

CLINICAL PRACTICE GUIDELINES

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MANAGEMENT OF DIABETIC FOOT



MINISTRY OF HEALTH MALAYSIA



ACADEMY OF MEDICINE MALAYSIA

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- The members of the Advisory Panel
- The members of the Technical Advisory Committee on Clinical Practice Guidelines, Ministry of Health Malaysia
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- All those who had provided valuable input and feedback.

GUIDELINE DEVELOPMENT AND OBJECTIVES

Guideline Development

Foot complications are common in diabetic patients and are associated with a high amputation rate as well as being life threatening. It also accounts for substantial health care cost and resources. It is a major burden to the patient and the health care system. Currently there is variation in the management of these patients due to various factors stressing the need for a patient oriented multidisciplinary approach as well as a structured organization with facilities for providing foot care. For such an approach to be useful concerted effort by all health care providers working with diabetic patients is required and specific guidelines are needed to ensure uniformity in diabetic foot care. There is still lack of awareness, knowledge and skills by both the diabetic patients and health care providers resulting in poor management of the “at risk foot.”

This clinical practice guideline has been compiled by a committee comprising of Orthopaedic Surgeons and a Vascular Surgeon with input from an Advisory Panel, which comprises of Orthopaedic Surgeons, Vascular Surgeon, Rehabilitation Specialist, Endocrinologist, Podiatrist and Clinical Nurse specialist from the public and private sectors as well as from the Universities. This Guideline helps to identify diabetic patients at risk of foot complications and also serve as a guide for the management of Malaysian diabetic patients’ with foot disorders.

Objectives

The aim of the guideline is to present evidence based recommendations to assist health care providers in the proper detection and management of the “at risk foot” in diabetic patients.

Clinical Questions

The clinical questions of these guidelines are: -

1. Could complications to the “at risk foot” in diabetic patients be reduced with proper evaluation and management?
2. Could the amputation rate and the cost of management of diabetic patients with foot complications be reduced if there is a multidisciplinary team approach as well as a structured organization with facilities for providing foot care?

Target Population

These guidelines are to be applied to diabetic patients.

Target Group

These guidelines are developed for all health care providers involved in the evaluation and management of cases with diabetes and diabetic foot disorders.

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EVIDENCE IDENTIFICATION AND SEARCH STRATEGIES

Literature search for this CPG was made mainly through bibliographic databases found in PubMed and Medline. Some “hand searches” were also carried out in books, non-indexed journals and “grey literature”. Extensive use was made of recent review articles and bibliographies. The experience and knowledge of the CPG development group and Advisory Panel were also considered. Search was limited to English Language citations only. Assessment of abstracts and papers retrieved was conducted independently by any two members of the CPG development group and any disagreements were resolved by discussion. In each area considered, the best evidence available was given importance and used whereas lesser design studies were either merely mentioned or excluded, unless they add a different view for understanding.

EVALUATION OF GUIDELINES

The draft guideline has been reviewed by members of the Advisory Panel. It was also posted on the Ministry of Health Malaysia and Academy of Medicine Malaysia websites for public viewing and opinion.

KEY TO EVIDENCE STATEMENTS AND GRADES OF RECOMMENDATIONS

The recommendations given in this guideline are evidence based wherever possible or explicitly linked to evidence whenever available. Where evidence is not available, recommendations were based on consensus of CPG development group and will be clearly stated as such. The levels of evidence scale used in this guideline are adapted from Catalonian Agency for Health Technology Assessment of Spain (CAHTA). The Grades of Recommendation is also given below.

LEVELS OF EVIDENCE

Level	Strength of Evidence	Study Design
1	Good	Meta-analysis of RCT, Systematic reviews.
2	Good	Large sample of RCT
3	Good to fair	Small sample of RCT
4		Non-randomised controlled prospective trial
5	Fair	Non-randomised controlled prospective trial with historical control
6	Fair	Cohort studies
7	Poor	Case-control studies
8	Poor	Non-controlled clinical series, descriptive studies multi-centre
9	Poor	Expert committees, consensus, case reports, anecdotes

GRADES OF RECOMMENDATIONS

A	Requires at least one randomized controlled trial as part of a body of literature of overall good quality and consistency addressing the specific recommendation. (Evidence level, 1,2 & 3)
B	Requires the availability of well-conducted clinical studies but no randomized clinical trials on the topic of recommendation. (Evidence level,4,5,6,7 & 8)
C	Requires evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities. Indicates an absence of directly applicable clinical studies of good quality. (Evidence level, 9)

Good Practice Points

@ Recommended best practice based on the knowledge and clinical experience of the guideline development group and Advisory Panel.

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1. Introduction

Diabetes Mellitus is a common disease affecting 30 million people worldwide. In Malaysia, the prevalence rate has been reported to have increase from 6.3% in 1986 to 14.6% in 1996¹. Fifteen percent of patients with diabetes mellitus will develop a lower extremity ulcer during the course of their disease^{2,3}. The prevalence of foot ulceration in patients attending a diabetic outpatient clinic in Malaysia has been reported as 6%⁴. Diabetic foot complications pose a substantial problem in the Malaysian diabetic population. They are a major source of morbidity, a leading cause of hospital bed occupancy and account for substantial health care costs and resources⁵. Foot complications have been found to account for 12% of all diabetic hospital admissions, which in turn made up 17% of all hospital admissions at Hospital Kuala Lumpur, Malaysia⁶.

Foot complications result from a complex interplay of ischaemia, ulceration, infection and diabetic Charcot's joint. They can be reduced through appropriate prevention and management. It is envisaged that these clinical practice guidelines, which has been compiled, can be used to identify patients at risk of foot complications, and serve as a guide for the management of Malaysian diabetics with foot disorders. Each patient however should be treated according to the individual's clinical, socioeconomic and domestic situation.

The objectives of these guidelines are to prevent limb loss and life threat; maintain quality of life through the prevention, early recognition and treatment of foot complications; prevent recurrence; and provide education to the patient and health care providers⁷.

2. APPROACH TO A PATIENT WITH DIABETIC FOOT PROBLEMS

2.1 Diagnosis and Evaluation

The evaluation of the diabetic foot requires a detailed history and physical examination, appropriate diagnostic procedures and identification of risk factors for ulceration, amputation, infection and Charcot's arthropathy. These can then identify patients at risk, institute and / or improve preventive measures and formulate appropriate management strategies.

2.1.1 History

This should include the general, medical and foot and ulcer history. Emphasis should be placed on the following points:

General and Medical History

- History of presenting foot complaints and duration
- Duration of diabetes, management and control
- Cardiovascular, renal, ophthalmic evaluation & other co morbidities
- Social history – alcohol / tobacco / occupation / dietary habits
- Current medication and antibiotic use
- Allergies
- Past Medical & Surgical history
- Cultural habits – walks barefoot / wets feet at work / wear socks / walks a lot
- Patients' perception of Diabetes Mellitus, necessity of weight and diet control
- Able to afford diabetic drugs

History of Foot Problems

- Daily activity and current diabetic foot status
- Footwear – shoes / slippers / sandals / use different footwear / Fit
- Foot-care – aware of foot problem / inspect foot / wash feet / proper nail clipping / attend podiatry
- Callus formation
- Deformities and previous foot surgery
- Neuropathy and ischemic symptoms
- Skin & nail problems – sweaty feet / fungal infections / skin disease / blisters / Ingrown toenails

History of Foot Ulcer

- Site, size, duration, odour and type of drainage
- Precipitating event or trauma
- Recurrences – number of times
- Associated infections
- Frequency of hospitalizations and treatment given
- Wound care / measures to reduce plantar pressure
- Patient compliance
- Previous foot trauma or surgery
- Features of Charcot's joint

2.1.2 Physical Examination

It is important to identify the key risk factors on physical examination. All diabetic patients should receive a thorough foot examination at least once a year⁸. The following are the key components of the examination:

A. General Examination of the patient (including the extremities)

- a. Include signs of inflammation (pyrexia, ascending infection, lymphangitis and sepsis).

B. Local Examination – compare both lower extremities

Evaluation of the musculoskeletal status of the foot and leg

- Attitude and posture of lower extremities and foot
- Orthopedic deformities – Hammertoes / Bunions / Pes planus or cavus / Charcot deformities / amputations / prominent metatarsal heads
- Limited joint mobility – active and passive movements
- Tendo - Achilles contractures / equines / foot drop
- Gait evaluation
- Muscle group strength testing
- Plantar pressure assessment

Evaluation of the skin and nails of the foot

- Skin appearance: color, texture, turgor, quality, and dry skin
- Calluses, heel fissures, cracking of skin due to reduced sweating in autonomic neuropathy
- Nail appearance: Onychomycosis, dystrophic, atrophy, hypertrophy, paronychia
- Presence of hair
- Ulceration, gangrene, infection
- Interdigital lesions
- Tinea pedis

Evaluation of vascular status of the foot and leg

- Pulses (dorsalis pedis, posterior tibial, popliteal, femoral)
- Capillary return (normal < 3 seconds)
- Venous filling time (normal < 20 seconds)
- Presence of edema
- Temperature gradient
- Colour changes: Cyanosis, dependent rubor, erythema
- Changes of ischemia: Skin atrophy; nail atrophy, abnormal wrinkling, diminished pedal hair

Evaluation of neurological status of the foot and leg

- Vibration perception: Tuning fork 128 Hz
- Pressure & Touch: Cotton wool (light), Monofilament (5.07) 10gm (Semmes Weinstein)
- Pain: Pinprick, using sharp and blunt tool (e.g. Neurotip)
- Two-point discrimination
- Temperature perception: hot and cold
- Deep tendon reflexes: ankle, knee
- Clonus testing
- Babinski test
- Romberg's test

Evaluation of patient's footwear

- Type and condition of shoes / sandals
- Fit
- Shoe wear, pattern of wear. lining wear
- Foreign bodies
- Insoles, orthoses

❖ ***Evaluation of foot ulcer, infection and Charcot's arthropathy*** are discussed in their respective sections.

2.1.3 Investigations

Biochemical investigations

Fasting or random blood sugar (FBS, RBS)
Glycohemoglobin (HbA1C)

- Full blood count (FBC)
- Erythrocyte sedimentation rates (ESR)
- Serum chemistries (BUSE)
- Wound and blood cultures(C&S)
- Urinalysis (Urine FEME, C&S)

Care has to be taken when assessing laboratory results as 50% of diabetic patients can have severe foot infection despite the absence of leucocytosis or fever, possibly due to impaired host defenses and attenuated inflammatory responses^{9, 10, 11, 12, 13, 14, 15}. Infection adversely affects blood sugar control and uncontrolled diabetes adversely affects infection¹⁶. Persistent or unexplained hyperglycemia despite adequate anti-hyperglycemic treatment can be used as a prognostic indicator of infection severity¹⁷.

A normal white cell count and white cell differential should not deter the physician from taking appropriate treatment to mitigate the spread of a potentially threatening foot infection. **(B)**

Imaging of Foot

The initial imaging is usually a plain radiograph of the foot^{14, 18}. However, features of osteomyelitis may not be evident until 10-14 days after the initial infection^{14, 19}. Other possible findings on plain radiographs are osteolysis, fractures, dislocations, medial arterial calcification, soft-tissue gas and Charcot's joint¹⁹.

Computer tomography (CT) scans may be used to delineate suspected bone or joint pathology not evident on plain radiographs^{14, 19}.

Radioisotope Technetium bone scans can also be used to detect early pathology such as osteomyelitis, fractures and Charcot's arthropathy. Gallium 67 citrate and Indium 111 leucocyte scans are more specific for detecting infections and differentiating infections from Charcot's arthropathy which can also present as an erythematous and warm foot^{14, 19, 20, 21, 22, 23, 24, 25, 26}.

Magnetic Resonance imaging is becoming an important imaging modality in diabetic patients with foot infections. It allows evaluation of both soft-tissue and bone pathologies. It can aid in the diagnosis of osteomyelitis, deep abscess, septic joint, tendon rupture and is superior to the other imaging modalities and also helps in surgical planning^{14, 19, 25, 27, 198}.

All diabetic patients with clinically suspicious foot infections should initially be evaluated with a plain radiograph of the foot for osteomyelitis. In doubtful cases and in those, which are difficult to diagnose, a MRI study will be helpful.

(B)

Vascular Investigations of the Lower Extremity

Vascular investigations are indicated to evaluate the extent of occlusive vascular disease and in the assessment of healing potential especially when clinical examination suggests lower extremity ischaemia^{28, 29, 30}. These include:

- Doppler segmental artery pressures.
- Ankle-brachial indices (ABI) – easy way to determine foot blood flow³¹ but may be misleading due to calcification of the arteries giving rise to higher pressures at the ankle^{32, 33}. Normal value 1.1, <0.9 abnormal.
- Toe pressure measurements – Less calcification in digital vessels enable toe pressures to be measured more accurately and be more reliable in the assessment of healing potential^{34, 35}. In general, 85%-100% of foot lesions will heal when toe pressures are >40mmHg and less than 10% will heal if <20mmHg^{29, 34, 36, 37, 38, 72}.
- Transcutaneous oxygen tension (TcPO₂) – <10mmHg correlates with non-healing, >30mmHg correlates with healing. Measurements require an experienced technician and may vary depending on measurement site^{39, 47, 72}.

Any abnormal results of the above investigations in the presence of a non-healing foot ulcer warrant a vascular assessment^{40, 41}. Determination of distal run-off and perfusion can be assessed by arteriography, digital subtraction angiography (DSA) or magnetic resonance angiography (MRA)^{42, 43}.

Estimating the ankle brachial index is an easy, readily available way to determine foot blood flow and healing potential and to detect patients who require further vascular work-up.

(B)

Neurological Investigations of Foot

Two-point discrimination, monofilament test and vibration perception are used to assess peripheral sensory neuropathy, which is major independent risk factor for diabetic foot ulceration^{44, 45, 46, 47, 48}. Sensory examination with a 5.07 Semmes-Weinstein monofilament (10gm) wire is the single most practical measure of risk assessment and is cost effective.

Peripheral neuropathy can be identified using a 5.07 Semmes-Weinstein monofilament (10gm) wire **(B)**

Assessment of Plantar Foot Pressures

High plantar foot pressures have been identified as a significant risk factor for ulceration^{44, 45, 46, 47, 48}. Measurements are to be done regularly as important changes in the distribution and level of pressures under diabetic neuropathic feet occur during a relatively short period. Harris mat and computer techniques allow qualitative and quantitative measurements of plantar foot pressures respectively. They are able to identify potential areas of ulceration^{49, 50, 51, 52, 53}.

Assessment of plantar foot pressures to be carried out regularly to establish significant changes in pressure distribution and hence dictates a change in treatment. **(B)**

2.2 Identification of risk factors

The three pathogenetic mechanisms involved in diabetic foot complications are neuropathy, infection and ischaemia. Seldom does each work in isolation. Rather, most foot problems result from a complex interplay among all three and possibly other factors such as altered foot pressures, limited joint mobility, glycaemic control and ethnic background^{39, 54}. Identification of risk factors predisposing to foot ulceration, amputation, infection and Charcot's arthropathy in the history taking and physical examination is important in the treatment and prevention of diabetic foot problems^{39, 54}.

Risk factors identified for ulceration are peripheral sensory neuropathy, vascular disease, limited joint mobility, abnormal foot pressures, minor trauma, history of ulceration or amputation, impaired vision, structural foot deformity, uncontrolled hyperglycemia, duration of diabetes, chronic renal disease and old age^{7, 55}. The most common single factor to lower limb amputations among diabetics is foot ulcer^{40, 56, 57, 64} and peripheral sensory neuropathy is the primary factor responsible for diabetic foot ulcerations^{46, 48, 58, 59}.

The risk factors for amputation are similar to those responsible for ulceration⁷. Infection is a significant risk factor of amputation although not for ulceration^{3, 47}. Chronic hyperglycemia can contribute to foot ulceration, delay normal wound healing, and is associated with foot amputations^{44, 60, 61}. A history of previous amputation is the best predictor for subsequent amputations^{45, 62, 63, 64}.

Risk factors associated with Charcot's arthropathy are peripheral sensory and sympathetic neuropathy, normal circulation with preceding trauma, often-minor^{65, 66, 67, 68}. Stresses that lead to Charcot's joint disease are foot deformities, amputations, and joint infections or surgical trauma⁶⁹.

Risk factors leading to limb threatening diabetic foot infections are hyperglycemia, impaired immunological response, neuropathy and peripheral vascular disease^{31, 41, 70}.

Identification of Risk Factors

Condition	Risk Factors
1. Foot Ulcers	Neuropathy, Peripheral Vascular Disease, Abnormal Foot Pressures, Hyperglycaemia, Trauma, Foot Deformity, Limited Joint Mobility, Previous Ulceration /Amputation, Poor Vision, Chronic Renal Disease, Old Age, Duration of Diabetes.
2. Amputation	Foot Ulcer and it's Risk Factors, Infection, Chronic Hyperglycaemia, Previous Amputations.
3. Charcot's Arthropathy	Neuropathy, Minor Trauma, Foot Deformities, Joint Infections, Amputations and Surgical Trauma.
4. Threatening Infections	Hyperglycaemia, Impaired Neurological Response, Neuropathy and Peripheral Vascular Disease.

Important to identify early the risk factors for foot complications in diabetic patients as education and early intervention will help to prevent life threatening infections, amputations, ulcerations and Charcot's arthropathy **(B)**

3. DIABETIC FOOT ULCERS

3.1 Assessment

Diabetic foot ulcers are assessed for etiology, infection, vascular and neuropathic risk factors and musculoskeletal deformities. The findings can be classified using Wagner's Classification or University of Texas Diabetic Wound Classification and treatment instituted as appropriate.

3.1.1 Lower extremity Assessment

Vascular examination and investigations are carried out as described above to identify risk factors. Check for foot pulses, dependent rubor, venous filling time, capillary return, and ankle brachial index and toe pressures. Indication for vascular consultation include an ABI of less than 0.9, toe systolic pressure <40 mm Hg or transcutaneous PO₂ levels <30mmhg^{36, 71, 72, 73, 74}.

Two point discrimination; 5.07 SW monofilament testing and vibration perception and deep tendon reflexes are undertaken in assessment for identification of neuropathic risk factors.

Musculo-skeletal examination to be done to evaluate for deformity and areas of high plantar pressure like callus, hammertoes, bunion, Charcot's joint and previous amputation causing a structurally deformed foot.

3.1.2 Ulcer Examination

Ulcer evaluation should include location, size, depth, margins, swelling, colour, odour, base, floor, type of discharge and attempts made to express pus. Their findings, on presentation are important in mapping the progress of treatment and have prognostic value during management^{40, 75}. The etiology of the ulcer (chemical vs. mechanical) and the type of ulcer (neuropathic, ischemic or neuro-ischemic) needs to be determined⁷⁶. The ulcer is probed to look for extension into bone, sinus tract, joint and tendon sheath. Probe hitting bone signifies possible underlying osteomyelitis⁷⁷. When bone is exposed, the patient is assumed to have osteomyelitis until proven otherwise^{77, 78}.

Cultures are taken when there are signs of infection and they should be taken from deeper tissues by curettage or from the wound base or aspiration of abscess material^{39, 40} and sent for aerobic and anaerobic cultures. In non-inflamed neuropathic ulcers

or clinically uninfected ulcers, the role of antibiotics in these circumstances is questionable, hence cultures may not be required ^{40, 79}. If osteomyelitis is present, bone cultures are mandatory ⁸⁰.

Radiographs and other imaging modalities are indicated depending on the clinical picture.

- Probing for bone is included in the initial assessment of all diabetic patients with infected foot ulcers. **(B)**
- Cultures should be taken from deeper tissues as superficial wound cultures are inaccurate and correlate with deep wound cultures poorly because of wound colonization. **(B)**

3.1.3 Classification of Diabetic Foot Ulcers

Diabetic foot ulcers are classified using the commonly used **Wagner's Classification** (Appendix 1)⁸¹. Wagner's Classification only grades the diabetic wound. Another useful classification, which uses grading as well as staging, is The University of Texas Diabetic Wound Classification (Appendix 2)⁸². The inclusion of stage makes this classification a better predictor of outcome ^{83, 129}.

3.2 Treatment

Proper treatment of diabetic foot ulcers can lower the incidence of lower limb amputations ^{41, 59, 75, 84, 85}. The aim is to obtain wound closure as soon as possible and to prevent recurrence.

Principles of Treatment

- Debridement of necrotic tissue
- Wound care
- Reduction of plantar pressure (off-loading)
- Treatment of infection
- Vascular management of ischaemia
- Medical management of co morbidities
- Surgical management to reduce or remove bony prominences and / or improve soft tissue cover
- Reduce risk of recurrence

Debridement of necrotic tissues

Debridement is the removal of all non-viable tissues and slough from the ulcer. It is only after a thorough wound debridement that application of topical wound healing agents, dressings or wound closure procedures are carried out ^{40, 86, 87, 88}.

- a. Surgical debridement is an important and effective procedure in the management of diabetic foot ulcers ⁸⁸. This involves surgical debridement and removal of all nonviable tissue / bone until healthy bleeding soft tissue / bone are encountered. Diabetic foot abscesses requires immediate incision and drainage. Osteomyelitic bones, joint infection or gangrene digits require resection or partial amputation ^{41, 89, 90, 91}. Regular and repeated debridement of necrotic tissue leads to early closure of the diabetic ulcer ^{88, 92}.
- b. Mechanical debridement includes surgical debridement, wet-to-dry dressings and high- pressure irrigation ^{17, 40, 60, 93, 94}.
- c. Enzymatic debridement uses topical proteolytic enzymes as adjuvant in managing chronic wounds. Their efficacy is however controversial ^{40, 60, 93}.
- d. Autolytic debridement occurs naturally in healthy, moist wound environment with adequate circulation ⁷.

Diabetic foot ulcers should be frequently and thoroughly debrided of necrotic tissues to enhance healing. **(A)**

Wound Care

After debridement, the ulcer is covered to protect it from trauma and contaminants. A moist wound environment will also facilitate healing ^{93, 95}. Factors that determine the type of dressings to be applied are wound size, depth, location, surface and discharge. Normal saline dressings are commonly used and are regarded as standard wound dressings though there is lack of evidence to support its use. There is also insufficient evidence to support the effectiveness of currently available dressings or topical agents over other forms of treatment of diabetic ulcers.^{7, 96}. Other types of wound care products are as listed in Appendix 3.

Other topical agents not readily available in Malaysia as yet but has shown promising results in clinical trials are: - (i) Growth factors, (Becaplemin gel, autologous platelets) for use in neuropathic diabetic ulcers but contraindicated in infected and necrotic

wounds^{92, 97, 98, 99, 102}. (ii) Dermal / skin substitutes, for venous stasis ulcers and diabetic foot ulcers. However, they are contraindicated in infected necrotic wounds^{93, 100, 101, 102, 103}. (iii) Contreet foam and Contreet hydrocolloid are two new silver containing dressings that show promise in promoting healing in infected venous leg ulcer and diabetic foot ulcers¹⁰⁴.

The use of dressings or topical agents depends on the health care provider's experience, type and site of ulcer, costs involved and patient's preference.

(A)

Hyperbaric oxygen therapy is available in certain centers in Malaysia and is used as an adjunctive treatment for hypoxic diabetic foot ulcers. It may be beneficial in wounds with limb threatening infections or non re-constructible ischemic limbs^{105, 106, 107, 108, 109, 110, 111, 112, 113}. However, a systematic review of the literature reveals insufficient evidence as to when to start treatment and there are no criteria that determine whether patients will benefit. Also, evidence shows that serious adverse events may occur¹¹.

Careful patient selection is important when considering hyperbaric oxygen therapy as an adjunctive treatment for diabetic foot ulcers.

(A)

Reduction of plantar pressure (Off-loading)

This involves reducing the pressure to the diabetic foot ulcer, thus reducing the trauma to the ulcer and allowing it to heal. This is an essential component of ulcer healing^{29, 40, 41, 50, 114}. The method chosen for off-loading depends on the potential compliance of the patient, the location and severity of the ulcer and the physical characteristic of the patient. Patients should not use the shoes that resulted in the initial ulceration. Modified shoes should only be used when the ulcer has healed completely^{40, 41, 50, 76}.

The methods of off-loading include:

- Total non-weight bearing.
- Total contact cast^{115, 116, 117}.
- Foot cast or boots^{118, 119}
- Removable walking braces with rocker bottom soles¹²⁰.
- Total contact orthoses – custom walking braces⁸⁸.
- Patellar tendon bearing braces¹²¹.
- Half shoe or wedge shoes¹²².
- Healing sandal – surgical shoe with molded plastizote insole^{60, 123}.

- Accommodative dressing: felt, foam, felted-foam, etc ^{60, 124, 125, 126}.
- Shoe cutouts (toe box, medial, lateral or dorsal pressure points).
- Assistive devices: crutches, walker, cane, etc.

- Reducing plantar foot pressures enables diabetic neuropathics ulcers to heal **(B)**
- Total contact casting is considered the gold standard in the treatment of neuropathic diabetic foot ulcers but requires careful application, close follow up and patient compliance with scheduled appointments to minimized complications. **(A)**

Treatment of Infection

Infection in a diabetic foot is usually secondary to ulceration ⁸⁹. Rarely, infection itself causes ulceration ⁴⁸. It can either be local or systemic. Treatment requires early incision and drainage or debridement and empirical broad-spectrum antibiotic therapy ^{40, 41}. If there is co-existing gangrene or extensive tissue loss, early amputation at the appropriate level should be considered to remove the focus of infection ^{17, 41, 91}.

Vascular Management of Ischaemia

Vascular supply to the affected limb should be assessed early ³¹ and if impaired, vascular reconstruction surgery (if feasible) should be performed prior to definitive surgical management ^{41, 127, 128, 140}.

Any clinically suspicious lower extremity ischaemia should be fully investigated and corrected before any definitive foot surgery is contemplated. **(B)**

Medical Management of Co-morbidities

Diabetes is a multi organ systemic disease. Co-morbidities must be assessed and managed via a multidisciplinary team approach for optimal outcome. Patient compliance is also important as it determines the outcome ^{129, 130, 131, 132}.

Surgical Management of Diabetic Foot Ulcers

Chronic foot ulcers are usually associated with areas of increased peak pressure where off loading and wound care techniques are not effective. These ulcers are best treated surgically¹³³ which includes removal of infected bone or joints. Such operations include metatarsal head resections, partial calcaneotomy, exostectomy, sesamoidectomy and digital arthroplasty^{60, 123, 134, 135, 136, 137, 138, 139, 140 141, 143}.

A structurally deformed foot may give rise to high-pressure areas causing ulcers that do not heal with off loading treatment or therapeutic footwear. Such deformities are treated surgically to effect healing and to prevent recurrence^{41, 60, 133, 134, 137, 142, 143, 144}. Examples are correction of hammertoes, excision of exostoses, bunions and tendo-achilles lengthening¹⁴⁵.

Amputation may be necessary in the treatment of gangrene and ulcers with osteomyelitis. All necrotic infected tissue and bone is removed until a healthy bed of viable soft tissue and bone is attained. If possible, it should be performed in a manner so as to allow for optimum function of the remaining foot⁴¹. The wounds are packed with antiseptic dressing and periodically assessed during wound care. Secondary wound healing may be the best option in most patients. The use of local flaps, split skin grafts or full thickness grafts may be required^{146, 147}.

- Chronic foot ulcer or high pressures in structurally deformed foot not amenable to treatment with therapeutic footwear or off loading techniques are treated surgically to reduce high-pressure areas or to redistribute pressure evenly so as to affect ulcer healing. **(B)**
- All infected bones and tissues are to be removed and amputation done for gangrenous parts until viable bones and tissues are attained. It is performed in such a manner so as to allow optimum function of the remaining foot. **(B)**

Preventing Ulcer Recurrence

Once an ulcer has healed it must be prevented from recurring. This will require a multidisciplinary approach with committed dedicated professionals including podiatrist, orthopaedic surgeon, vascular surgeon, endocrinologist / physician, infection control nurse and others including cardiologist, nephrologist and neurologist^{131, 132, 148, 149, 150, 151, 152, 153, 154}. Patient education is of utmost importance and these include instructions in foot hygiene, daily inspection, proper footwear, identification

and early treatment of new lesions ^{59, 131, 155, 156, 157, 158, 159}. Other preventive measures include proper and regular podiatric management of calluses and ingrown toe nails ^{131, 160} therapeutic footwear with high toe box and pressure relieving insoles ^{150, 159, 161, 162, 163} and consideration of surgical procedures.

Specialty diabetic foot care clinics with a multidisciplinary approach encompassing patient education, podiatric and orthotic care play a vital role in diabetic foot care. (A, @)

4. Diabetic Foot Infections

Management of these infections is guided by classification into the entities of either limb threatening or non-limb threatening infections ^{11, 13, 17, 40, 41}.

Parameters	Non limb threatening	Limb threatening
1. Foot ulcer	Superficial or subtle	Deep and overt
2. Foot infection	Mild to moderate, may arise from scratches, small punctures, fissures	Severe, gangrene, necrotising fasciitis and abscesses may be present
3. Organisms	Usually monomicrobial, aerobic gram-positive cocci ¹⁶⁷	Usually poly-microbial in nature
4. Cellulitis from ulcer	< 2 cm	> 2 cm ¹⁶⁶ , lymphangitis
5. Osteomyelitis	Absent, wound does not probe to joint or bone	Present, wound probes to bone or joint ¹⁶⁴
6. Clinical features of systemic illness	Stable, no symptoms or signs of sepsis or systemic involvement	Ill, with features of sepsis or systemic involvement. e.g. fever, hyperglycemia
7. Ischemia	Absent	Present, vascular consultation needed ^{40, 41}
8. Hospitalization	Hospitalization not required, close supervision on outpatient basis ^{93, 97, 146}	Hospitalization required to treat infection and systemic involvement

4.1 Assessment of Diabetic Foot Infections

Assessment of diabetic foot infections entails taking a detailed history, performing a comprehensive physical examination, imaging and appropriate laboratory investigations as previously outlined.

4.2 Treatment of Diabetic Foot Infections

The tenets of treatment of diabetic foot infections are surgical treatment, antibiotics treatment, wound care, treatment of metabolic and co-morbid problems, and frequent reassessment of response of treatment, patient education, prevention and orthotics / prosthetic management. A multidisciplinary team approach is envisaged^{89, 151, 153, 165}.

4.2.1 Non- limb threatening infections

These patients are initially managed as outpatients and hospitalized only when no improvement is noted after 48-72 hours or the condition deteriorates^{13, 40, 91, 166, 167}. Antibiotic therapy is commenced and if ulcer is present. The ulcer is cleansed and debrided. Ulcer management is then followed as previously outlined. Correction of hyperglycemia and stabilization of other co-morbidities are carried out simultaneously. The response to treatment is then re-evaluated after 48-72 hours^{91, 166} and necessary action may need to be taken. Aspects of prevention, patient education, podiatric care and orthotic treatment are also carried out.

No-limb threatening lower extremity infections can be treated as on an outpatient basis with wound toilet and oral antibiotics. However, patients should be hospitalized if there is no improvement or if the condition deteriorates. **(A)**

4.2.2 Limb threatening infection

Patients with limb threatening infections should be hospitalized for appropriate management⁴⁰. Consultations and treatment of such patients by a multidisciplinary team significantly improves outcome^{131, 150, 151, 153, 168, 169}.

1. **Surgical treatment** - necessary to be done early^{40, 41, 170, 171, 172, 173}. Surgery on infected site includes debridement of wounds, incision & drainage of abscesses, necrotising fasciitis and amputations of gangrenous tissues^{170, 174}. Tissues taken deep

from the wound are sent for aerobic and anaerobic cultures¹⁷⁵. Whenever possible, osteomyelitic bones are removed and sent for microbiological culture and histology⁹⁰. Repeated procedures may be necessary to control infection. Even ill patients are considered for operation, which should be performed as soon as possible^{40, 41, 166, 171}.

2. **Wound care** – the wound is cleansed, debrided, packed or dressed. Wound management is followed as described under the section diabetic foot ulcers.
3. **Antibiotics** – refer to section on antibiotic treatment.(below)
4. Control of hyperglycemia, electrolyte imbalance and stabilization of other co-morbidities are carried out simultaneously.
5. Reassessment of the response to treatment should take place frequently. If infection has subsided but ulcer persists – follow principles of diabetic ulcer treatment.
6. After infection and ulcer has healed, the residual foot needs close follow up. Aspects of prevention, patient education, podiatric care and off loading measures are then undertaken^{40, 119, 162}.

Limb threatening infections should be treated early with surgery, wound care, antibiotics and metabolic control by a multidisciplinary team for best outcome. **(A)**

Antibiotic Treatment

1. **Start with an empiric regime** that covers important and common pathogens, taking into account infection severity, while awaiting culture results¹⁷⁶.
2. **The empiric therapy** for severe infections should be broad-spectrum and given intravenously whereas minor infections can be treated with narrower spectrum antibiotics. It should take into consideration factors such as costs, patient tolerance, allergies, potential renal or liver adverse effects, ease of administration and local antibiotic resistance patterns.
3. **Mild and moderate non-limb threatening infections** are usually monomicrobial, with Staph. Aureus, Staph. Epidermidis and Streptococci

being the most common infecting organisms^{89, 172, 177, 178, 179}. These patients are given gram- positive coverage but keeping in mind gram- negative organisms may also be involved^{37, 41, 91, 177}. It may be prudent, especially in the immuno-compromised patient to treat even apparently mild infections with broad-spectrum antibiotics.

- 4. Severe limb and life threatening infections** are poly-microbial in nature, which includes gram-positive and negative organisms, anaerobic organisms and enterococci. Pseudomonas species are often isolated from wounds that have been soaked or treated with wet dressings. Enterococci are commonly cultured from patients who have previously received cephalosporin therapy. Anaerobes are found in wounds with necrosis, deep tissue involvement or a feculent odour. MRSA are often acquired during a previous hospitalization.

Empiric intravenous broad- spectrum antibiotics therapy in these patients should cover common isolates of the above organisms and then adjusted according to culture and sensitivity results. Recurrent infections, despite ongoing antibiotic therapy, should have repeated deep tissue cultures done to exclude super infection. If MRSA is isolated, this should be treated early and appropriately¹⁸⁰.

- 5. Duration of antibiotic treatment** – 1-2 weeks course for mild to moderate infections^{167,181, 182}, more than 2 weeks for more serious infections¹⁸³. For osteomyelitis, if infected bone is not removed, antibiotics are given for 6 - 8 weeks, depending on culture results^{89,90,177}. If all infected bone is removed, a shorter course (1-2 weeks) of antibiotics, as for soft tissue infection, may be adequate⁹⁰.
- 6. Maintaining effectiveness of therapy** through parameters including, the patient's clinical response, temperature, WBC count, ESR and other inflammatory markers, blood sugar control and other metabolic parameters, signs of wound healing and inflammation. If there is vascular impairment, the antibiotics may not be able to reach the infected site. Hence, vascular reconstructive procedures may have to be undertaken to improve blood flow to infected tissues¹⁸⁴.

Suggested antibiotic treatment for treating diabetic foot infection is as shown in Appendix 4.¹⁸⁵

Clinical trials to examine the efficacy of antibiotic therapy used in diabetic foot infections reveal that the outcomes of the various studies are similar and no one drug or combination emerges as optimal.¹⁸⁵ A good response is seen in 80%-90% of mild

to moderate cases^{167, 181}. When bone or deeper tissues are involved, extensive debridement or partial amputation may be needed in about two thirds of this patients.¹⁸⁶. Most of these amputations are foot sparing and long-term infection control is achieved in 80% of cases. Re-infection occurs in 20%-30% of patients, most of them have underlying osteomyelitis.¹⁸⁶.

When choosing an antibiotic treatment for diabetic foot infections, it is important to understand the principles involved and also take into consideration the costs and local antibiotic resistance patterns. (A)

5. DIABETIC CHARCOT'S FOOT

Diabetes Mellitus is the most common cause of Charcot's foot^{69, 187}. There is impairment of the efferent sensory input from joint receptors giving rise to progressive destruction of foot architecture characterized by pathological fracture, joint dislocation and fragmentation of articular cartilage, which may result in severe debilitating deformity, or even amputation of the affected limb^{69, 188, 189, 190, 191, 192, 193}.

5.1 Assessment

5.1.1 Clinical examination - An acute Charcot's foot will have swelling, erythema, raised skin temperature, joint effusion and bone resorption in an insensate foot^{69, 191, 194, 195}. However, 75% of patient with Charcots foot have some degree of pain in an otherwise insensate foot, thus complicating diagnosis^{65, 187}. Furthermore in the presence of a concomitant ulcer, the diagnosis of osteomyelitis may be difficult to rule out¹⁹⁵.

5.1.2 Investigations - Plain X-ray¹⁹⁶, white cell count (WBC), ESR and a bone biopsy when indicated. A plain radiograph confirms the presence of osteoarthropathy; WBC and ESR can be helpful in the presence of a concomitant ulcer to rule out osteomyelitis. Bone biopsy is the most specific way of distinguishing between osteomyelitis and osteoarthropathy. A pathognomonic biopsy showing neuropathic osteoarthropathy consists of multiple shards of bone and soft tissue embedded in the deep layers of synovium¹⁹⁷. Other imaging modalities like MRI and nuclear medicine bone scans may be useful in depicting Charcot's neuropathic osteoarthropathy^{198, 199}.

5.2 Treatment

5.2.1 Immobilization and rest

Treatment in the acute phase consists of using off loading modalities to reduce stress, like crutches, wheelchair, and walker, total contact cast^{67, 69, 188, 190, 191, 193, 194}.

5.2.2 **Protected weight bearing**

In the post-acute stage, when there is reduction in edema and skin temperature, protected weight bearing is allowed with the help of some assistive device (removable walking cast). The walking cast redistributes pressure that will otherwise be concentrated on bony prominences. Patients may be allowed to ambulate while bony consolidation occurs^{69, 188, 200}. After 4-6 months, patients may resume using their usual footwear^{65, 69, 188, 189, 190, 201}.

5.2.3 **Surgery**

Objective: To create a stable and plantigrade foot^{188,189, 190, 193, 200, 202}. It is generally undertaken only at the quiescence phase. Avoided in the acute phase because of hyperaemia, oedema and osteopenia^{188, 189, 190, 193, 200, 203, 204, 205} except when acute subluxation occurs without osteochondral fragmentation, surgical intervention can then be considered²⁰⁶. Common operations on Charcot's foot consist of exostectomies for prominent plantar (rocker bottom) deformities, which has been responsible for ulceration when the remainder of the foot is stable^{188, 190, 205, 207}. Other procedures performed include ankle fusion, tibiocalcaneal fusion, isolated or multiple midfoot fusion and triple arthrodesis^{195, 204, 205, 206, 208, 209, 210, 211, 212}. A period of immobilization is required after surgery. This is followed by mobilization wearing a removable walking cast and then to usual standard footwear¹⁸⁸.

Early detection and immediate treatment of Charcot's joint disease is paramount in preventing the structural deformities and complications that ensues like ulceration, osteomyelitis and a threatened limb. The diagnosis of Charcot's foot should not be missed and when detected, appropriate treatment should be given early.

(B)

6. PREVENTION

Diabetes is a lifelong problem, the prevalence of diabetic foot complications increase with the duration of the disease. Therefore patients must be educated so that they understand that a program of lifelong surveillance is required to prevent repeated episodes of all these complications^{40, 59, 75, 76, 131, 213, 214, 216}. Aspects of a diabetic foot prevention program⁷ include:

a. Education:

Patient education on

- the importance of daily foot inspection and early intervention to the patient
- hyperglycemic control and diet

Physicians also need to be educated about the significance of foot lesions, regular foot examination and current concepts of foot management^{8, 131, 155, 215}.

b. Foot care:

Regular podiatric visits for foot examination, debridement of calluses, toenails care and foot care risk assessment; leading to early detection and aggressive treatment of new lesions^{40, 68, 160}. Apply skin emollients regularly to keep foot skin supple and moist. Do stretching exercises to keep muscles, tendons and joints supple.

c. Therapeutic Shoes:

Adequate room at toes and depth to protect from injury, custom molded shoes, well-cushioned walking sneaker and special modifications^{59, 217, 218, 219}.

d. Reduction of plantar pressure (off loading):

Pressure measurements - computerized or Harris mat, custom orthoses, padded hosiery and insoles to reduce plantar pressure.

e. Surgery:

Correction of structural deformities like hammertoes, bunions, prevention of recurrent ulcers over deformity with high peak pressure areas has to be done if cannot be accommodated by therapeutic footwear^{133, 220, 221}.

All efforts must be made to prevent foot complications from occurring in diabetics and this is done through patient and provider education and through a multidisciplinary approach. **(B)**

7. A Multidisciplinary Team Approach to the Management of Diabetic Foot

A multidisciplinary care team has been found to be effective in profoundly reducing the occurrence and recurrence of diabetic foot complications, including ulceration and amputation.^{7, 12, 41, 59, 75, 131, 132, 148, 149, 150, 151, 153, 204, 213} Management by a multidisciplinary team can bring down the overall costs of the treatment of diabetic foot complications.^{75, 126} The multidisciplinary team should consist of Orthopaedic Surgeons, Vascular Surgeons, Endocrinologists or Physicians, Podiatrists, Orthotist, Orthopaedic shoe fitter, Diabetic Educator and Clinical Nurse.¹⁵⁰

Diabetic foot complications should be treated by a multidisciplinary team
(A)

8. Economic Aspects

Treating diabetic foot complications is a costly affair. A pharmacoeconomic study from France (Social Security) in 2003 using direct and indirect costs put average monthly costs in the outpatient treatment of foot ulcers at 697 Euros (RM3136.5), short hospital stays at 1556.20 Euros (RM7002.9) and 34.76 Euros (RM156.42) for sick leaves.⁵ Another study from Boston, USA in 1993 showed that it was very costly to treat diabetic foot problems and Medicare reimbursement was inadequate, suffering an average loss of US\$7480 (RM28424) per admission.¹²⁶ The total direct and indirect costs of treating Diabetes in the USA in 1997 was estimated at US\$98 billion (RM372.4 billion)⁷ and foot ulcer accounts for US\$5 (RM19) billion,²²² amputations in 1994 accounts for more than US\$1 (RM3.8) billion. The estimated overall costs to treat diabetic foot disease in USA can exceed US\$6 (RM22.8) billion annually.⁷

In Malaysia, treatment at Government Hospitals' 3rd class wards are heavily subsidized. The payment ceiling is RM500 irrespective of any number of days hospitalized and for any amount of treatment rendered. Costs incurred at private hospitals are more reflective of the actual direct costs accounted for treatment of diabetic foot problems. On the average and depending on location and type of private facility, a 5-day stay for mild to moderate foot problems will cost approximately RM2500 to RM3500, whereas a 7-day stay for more severe cases will cost around RM 7000 to RM8000.

9. SCREENING

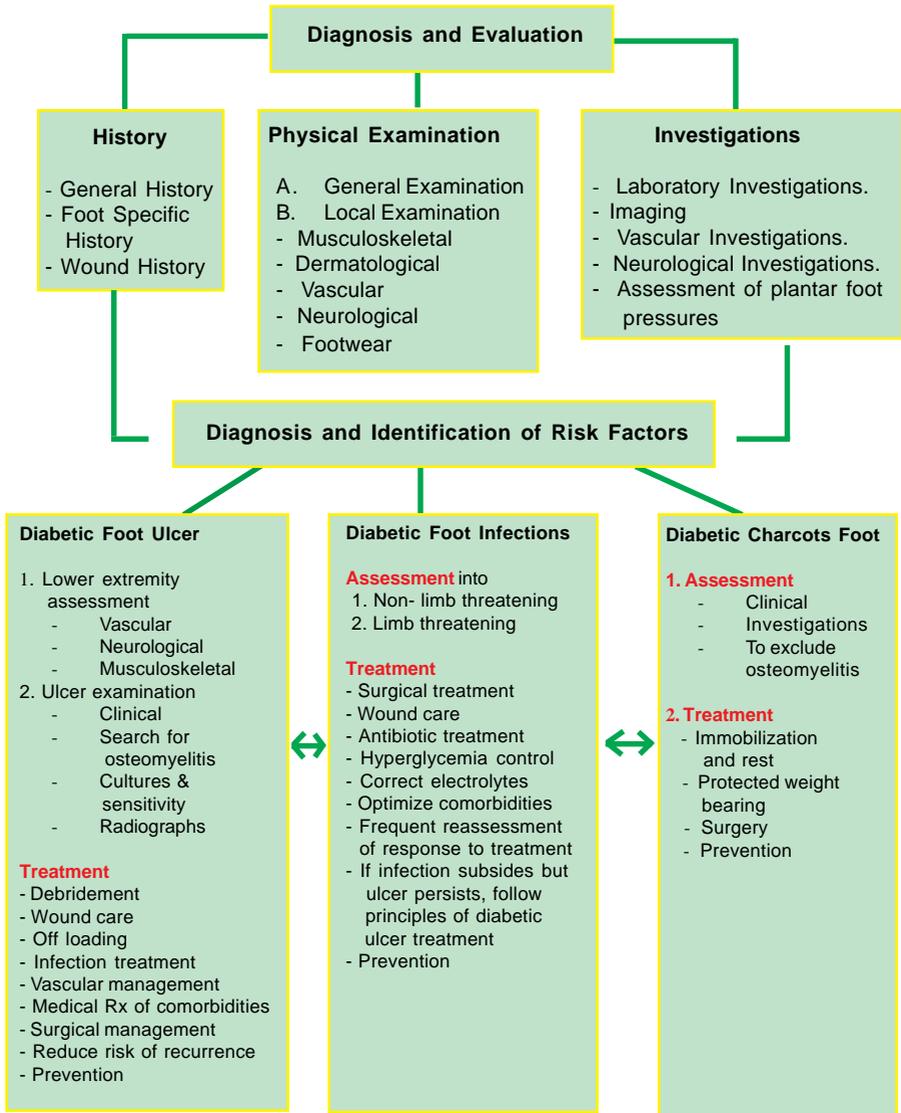
Screening of diabetic foot disorders should be carried out on all patients suffering from Diabetes Mellitus (Appendix 5). Primary healthcare providers and doctors working in Health Clinics, District Hospitals and Outpatient Departments can carry out screening to identify and 'capture' diabetics with 'foot at risk'. Early management of these patients can minimise foot complications and will also indirectly reduce the overall cost of treatment and reduce economic loss due to absence from work.

10. CONCLUSIONS

Diabetes Mellitus is a lifelong disease and diabetic foot complications can be life threatening, physically incapacitating, costly to treat and result in extensive morbidity. Screening, proper evaluation, early identification and treatment of the 'at risk foot' can reduce complications. A multidisciplinary team approach to diabetic foot problems can save costs and reduce most foot complications and amputation rate. If we incorporate these diabetic foot management guidelines into our practice protocols we may attain the objectives of preventing limb loss, mortality maintain the quality of life of the patient.

11. ALGORITHM OF MANAGEMENT OF DIABETIC FOOT

APPROACH TO A PATIENT WITH DIABETIC FOOT PROBLEMS



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Level of
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Appendix 1

Wagner's Classification of Diabetic Foot Ulcers⁸¹

Grading	Features
0	Pre-ulcer. No open lesion. May have deformities, erythematous areas of pressure or hyperkeratosis.
1	Superficial ulcer. Disruption of skin without penetration of subcutaneous fat layer.
2	Full thickness ulcer. Penetrates through fat to tendon or joint capsule without deep abscess or osteomyelitis.
3	Deep ulcer with abscess, osteomyelitis or joint sepsis. It includes deep plantar space infections, abscesses, necrotizing fasciitis and tendon sheath infections.
4	Gangrene of a geographical portion of the foot such as toes, forefoot or heel.
5	Gangrene or necrosis of large portion of the foot requiring major limb amputation.

Another useful classification, which uses grading as well as staging, is The University of Texas Diabetic Wound Classification⁸². The inclusion of stage makes this classification a better predictor of outcome^{83, 129}.

Appendix 2

University of Texas Diabetic Wound Classification⁸²

Stages

1. Stage A: No infection or ischaemia
2. Stage B: Infection present
3. Stage C: Ischaemia present
4. Stage D: Infection and ischaemia present

Example of classification

- Stage A
- Grade 0
 - Grade 1
 - Grade 2
 - Grade 3

Grading

1. Grade 0: Epithelialized wound
2. Grade 1: Superficial wound
3. Grade 2: Wound penetrates to tendon or capsule
4. Grade 3: Wound penetrates to bone or joint

TYPES OF WOUND CARE PRODUCTS⁷

Category	Indications	Contraindications
<p>Dressings</p> <ul style="list-style-type: none"> • <i>Transparent films</i> – polyurethane film with adhesive layer, semi permeable • <i>Hydrogels</i> – gel, sheet, gauze, 95% water or glycerin • <i>Foam</i> – polyurethane foam, open cell absorbent. • <i>Hydrocolloids</i> – wafer with adhesion. carboxymethylcellulose; pectin gelatin; impermeable to oxygen. • <i>Calcium Alginates</i> – pad made of fibre from seaweed. • <i>Gauze pads - sterile cotton</i> • <i>Collagen dressing</i> – composite pads with collagen component. • <i>Antimicrobial dressing</i> – contain silver or iodine. 	<p>Dry to minimal draining</p> <p>Dry to minimal draining</p> <p>Moderate, large exudates clean wound surface</p> <p>Low to moderate drainage</p> <p>Heavy exudates wounds</p> <p>Low to heavy draining, surgical wounds</p> <p>Low to heavy draining wounds.</p> <p>Infected or clean wound to prevent infection.</p>	<p>Infection; significant drainage.</p> <p>Moderate to heavy drainage</p> <p>Dry wounds</p> <p>Heavy drainage</p> <p>Dry wounds</p> <p>Undefined</p> <p>Dry wounds</p> <p>Allergies to components</p>
<p>Topical therapies</p> <ul style="list-style-type: none"> • <i>Saline</i>- amorphous hydrogels, skin cleansers • <i>Detergents/ antiseptics</i> – povidone-iodine, etc • <i>Topical antibiotics</i> – Silver sulfadiazine, Bacitracin, Mupirin, etc. • <i>Enzymes</i> – collagenase, papain-urea, etc. 	<p>Clean or infected wounds</p> <p>Contaminated or infected wounds</p> <p>Contaminated or infected wounds</p> <p>Necrotic or escharotic wounds</p>	<p>Undefined</p> <p>Healthy granulating wound</p> <p>Healthy granulating wound</p> <p>Healthy or infected wounds</p>

ANTIBIOTIC TREATMENT FOR TREATING DIABETIC FOOT INFECTION¹⁸⁵

Severity of infection	Recommended	Alternatives
Mild / Moderate (Oral for entire course)	<ul style="list-style-type: none"> - Cephalexin (500 mg qid) - Amoxicillin/Clavulanate (875/125 mg bid) - Clindamycin (300 mg tid) 	<ul style="list-style-type: none"> - Ofloxacin (400 mg bid) ± Clindamycin (300 mg tid) - Cotrimoxazole (2 DS bid)
Moderate / Severe (IV until stable, then switch to oral)	<ul style="list-style-type: none"> - Ampicillin / Sublactam (3.0g tid) - Clindamycin (450 mg qid) + Ciprofloxacin (750 mg bid) 	<ul style="list-style-type: none"> - Trovofloxacin (500 mg qid) - Metrodinazole (500 mg qid) + Ceftazidime (2 gm tid)
Life threatening (Prolonged IV)	<ul style="list-style-type: none"> - Imipenem / Cilastin (500 mg qid)- - Clindamycin (900 mg tid) + Tobramycin (5.1 mg kg⁻¹ d⁻¹) + Ampicillin (500 mg qid) 	<ul style="list-style-type: none"> - Vancomycin (1 gm bid) + Aztreonam (2.0 gm tid) + Metronidazole (7.5 mg kg⁻¹ qid)

SCREENING FOR FOOT DISORDERS IN DIABETIC PATIENTS

- 1. All patients with Diabetes Mellitus (to be screen at least once a year)**
 - Foot and leg examination to look for underlying risk factors like sensory, motor and autonomic neuropathy.
 - Assess vascular status of lower extremity.
 - Inspection of foot shape and foot wear.
 - Foot-care education. Those who frequently walk barefooted, wets feet at work or stands for long hours during work may need to have their feet evaluated twice a year.

- 2. Patients with neuropathy and/or ischaemia (to be screen 3-6 monthly)**
 - Evaluate for worsening of neuropathy and/or ischaemia.
 - Enhance foot care education.
 - Frequent recall and review risk of diabetic foot disease
 - Advise proper footwear.

- 3. Patients with foot deformities / skin changes / previous ulcer (screen 1-3 monthly)**
 - Refer to a multidisciplinary team for review if indicated.
 - May need vascular assessment
 - Frequent review of patient's foot care education.
 - Podiatrist referral for specialist footwear and nail care

- 4. Patients with ulcerated foot / infected foot / gangrene (Urgent referral)**
 - Refer immediately for hospitalization if limb or life threatening.
 - Refer to multidisciplinary diabetic foot care team.
 - Optimized treatment of underlying risk factors and co-morbid factors.
 - Antibiotic treatment for foot infection.
 - Wound management and dressing and intensify foot care education.

Statement of Intent

These guidelines are meant to be a guide for clinical practice, based on the best available evidence at the time of development. Adherence to these guidelines may not necessarily ensure the best outcome in every case. Every health care provider is responsible for the management of his/her unique patient based on the clinical picture presented by the patient and the management options available locally.

Review of the Guidelines

These guidelines were issued in August 2004 and will be reviewed in August 2006 or sooner if newer evidence becomes available.

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