitis less than 2 cm and without involvement of deeper tissues</li> <li>Non-limb threatening</li> <li>No signs of systemic toxicity</li> </ul>	<p><b>Wound less than 4 weeks duration</b></p> <ul style="list-style-type: none"> <li>cephalexin 500 mg PO four times daily*</li> </ul> <p><b>Wound greater than 4 weeks duration</b></p> <ul style="list-style-type: none"> <li>sulfamethoxazole/trimethoprim 800/160 mg PO twice daily* + metronidazole 500 mg PO three times a day</li> <li>clindamycin 450 mg po three times daily + ciprofloxacin 500 mg po twice daily</li> </ul>	<p><b>Wound less than 4 weeks duration</b></p> <ul style="list-style-type: none"> <li>clindamycin 450 mg PO three times daily (only if severe <math>\beta</math>-lactam allergy)</li> </ul> <p><b>Wound greater than 4 weeks duration</b></p> <ul style="list-style-type: none"> <li>amoxicillin/clavulanate 875/125mg PO twice daily*, OR</li> <li>doxycycline 100 mg PO twice daily + metronidazole 500 mg PO three times daily</li> </ul>	<ul style="list-style-type: none"> <li>Outpatient management with oral antibiotics recommended.</li> <li>Tailor regimen based on C&amp;S results &amp; patient response.</li> <li>Consider risk for CA-MRSA</li> </ul>
<p><b>Moderate</b></p> <ul style="list-style-type: none"> <li>Cellulitis greater than 2 cm or involvement of deeper tissues</li> <li>Non-limb threatening</li> <li>No signs of systemic toxicity</li> </ul>	<p><b>Wound less than 4 weeks duration</b></p> <ul style="list-style-type: none"> <li>cefazolin 1 g IV q8h* , OR</li> <li>ceftriaxone 1 g IV once daily (to facilitate outpatient management when ambulatory administration of ceFAZolin not possible)</li> </ul> <p><b>Wound greater than 4 weeks duration</b></p> <ul style="list-style-type: none"> <li>cefazolin 1 g IV q8h* + metronidazole 500 mg PO three times daily, OR</li> <li>ceftriaxone 1 g IV once daily + metronidazole 500 mg PO three times daily (to facilitate outpatient management when ambulatory administration of cefazolin not possible)</li> </ul>	<p><b>Wound less than 4 weeks duration</b></p> <ul style="list-style-type: none"> <li>moxifloxacin 400 mg PO once daily* (only if severe <math>\beta</math>-lactam allergy)</li> </ul> <p><b>Wound greater than 4 weeks duration</b></p> <ul style="list-style-type: none"> <li>moxifloxacin 400 mg IV/PO once daily*</li> <li>piperacillin-tazobactam iv 4.5g q8h</li> <li>carbapenem iv, consult ID</li> </ul>	<ul style="list-style-type: none"> <li>Initial management with inpatient or outpatient parenteral therapy with rapid step-down to oral therapy after 48 to 72 hours based on patient response recommended.</li> <li>Tailor regimen based on C&amp;S results &amp; patient response.</li> <li>Consider risk for CA-MRSA .</li> </ul>
<p><b>Severe</b></p> <ul style="list-style-type: none"> <li>Systemic signs of sepsis</li> <li>Limb or foot threatening</li> <li>Extensive soft tissue involvement</li> <li>Pulseless foot</li> </ul>	<ul style="list-style-type: none"> <li>piperacillin-tazobactam 3.375 g IV q6h* or 4.5g iv q8h</li> <li>if high risk for CA-MRSA, add vancomycin 25 mg/kg loading dose, or Linezolid po 600 mg BID</li> </ul>	<ul style="list-style-type: none"> <li>moxifloxacin 400 mg po once daily*</li> <li>ciprofloxacin 500 mg po twice daily + metronidazole iv or clindamycin iv</li> <li>ceftriaxone 2g iv q24h + metronidazole 500 mg iv q8h</li> <li>iv carbapenem, consult ID</li> </ul>	<ul style="list-style-type: none"> <li>Inpatient management recommended.</li> <li>Urgent vascular assessment if pulseless foot.</li> <li>Tailor regimen based on C&amp;S results &amp; patient response.</li> </ul>

\*Adjust dose if eGFR  $\leq$  30 ml/min

### Clinical Pearls:

- Always consider risk for CA-MRSA..
- **Bacteria change with duration of wound and severity of infection:**
  - In **short duration** ulcers - targeting Staph and Strep initially;
  - with **longer duration** wounds - anaerobes may be an issue;
  - with **severe infections** - need to think about gram negatives and MRSA
- **Debridement, good glycemic control and appropriate wound care** are essential for the management of diabetic foot infections.
- **Cultures:** prefer tissue specimens post-debridement and cleansing of wound.
- Surface or wound drainage swabs not recommended.
- Positive probe-to-bone test indicative of osteomyelitis.
- **Imaging:** recommend plain radiography, MRI if concerned about osteomyelitis (radionuclide imaging unnecessary).

### Duration of Therapy:

- Soft tissue only – 2 weeks
- Bone involvement with complete surgical resection of all infected bone – 2 weeks
- Bone involvement with incomplete surgical debridement of infected bone – 6 weeks IV
- Bone involvement with no surgical debridement – 6 weeks IV, followed by 6 weeks PO

### References:

1. Bowering K, Embil JM. Canadian Diabetes Association 2013 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada: Foot Care. Can J Diabetes 37(2013) S145-S149
2. Lipsky BA, Berendt AR, Cornia PB et al. 2012 Infectious Disease Society of America Clinical Practice Guidelines for the Diagnosis and Treatment of Diabetic Foot Infections. CID 2012;54(12):132-173
3. Lipsky BA, Armstrong DG, Citron DM et al. Ertapenem versus piperacillin/tazobactam for diabetic foot infections (SIDESTEP): prospective, randomized, controlled, double-blinded, multicentre trial. Lancet 2005; 366:1695 – 1703
4. Blond-Hill E, Fryters S. Bugs & Drugs An Antimicrobial/Infectious Diseases Reference. 2012. Alberta Health Services

# DFU Treatment: Offloading

- Offloading refers to directing pressure from weight-bearing away from the ulcerated area of the patient's ankle and foot.
- In the past patients were prescribed bed rest, wheelchairs or canes to help keep weight off of feet.
- Modern offloading is done with shoe padding, contact casting, or custom shoes and braces. These remove weight from wounds while allowing ambulation.
- There is strong consensus among surgeons and wound specialists that appropriate offloading is as important as correct wound dressing.

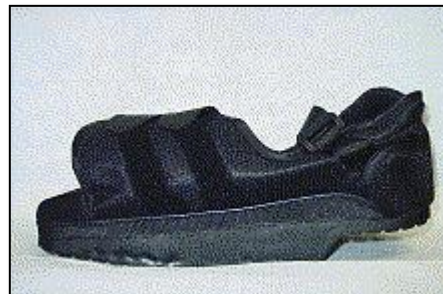
# A few facts about DFU and offloading – Canadian data

- Probability of a DFU healing without complications is 31% without use of an offloading device, increasing to 64% when an offloading device is effectively used.
- Despite this data, there is currently no coverage for short-term offloading devices.
- If an individual has had foot/lower limb amputated for DFU, the other foot is at high risk of developing DFU, and also increased risk of stump skin ulceration.
- Death following amputation for DFU is estimated at 20-40% at one year, and 60-80% at 5 years.



# Short-term offloading

- Customized padding can be placed in the patient's shoe; shoe must be deep enough to accommodate this.
- Consider “healing shoe” or “post-op shoe” if patient shoes don't accommodate padding (for short term use only)
- Smaller (less than 2 cm), less complex wounds may heal with short-term offloading



# Coverage for short-term offloading

- No insurance coverage for these products.
- Padding may be supplied by homecare.
- Healing shoes may be provided by homecare but billed to patient.
- Healing shoes available for purchase from podiatrist, drugstore, shoe store or medical supply store, or order on-line.
- Cost starts at around \$30.



# Longer-term offloading

## **Total Contact Cast (TCC)**

- Provides best wound healing
- Must be removed weekly for wound assessment and re-applied
- Should be applied by specially trained cast technician – cost is covered as applied in hospital outpatient setting.



# Longer-term offloading

## Removable Cast/Air Walker

- Most commonly used type of orthoses for diabetic foot
- Custom fit by orthotist
- Studies show that healing is the same with walker as with TCC, as long as the walker is worn consistently
- Because the cast walker is removable, the patient may not wear it all the time
- If patient cannot feel pain due to neuropathy, there may be no incentive to comply with offloading
- Need to encourage patient to wear device at all times for best results



# Coverage for longer-term offloading

- All custom products are covered by private insurance / public insurance / NIHB.
- Patients who see a vascular surgeon for wound assessment and require longer-term offloading will be prescribed custom device or casting.
- Must be prescribed by specialist (e.g. vascular, plastic or orthopedic surgeon, physiatrist) and fitted by an orthotist (Regina/Saskatoon).
- These will NOT be covered with prescription by family physician or NP.

# DFU: Monitoring and surveillance

- Diabetic foot ulcers can close in 3-4 months with optimal management.
- To prevent recurrence, regular foot check-up (at every diabetic review/CDM visit) and foot care are of utmost importance.
- Encourage patient self-care.
- Encourage patients to pay attention to footwear.
- Primary care providers can play an important role in connecting patients to community resources for foot care and diabetes management.

# Physician/NP role in supporting DFU patient

- Individuals with DFU tend to possess fewer cognitive resources than individuals with similar duration DM without foot ulcer.\*
- This is potentially problematic as management of DFU requires increased demands for self-treatment and adherence to treatment regimens that may be complex and of long duration.
- Family physician/nurse practitioner can play an important role in explaining and promoting adherence; advocating for patient.

\*Reference: Natovich R et al. *Cognitive Dysfunction: Part and Parcel of the Diabetic Foot*. Diabetes Care 2016 May; dc 152838. Case control study in Israel – 95 Pts with DFU and 95 controls matched for sex, age, duration DM; Individuals with diabetic foot ulcers had significantly ( $P < 0.001$ ) lower cognitive scores than individuals with diabetes without this complication.

# References

- Hingorani, Anil et al. *The management of diabetic foot: A clinical practice guideline by the Society for Vascular Surgery in collaboration with the American Podiatric Medical Association and the Society for Vascular Medicine*. Journal of Vascular Surgery, 2016: Volume 63 , Issue 2 , 3S - 21S.
- Registered Nurses' Association of Ontario (2013). *Assessment and Management of Foot Ulcers for People with Diabetes* (2nd ed.). Toronto, ON: Registered Nurses' Association of Ontario.
- Health Service Executive, Ireland (2009). *National best practice and evidence based guidelines for wound management*.
- Bugs and Drugs – [www.bugsanddrugs.ca](http://www.bugsanddrugs.ca) 2016 Anti-infective Guidelines for Community-acquired Infections

# END OF MODULE

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Proceed to Module 6 Quiz