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# Diabetic Foot

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# Diabetic Foot Definition

- Diabetic foot is a disease complex that can develop in the skin, muscles or bones of foot as a result of nerve damage , poor circulation & or infection that is associated with diabetes
- It is syndrome in which neuropathy, angiopathy & infection leads tissue breakdown resulting in morbidity & possible amputation (WHO)



- Any foot pathology that results from diabetes or its long term results (Boulton 2002)

# Introduction

- Frequent clinical problem
- Properly managed can be cured
- 50% of Pts who get amputation die in 5 years
- Many get needless amputations



# Introduction

- Foot ulcers affect 10% diabetics in lifetime
- Impaired collagen synthesis
- Impaired wound healing
- Damage to nerves & blood vessels by high glucose levels
- Main cause is peripheral arterial disease



# Diabetic Vascular Disease Components

- Arteritis & small vessel thrombosis
- Neuropathy (possibly ischemia cause)
- Large vessel atherosclerosis
- Cause problems in weight bearing areas
- Diabetic ulcers deep
- Although More infected than other leg ulcers
- **BUT** 50% not infected



# Ulcer Evaluation

- Critical to evaluate
- Directs management
- Size, depth , appearance, location
- Try to find etiology
- Probing of ulcer
- A +ve probe –to –bone finding has high predictive value for osteomyelitis
- Odor , exudate & cellulitis



## Probe-to-Bone study

- A study of outpatients w/ diabetic foot ulcers found probe-to-bone testing to be 87% sensitive and 91% specific for osteo.
- Negative result on probe-to-bone makes osteomyelitis unlikely but does not exclude the dx.



# Investigations

- Radiographs
- Bone scan
- MRI
- Labelled Leukocytes scan
- Bone Biopsy
- Vascular status

# Radiographs

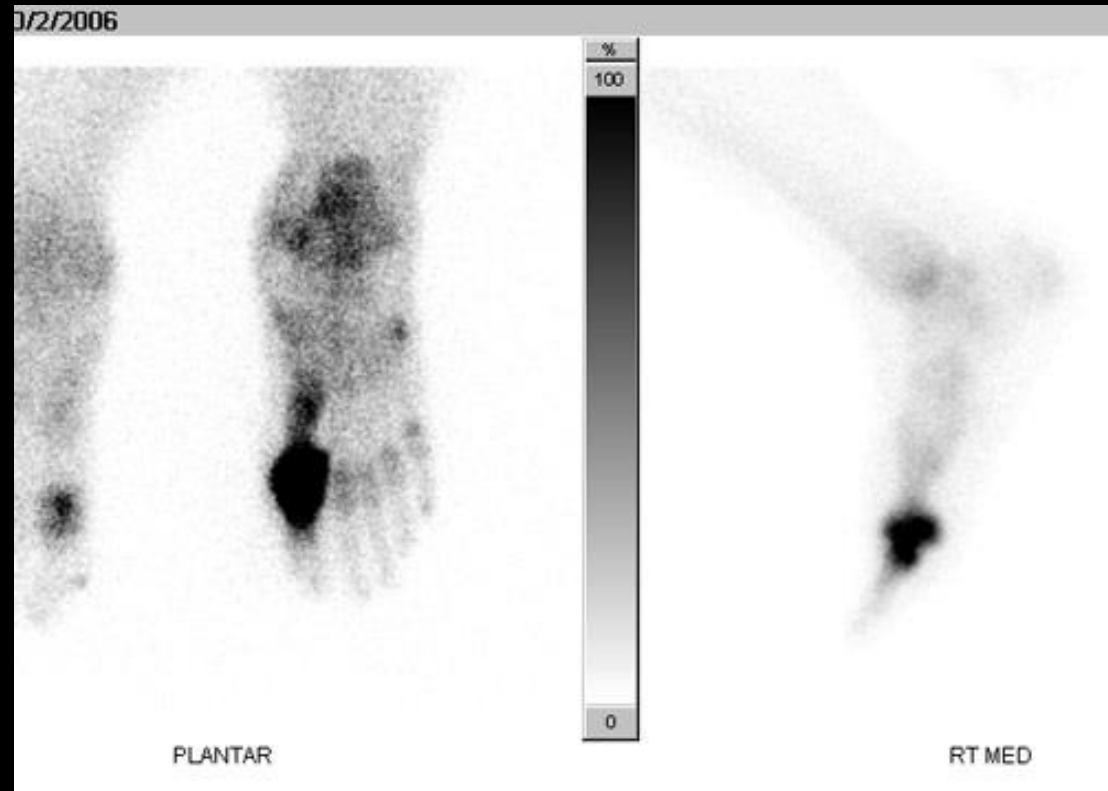
- Needs to do X-rays
- Osteomyelitis in Diabetic foot
- Not very sensitive indicators of osteomyelitis



# Bone Scan

If X-rays -ve but clinical suspicion

- Falsely +ve in hyperemia or Charcot's arthropathy
- Osteomyelitis of MTP joint
- MRI or Leukocyte scanning needed



# MRI

In a comparative analysis by Lipman(1), magnetic resonance imaging was 100 percent sensitive; however, only 25 percent specific and 50 percent accurate in detecting osteomyelitis with concomitant Charcot.

- MRI or Leukocyte scan better specificity in this situation

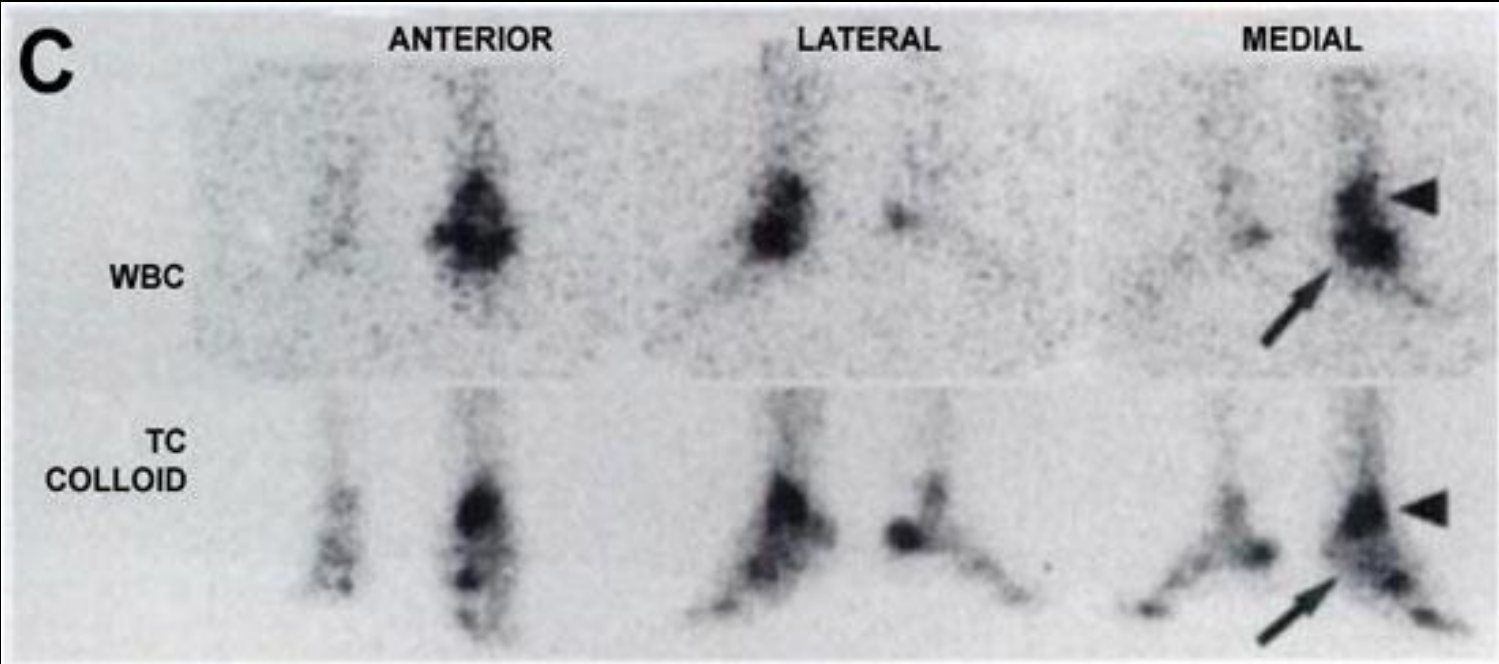


5/A/2020



B

Labeled leukocyte and marrow images are congruent in the distal left tibia and talus, consistent with marrow (arrow heads). There is uptake of labeled leukocytes without corresponding uptake of sulfur colloid (incongruent images) in the distal tarsal and proximal metatarsal bones, consistent with osteomyelitis (arrows).



# Bone Biopsy

- Necessary to establish firm diagnosis of osteomyelitis





# Vascular Status

- Must always be assessed
- Non Invasive Doppler augment clinical findings
- Simple palpation of Pedal & Popliteal pulses very reliable indicators of foot perfusion
- Absent pedal pulses with palpable Popliteal is classic finding



# International Guidelines

- Prevention, early recognition & treatment
- 
- Control of diabetes, smoking, obesity
- Daily foot checks
- Removing callosity (neuropathic foot)
- Daily moisturizing
- Regular toe nail cutting
- Well fitted footwear
- If gangrene or ulceration  
PRESERVE VIALBE TISSUE



# Patient education



Decreases the chance of occurrence

- Foot hygiene
- Daily inspection
- Proper footwear
- Prompt treatment of new lesions

Must take an active role in their care

- Disease management
- Routine nail care
- Ulcer management

Elective surgery to correct structural deformities before ulcerations occur



# Logical Approach to Treatment

- Classification of ulceration
- Extent or depth of tissue loss
- Several systems available based on
- Location
- Degree of infection
- Wagner very popular based on
- Neuropathy
- Degree of infection
- ischemia

The depth of penetration

The presence of osteomyelitis or  
Gangrene

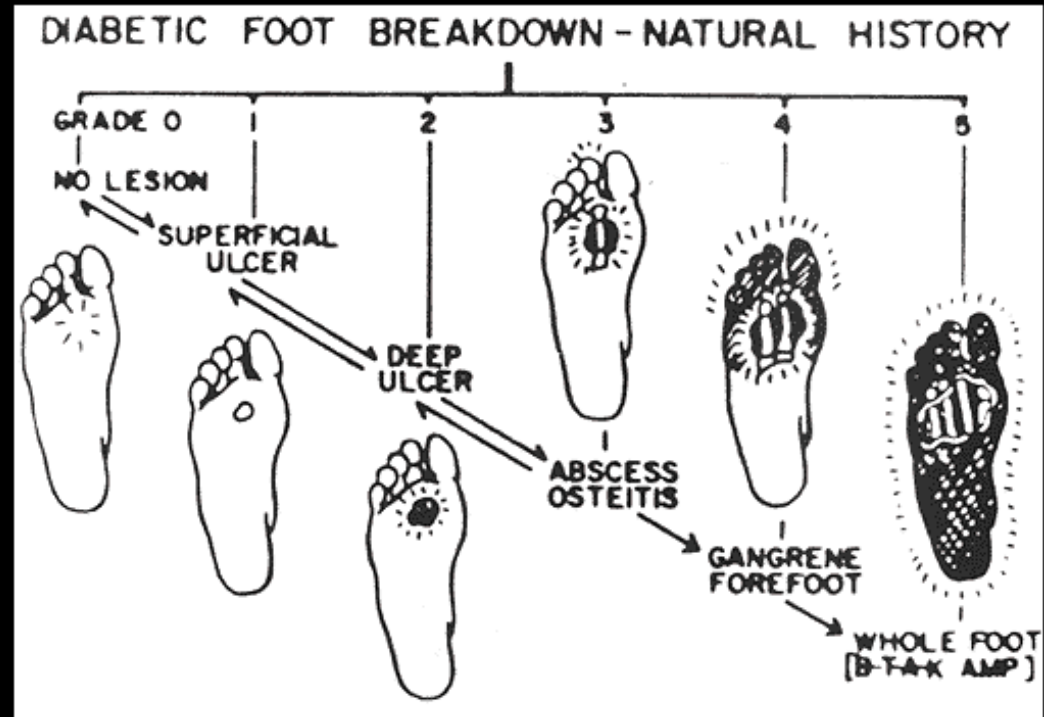
The extent of tissue necrosis

# Bases of Wagner Classification

- Depth of penetration
- Presence of osteomyelitis or gangrene
- Extent of tissue necrosis
- BUT does not address two issues
- Ischemia
- Infection

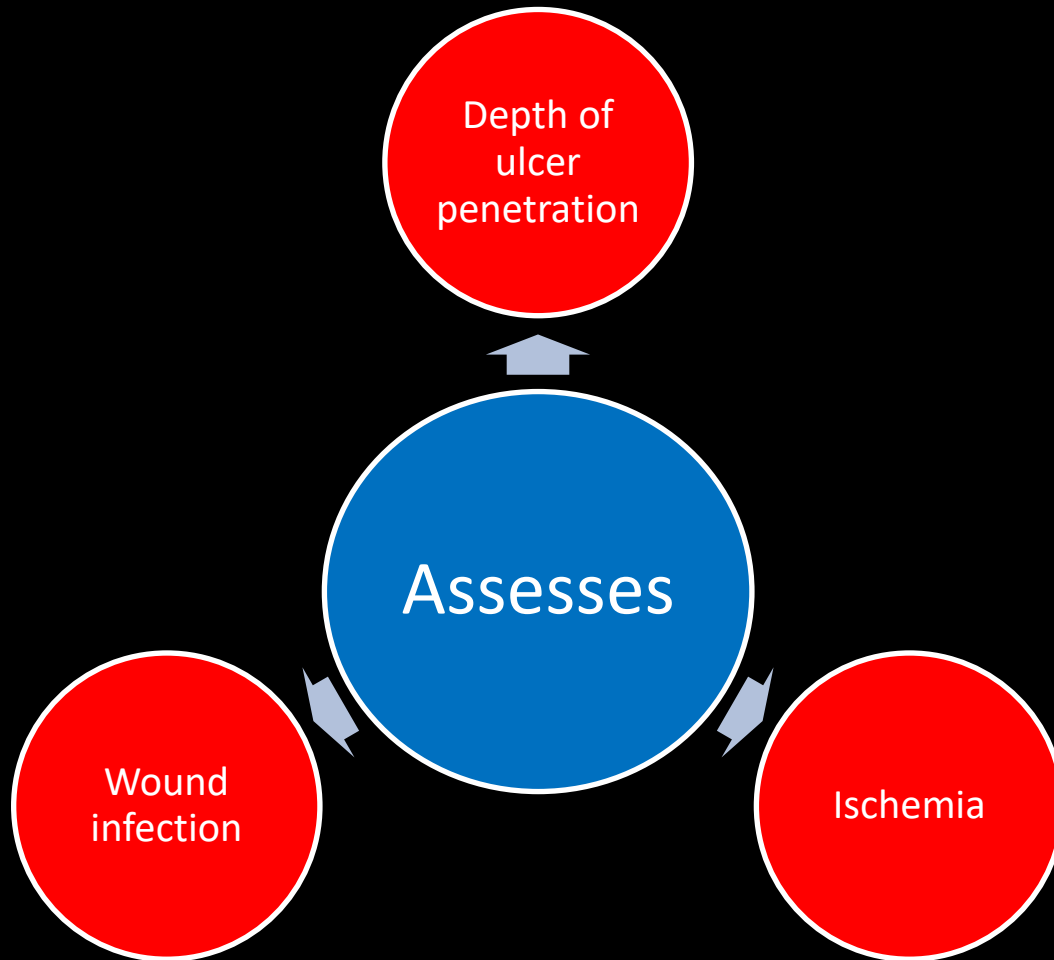
# The Wagner- Meggitt Classification

- **Grade 0** = *Intact skin*
- **Grade 1** = *superficial ulcer*
- **Grade 2** = *deep ulcer to tendon, bone or joint*
- **Grade 3** = *deep ulcer with abscess or osteomyelitis*
- **Grade 4** = *forefoot gangrene*
- **Grade 5** = *whole foot gangrene*















# University of Texas Diabetic Wound Classification



# The University of Texas Classification System for Diabetic Foot Wounds

Grade/Depth  
"How deep is the wound?"

Stage/Comorbidities  
"Is the wound infected, ischemic or both?"

	0	1	2	3
A	Pre- or post ulcerative lesion completely epithelialised 	Superficial wound not involving tendon, capsule or bone 	Wound penetrating to tendon or capsule 	Wound penetrating to bone or joint 
B	With infection 	With infection 	With infection 	With infection 
C	With ischemia 	With ischemia 	With ischemia 	With ischemia 
D	With infection and ischemia 	With infection and ischemia 	With infection and ischemia 	With infection and ischemia 

# University of Texas Diabetic Wound Classification System

Stage	Grade			
	0	I	II	III
<b>A</b> (no infection or ischemia)	Pre- or post-ulcerative lesion completely epithelialized	Superficial wound not involving tendon, capsule, or bone	Wound penetrating to tendon or capsule	Wound penetrating to bone or joint
<b>B</b>	Infection	Infection	Infection	Infection
<b>C</b>	Ischemia	Ischemia	Ischemia	Ischemia
<b>D</b>	Infection and ischemia	Infection and ischemia	Infection and ischemia	Infection and ischemia

# Treatment

- Rest & elevation of foot
- Relief of pressure
- Ill-fitting footwear need to be replaced with postoperative shoe or other type of pressure relieving footwear
- Crutches or wheelchair
- Total contact casting but needs to be careful
- Walking braces & Half shoes



# Treatment

- Debridement of all necrotic, callus & fibrous tissue
- Debridement up to bleeding tissue
- Topical enzymes have no role
- Soaking ulcer is controversial as can cause scald by hot water
- Topical medications & gels have no role as well
- Topical antiseptics as povidone-iodine toxic to healing wound

# Treatment

- Genetically platelet- derived growth factor useful in neuropathic ulcer
- Bioengineered skin & human dermis enhance healing
- Vascular consultation necessary
- Distal arterial reconstruction
- Vasodilator drugs no role
- Aerobic & anaerobic culture
- Appropriate antibiotics



**Gram-positive cocci**

*Staphylococcus aureus*, including MSSA and MRSA,  
 $\beta$ -hemolytic streptococci

**Gram-negative bacilli**

*Escherichia coli*, *Klebsiella* spp, *Proteus* spp, *Pseudomonas aeruginosa*

**Anaerobic bacteria**

*Bacteroides* spp, *Clostridium* spp, *Peptococcus* spp,  
*Peptostreptococcus* spp

*DFI: diabetic foot infection; MRSA: methicillin-resistant Staphylococcus aureus; MSSA: methicillin-sensitive Staphylococcus aureus; spp: species.*

*Source: References 6-8.*

**Table 3. Suggested Empiric Antibiotic Regimens and Monitoring Parameters for DFIs**

Infection Severity	Probable Pathogen(s)	Antibiotic Regimen(s)	Monitoring
Mild	MSSA, <i>Streptococcus</i> spp	Amoxicillin-clavulanate <sup>a</sup> 875/125 mg po q12h Cephalexin <sup>a</sup> 500 mg po q6h Clindamycin <sup>b</sup> 300-450 mg po q6-8h Dicloxacillin 500 mg po q6h Levofloxacin <sup>b</sup> 750 mg/day po	Allergic reactions Allergic reactions <i>C difficile</i> infection Allergic reactions Interaction with oral cations, QT-prolonging agents
	MRSA	Doxycycline <sup>b</sup> 100 mg po bid TMP-SMZ <sup>b</sup> 1-2 tabs (160/800 mg) po q12h	Interaction with oral cations; photosensitivity Allergic reactions
Moderate-to-severe	MSSA, <i>Streptococcus</i> spp Enterobacteriaceae, anaerobes	Ampicillin-sulbactam <sup>a</sup> 3 g IV q6h	Allergic reactions
		Cefoxitin 2 g IV q6-8h	Allergic reactions
		Ceftriaxone 1-2 g/day IV	Allergic reactions
		Ciprofloxacin <sup>b</sup> 400 mg IV (500-750 mg po) q12h + clindamycin <sup>b</sup> 600 mg IV q8h	Interaction with oral cations, QT-prolonging agents; <i>C difficile</i> infection
		Ertapenem <sup>a</sup> 1 g/day IV	Allergic reactions
		Imipenem-cilastatin <sup>a</sup> 500 mg IV q6h	Allergic reactions; seizures
		Levofloxacin <sup>b</sup> 750 mg/day IV/po ± clindamycin <sup>b</sup> 600 mg IV q8h	Allergic reactions; interaction with oral cations, QT-prolonging agents; <i>C difficile</i> infection
	MRSA	Meropenem 1 g IV q8h	Allergic reactions
		Moxifloxacin <sup>b</sup> 400 mg/day IV/po	Interaction with oral cations, QT-prolonging agents
		Tigecycline 100 mg IV LD, then 50 mg IV q12h	Increased mortality warning; NV; photosensitivity
	<i>P aeruginosa</i>	Daptomycin 4-6 mg/kg/day IV	CPK wkly
		Linezolid <sup>b</sup> 600 mg IV/po q12h	Myelosuppression; interaction with serotonergic agents
		Vancomycin <sup>a</sup> 15-20 mg/kg IV q8-12h	Infusion reactions; some nephrotoxicity
Aztreonam 2 g IV q6-8h		None	
Cefepime 2 g IV q12h		Allergic reactions	
Ceftazidime 2 g IV q8-12h		Allergic reactions	
Imipenem-cilastatin <sup>a</sup> 500 mg IV q6h		Allergic reactions; seizures	
MRSA, Enterobacteriaceae, <i>P aeruginosa</i> , anaerobes	Meropenem 1 g IV q8h	Allergic reactions	
	Piperacillin-tazobactam <sup>a</sup> 4.5 g IV q6h	Allergic reactions	
	Daptomycin, linezolid <sup>b</sup> , or vancomycin + antipseudomonal β-lactam ± metronidazole <sup>b</sup> 500 mg IV/po q8h	See above; interaction with alcohol (metronidazole)	

<sup>a</sup> Antibiotics shown to be effective in clinical studies that included DFIs.

<sup>b</sup> Antibiotics with excellent oral bioavailability.

*C difficile*: Clostridium difficile; CPK: creatine phosphokinase; DFI: diabetic foot infection; LD: loading dose; MRSA: methicillin-resistant *S aureus*; MSSA: methicillin-sensitive *S aureus*; NV: nausea and vomiting; *P aeruginosa*: Pseudomonas aeruginosa; *S aureus*: Staphylococcus aureus; spp: species; tab: tablet; TMP-SMZ: trimethoprim-sulfamethoxazole.

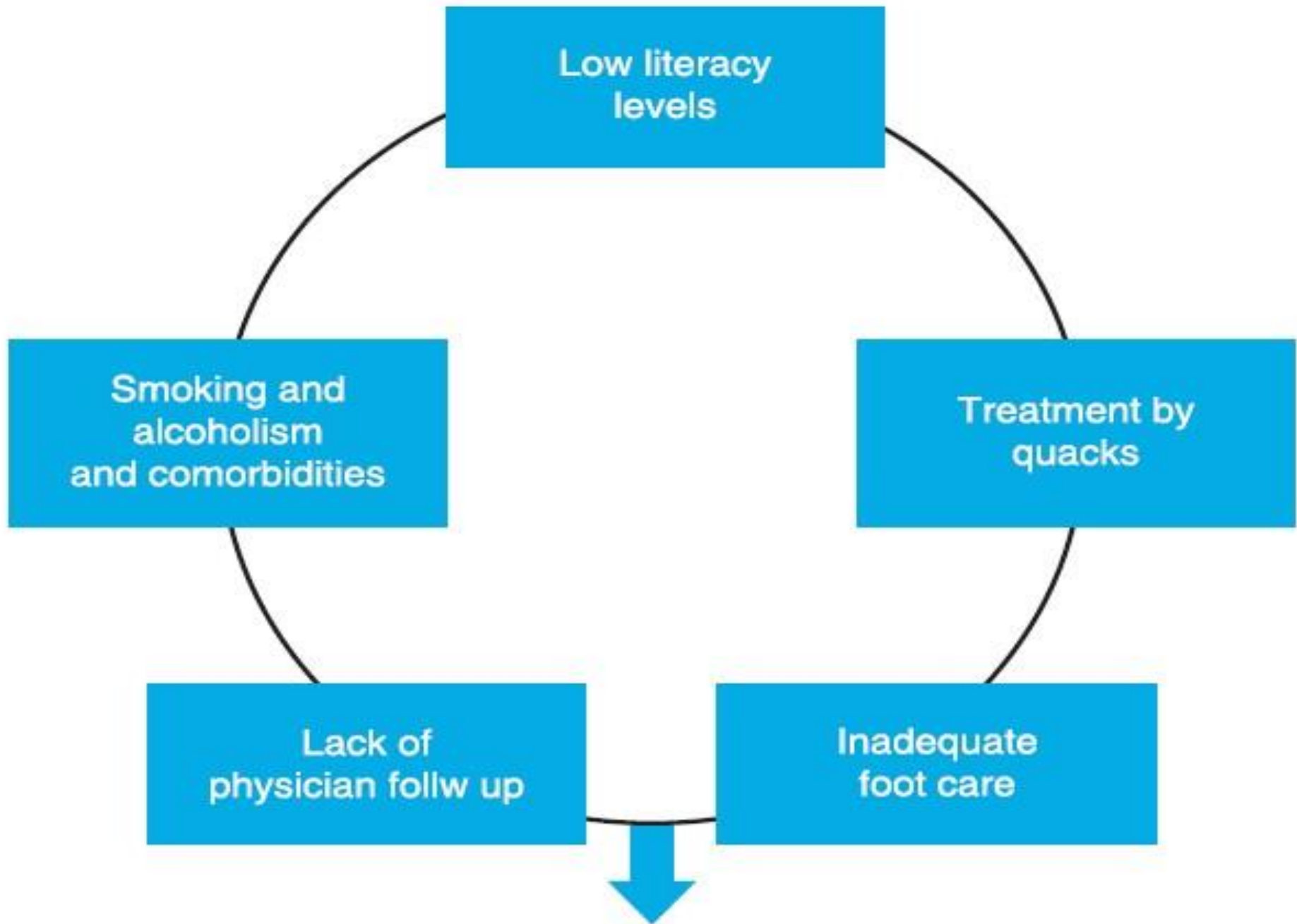
Source: References 6, 15.

# Duration of Antibiotics

- Infection is polymicrobial
- Mild infection mostly caused by Gram +ve cocci
- 1<sup>st</sup> generation cephalosporin or beta-lactamase inhibitors
- Moderate to severe infections by vancomycin, levofloxacin & metronidazole
- 2/52 mostly by most experts
- In osteomyelitis longer time

# Primary Amputation

- Aim is to
- Relieve pain
- Rapid & successful mobility with artificial limb
- Peripheral arterial disease & infection are predictors of amputation
- P t's symptoms, clinical & radiology findings dictate level of amputation
- Most surgeons observe intraoperative bleeding
- Below knee is Gold standard



Risk factors culminating in diabetic foot amputations

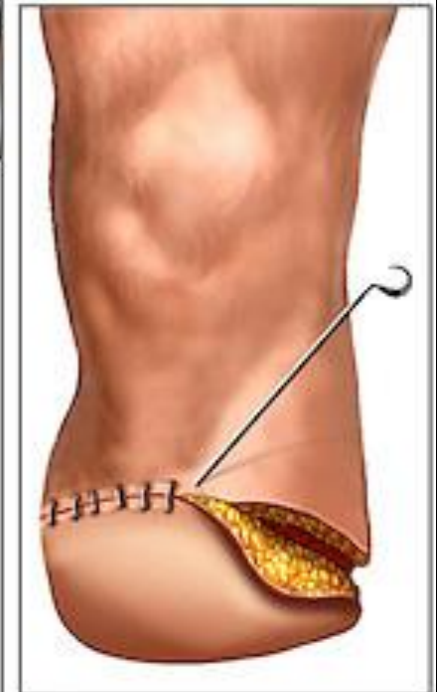
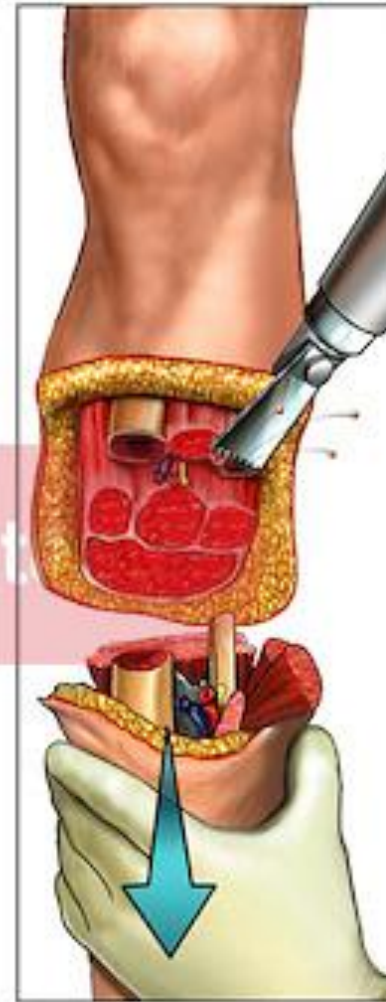
# Amputation

- Below knee
- 80% become independently mobile with it
- Others are
- Syme's amputation
- Ray amputation
- Trans metatarsal amputation
- Amputation of toe



# Below Knee Amputation

## Pre-operative Condition



# Complications of Below knee Amputation

- Inclusion of sensory nerve in ligature- Pain
- Poor healing with necrosis of skin edges
- Wound breakdown - inadequate blood supply
- Phantom pain
- Wound infection gas gangrene
- Flexion contracture

# indications for conservative surgical approach or primary amputation

Debridement / Minor amputation	Primary Amputation
Good blood supply to foot but infected	Wet gangrene ( Infection + Ischemia)
Small vessel disease & gangrenous toes	Life threatening sepsis
Successful surgical by pass	Extensive muscle necrosis
Neuropathic with little arterial disease	Revascularization technically impossible
Osteomyelitis with little arterial disease	Bed ridden patient/ functionally useless limb

???

Summary &  
Conclusion