

Guidelines on Management of the Patient with Diabetic Foot Infection

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ABSTRACT

Objective: This guideline provides recommendations for the management of diabetic foot infections (DFI) and is meant to standardize in-hospital and post-discharge care with the aim of reducing post-infection disability, particularly from high amputation rates prevalent in Jamaica. It is targeted at General Surgeons leading multidisciplinary treatment teams in the local, Jamaican context, but may be relevant in other middle-income countries with similar healthcare and socio-economic demographics.

Methods: The format of the guideline borrows generic elements from others identified in the literature. Synthesis involved crafting a discussion paper outlining all components of management of DFI, detailed systematic examination of the literature, particularly research emanating from Jamaica and the Caribbean, and preparation of referenced draft recommendations. Several iterations later, the final guideline was approved by the full committee.

Recommendations: Recommended public health interventions to prevent DFI precede the guideline. The guideline recommends hospitalization for established DFI and management by multidisciplinary teams led by General Surgeons. Hyperglycaemia is managed preferably with basal-bolus insulin. The affected limb should be clinically assessed for severe or critical limb ischaemia (CLI) and ankle-brachial index (ABI) measured, non-invasive angiography (duplex or computed tomography) performed if $ABI \leq 0.5$ and the result discussed with a vascular surgeon. If CLI is diagnosed and revascularization is not feasible, amputation no lower than below knee level should be contemplated. Wounds should be assessed for extent of infection (including osteomyelitis) and debrided, tissue sent for culture, and empirical bactericidal broad spectrum intravenous antibiotic therapy initiated. Methicillin-resistant *Staphylococcus aureus* coverage should be considered for severe or rapidly spreading DFI, pending culture reports. Wounds should be inspected, debrided and dressed daily. After-discharge care includes provision of diabetic foot care education, outpatient wound care, discontinuation of antibiotics when appropriate, early off-loading for slowly healing plantar wounds originating from or evolving into neuropathic ulcers, and referral for orthoses and prostheses.

Keywords: Antibiotics diabetic foot infection, critical limb ischemia diabetes, diabetic foot education, diabetic foot infection Jamaica, foot protection diabetes, foot infection risk diabetes, foot injury prevention diabetes, lower limb amputation risk diabetes

West Indian Med J 2019; 68 (Suppl. 2): 18

PREAMBLE

This guideline has been prepared under the mandate of The University of the West Indies (UWI)/University Hospital of the West Indies (UHWI), Department of Surgery and the Association of Surgeons in Jamaica

(ASJ). The format and process of synthesis were influenced by the “2016 AHA/ACC Guideline on the Management of Patients with Lower Extremity Peripheral Arterial Disease” (1), the “IWGDF Guidance on the Diagnosis and Management of Foot Infections

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in Persons with Diabetes” (2) and the “Guideline by the Society for Vascular Surgery, American Podiatric Medical Association and Society for Vascular Medicine on Management of the diabetic foot” (3). Supporting evidence was extracted from literature identified *via* systematic search of PubMed and Google Scholar with emphasis on Caribbean and Jamaican publications.

INTENDED USE

This practice guideline is meant to standardize management of patients with diabetic foot infections (DFIs) in the range of facilities operating in Jamaica, from the more sophisticated, multidisciplinary facilities to under-resourced rural, district hospitals. At the end of this report, the Guideline is summarized in a format that may be extracted and posted in relevant departments, clinics and wards for ease of reference and facilitation of implementation.

The aim is to realize generally improved outcomes among patients with DFI, particularly reduced amputation rates. Local research indicates that lower-limb amputation rates among diabetics in Jamaica may be among the highest in the world (4, 5).

PREVENTION OF DIABETIC FOOT INFECTIONS

The Committee recognizes that recommendation of measures to prevent or reduce the risk of diabetic foot infections (DFI) would not be appropriate for a Practice Guideline on management of established infections. However, optimum management of established infections is unlikely to achieve substantial reduction of amputation rates without accompanying Public Health and Primary Care interventions to reduce the risk and incidence of lower-limb infections in the first place (6); lower-limb infection is by far the most common indication for amputation in diabetics (7). Some such interventions may have been implemented in part in individual public and private practice settings, but the Committee is of the view that lower-limb infection prevention and risk reduction measures should be universally adopted.

The Committee, therefore, recommends that the sponsors of this guideline lobby the UWI/UHWI, Ministry of Health (MOH) and any other organizations responsible for Public Health policy and National health care, such as the Medical Association of Jamaica (MAJ), to have the following measures implemented as soon as possible:

1. Provision of education material to all existing and newly diagnosed diabetic patients, preferably in the form of an easily understood pamphlet that can be

kept for reference, as they attend for clinic visits; the pamphlet should emphasize:

- 1.1. **The pathogenesis and pathology of diabetes mellitus and its common complications in easily understood lay terms.** Qualitative research has shown that patients are less likely to comply with tedious, lifelong prevention and treatment measures if they do not understand the disease (8–12). Diabetes education is far from adequate (11–13), except in specialist diabetes clinics such as that at UHWI (14) and even in that setting, as in others, diabetes literacy and treatment compliance are low (10–12, 14–16).
- 1.2. **The importance of glycaemic control in prevention of complications of diabetes, including foot infections and amputation (17, 18). Compliance with medication, diet and a regimen of regular, moderate exercise should be encouraged.** Medication and lifestyle modification non-compliance are known to be high among diabetics in Jamaica (10–12, 14–16).
- 1.3. **The importance of taking measures to protect the feet from injury,** such as wearing proper footwear (14), enlisting the assistance of relatives to rid the home environment of sharp objects lying in the house or yard (19) and avoiding prolonged standing, walking, running and excessively strenuous activities (20). Diabetes foot protection education is particularly deficient in Jamaica (13) and even where it seems to have been delivered, has not resulted in the desired degree of behaviour change (14).
- 1.4. **The importance of daily foot care,** including daily examination of the feet, application of moisturizing lotion and nail care (14, 21). Diabetes foot care education, as foot protection education (above), is particularly deficient in Jamaica.
- 1.5. **The importance of seeing a doctor within 24 hours of sustaining a puncture wound, laceration or bruise (blunt injury) or detecting a change in the foot suggestive of infection or impending ulceration.** Although early presentation has not been associated with lower amputation risk (20, 22), morbidity and hospital stay are decreased (22), and it may be that the full benefit of early presentation and accelerated access to specialists in diabetic

foot treatment has not yet been realized. As far as the Committee is aware, education regarding recommended behaviour after recognition of alarm incidents and symptoms affecting the feet of diabetics is practically non-existent in Jamaica. Patients therefore almost invariably resort to home remedies after a foot injury or infection is first recognized (19).

- 1.6. **The importance of regular visits to clinics/primary care doctors, with at least annual foot checkups for patients at low risk for foot infection and more frequent examinations for those at high-risk** (21, 23).
2. Education of physicians attending to diabetics at the primary care level as to the importance of foot examination as a routine component of office visits, at least once per year, and training in diagnosis of diabetic foot alarm symptoms and signs that should prompt referral to a Podiatrist, General Surgeon or Orthopedist. Nurses may also be trained to perform this task. The examination should include objective testing for neuropathy (*eg*, monofilament test), palpation of pulses, identification of bony deformity and callus, inspection of the toes and between toes for fissures and identification of early neuropathic ulceration and/or infection of which the patient might be unaware (21, 23).
3. Health Service acknowledgement of the critical need for podiatrists; optimum care of the diabetic foot demands involvement of these professionals (23). The Public Health service in Jamaica has not traditionally included podiatrists and there are too few in the private sector. A reasonable target for the Public Health service would be to employ at least three podiatrists for each Regional Health Authority, to service hospital clinics and health centres. This requires, in the Public Sector, establishment of new posts with appropriate job definition and description and pay commensurate with their training. The UWI Faculty of Medical Sciences (FMS), should be encouraged to start a training course for Podiatrists with BMedSci or BSN as the matriculation requirement. Initially, podiatrists may have to be recruited and/or trained abroad.
4. Provision of Orthotic and Prosthetic services in the Public Health Sector. Currently these services, that are so important for diabetic foot care and rehabilitation, are only available from one public facility in Kingston. The private sector is also inadequately served.

GUIDELINE ON MANAGEMENT OF THE PATIENT WITH DIABETIC FOOT INFECTION

1. Criteria for hospitalization

Recommendation: Patients manifesting signs of foot infection, as defined by the Infectious Diseases Society of America (IDSA)/International Working Group on the Diabetic Foot (IWGDF), should be hospitalized. According to the IDSA/IWGDF definition (2), the foot is infected if at least two of the following items are present:

- Local swelling or induration
- Erythema > 0.5 cm around the wound
- Local tenderness or pain
- Local warmth
- Purulent discharge

Rationale and Evidence: It is tempting to attempt management of patients with apparently mild DFI as outpatients, particularly with current over-demand for hospital beds in Jamaica, but severity and depth of DFIs are notoriously difficult to assess as clinical signs are often deceptively trivial (24, 25). Accurate assessment of infection severity and wound depth, which often requires wound debridement and daily wound assessment, should not be attempted in the outpatient setting. It is better to err on the side of caution by admitting a patient with what turns out after detailed assessment to be a superficial infection than to send home a patient with a limb-threatening infection presenting with minimal signs.

2. Structure of clinical management team

Recommendation: Where feasible, diabetic patients with an acutely infected lower-limb should be managed from the outset by a multidisciplinary team consisting of specialists in General Surgery, Orthopaedics and Internal Medicine, with General Surgeons leading the team.

Rationale and Evidence: Diabetic foot infections in Jamaica are usually managed by General Surgeons, with Internal Medicine being consulted only if blood glucose proves difficult to control after infection subsides. Orthopedists are rarely consulted and usually unwilling to participate in management of these patients. There are no podiatrists on the staff of any public Hospital. But research indicates that patients managed by multidisciplinary teams enjoy better outcomes (6, 24, 26–28). Internal Medicine involvement should be sought at the time of admission and Orthopedists should be persuaded to offer

their expertise when indicated. Podiatrists should be brought into the team when available.

3. Management of hyperglycaemia in the diabetic with an acutely infected lower-limb

Recommendation: Oral hypoglycaemic agents should be discontinued on admission. Before infection is controlled, blood glucose should be managed using basal-bolus therapy (29–31). Basal insulin is best provided once daily with a long acting insulin analogue, such as insulin glargine (29, 30, 32), but NPH insulin, though less effective, may also be used (32). Bolus insulin is best provided immediately preprandial with a rapid-acting insulin analogue, such as insulin glulisine (29, 30, 32), but short-acting regular insulin injected 30 minutes before meals, though less effective, may also be used (32). Traditional sliding scale regular insulin should be abandoned as it is not as effective as basal-bolus therapy (31), unless the medical and nursing expertise necessary to execute basal-bolus therapy is not available. Blood glucose target before infection is controlled is 8–10 mmol/L.

Rationale and Evidence: Hyperglycaemia during an infection becomes relatively refractory to control with insulin because of increased insulin resistance (33). Once infection is controlled, insulin resistance falls precipitously, and hypoglycemia is probable if tight glucose control had been attempted prior. Basal-bolus therapy or sliding scale achieves relatively loose control of blood glucose during an infection and enables flexibility of response to fluctuating insulin resistance; note that the bolus component of basal-bolus therapy may be varied according to a “sliding scale” (30).

4. Assessment of the limb for severe/critical limb ischaemia

Recommendation 1: Diabetic patients presenting with an infected foot should have the arterial perfusion of the affected limb assessed clinically for symptoms and signs of severe/critical limb ischaemia. Ankle-brachial index (ABI) should be measured; a Doppler machine is preferable but an automated blood pressure machine may also be used (34, 35). If clinical critical limb ischaemia is diagnosed and/or ABI is ≤ 0.5 , AND the foot is clinically viable, duplex ultrasonography or computed tomography (CT) angiogram should be requested and the results discussed with a vascular surgeon. Necessary emergency treatment should not be delayed for the sake of getting the angiogram done.

Rationale and Evidence: Evidence is lacking that the presence of mild-to-moderate or sub-critical limb ischaemia and treatment thereof influences amputation risk either in an uninfected or infected diabetic foot (20). Revascularization of a critically ischemic diabetic limb in the presence of infection has not yielded good outcomes unless the infection is well controlled prior to bypass surgery (3, 7, 36). The Committee is of the view that if the arterial anatomy is amenable to reconstruction, the patient should be afforded the opportunity for limb salvage if a vascular surgeon is available to accept referral.

Recommendation 2: If critical limb ischaemia is diagnosed and either the angiogram reveals arterial anatomy unfavourable for revascularization or referral to a vascular surgeon is not feasible or the foot is not viable (and therefore not salvageable even if successful revascularization were feasible), amputation no lower than below knee level should be contemplated.

Rationale and Evidence: In the presence of critical limb ischaemia, an infected diabetic foot is unlikely to heal after debridement or foot-level amputation without revascularization (37, 38). Persistence with debridement or foot level amputation in these patients, appropriate for infected diabetic foot wounds without severe/critical limb ischaemia (see below), delays almost inevitable major amputation and increases hospital stay and risk of serious morbidity.

5. Antibiotic guidelines

Recommendation: Empirical antibiotics should be administered parenterally initially, should be bactericidal, and should cover aerobic gram-negative and anaerobic fecal organisms as well as gram-positive cocci, including methicillin-sensitive *Staphylococcus aureus* (MSSA) and β -haemolytic streptococci. Empirical antibiotic coverage for methicillin-resistant *Staphylococcus aureus* (MRSA) should be considered for severe or rapidly spreading DFI in patients at high-risk of infection with the organism. Where microbiology facilities are accessible, tissue (including bone when indicated) should be sent for culture in preference to exudate for determination of definitive antibiotic therapy; the wound should be cleaned or irrigated with normal saline before reaping the specimen. The antibiotic regimen should be adjusted as culture reports become available or, in the absence of microbiology facilities, as determined

by the response to empirical antibiotics. As culture of anaerobic bacteria is unreliable, anaerobic antibiotic should not be discontinued even if no growth of anaerobic bacteria is reported.

Rationale and Evidence: Antibiotics may be administered orally once a good clinical response has been observed. Bacteriostatic antibiotics are not as effective as bactericidal in diabetics, as their compromised immunity is not sufficient to the task of augmenting the killing effect of the antibiotic (39). Diabetic foot infections are usually polymicrobial, involving the three groups of bacteria mentioned above in various combinations and proportions (7, 40). Two publications reporting on bacterial isolates from swabs of diabetic foot ulcers in patients admitted to the University Hospital of the West Indies in Jamaica identified *Streptococcus* Group D as the predominant organism, but it is unclear what percentage of patients had active infections *versus* chronic indolent ulcers (41, 42). Anecdotal experience reported by General Surgeons in Jamaica parallels that reported by Islam et al out of Trinidad and Tobago, in which gram-negative rods predominated (40); *Staphylococcus aureus* predominates in reports from developed countries (7). Regardless of which bacterium predominates, empirical antibiotics must be effective against all three groups of bacteria and regimen changes directed by culture reports; where bacterial culture facilities are not readily available, antibiotic regimen adjustments must be based on clinical response (7).

Routine prescription of empirical (as compared to culture-directed) anti-MRSA antibiotic is not justifiable for community acquired DFIs at this time in Jamaica, given the low prevalence of MRSA reported in a UHWI study (43) [7% of *Staphylococcus aureus* isolates in 2007], the even lower prevalence reported for community acquired infections (44), the high cost of vancomycin and other anti-MRSA antibiotics, and the need to restrict usage of these antibiotics to forestall evolution of resistance. However, empirical MRSA antibiotic coverage is reasonable if infection is severe or rapidly spreading as the 48–72 hour delay before preliminary culture reports become available could prejudice outcomes when these organisms are responsible for an aggressive infection.

Culture of exudate (as compared to tissue) will often yield contaminants rather than the bacterium responsible for an infection (7).

6. Wound assessment and management

Recommendation 1: Plain X-rays should be requested to assess wounds for underlying osteomyelitis and foreign bodies and MRI (7), if available and affordable, may be considered for assessment of wound depth and for osteomyelitis, if urgency of treatment allows, particularly in equivocal cases. Wounds should be probed for osteomyelitis. However, most, if not all, infected diabetic foot wounds will require debridement for both detailed wound assessment and definitive treatment. The goal of debridement is to drain abscesses and remove necrotic tissue up to the interface between advancing infection and normal tissue.

Rationale and Evidence: Apart from plain X-rays, a reliable, readily available, non-invasive method for assessment of extent of soft-tissue and bone infection would be helpful, particularly in equivocal cases, such as patients with closed puncture wounds who present soon after injury and others with minimal signs of infection. Urgent requirement for treatment may not allow time for acquisition of MRI, even if available and affordable. Ultrasonography has potential for diagnosing both soft-tissue infection (45–50) and osteomyelitis (51) but this readily available diagnostic modality has not found popular application for this purpose; seemingly, more research needs to be done to reliably correlate ultrasound images with pathology. A clinical amputation risk prediction score derived by East *et al* (20) also has potential for predicting wound/infection severity but requires external validation.

Recommendation 2: Following debridement, wounds should be dressed daily. Desloughing dressings, such as wet-to-dry gauze, hydrogen peroxide, povidone iodine, EUSOL or papaya/papase, may be used during the inflammatory phase of wound-healing when the wound still contains much necrotic tissue debris, but should be discontinued and replaced by bland dressings, such as normal saline, once the wound is clean and granulating. Negative pressure wound therapy (NPWT) is a very effective dressing that may be applied, if available and affordable, once desloughing is complete.

Rationale and Evidence: Daily dressings are important to remove slough that is too tenuous to be cut away with a scalpel, to remove exudate, thereby keeping bacterial biofilm under control, to prevent desiccation of the wound and maintain a moist

wound environment and to limit exogenous contamination (52). Negative pressure wound therapy, in addition to possessing most of these properties, also stimulates wound contraction by its suction effect and accelerates wound-healing *via* a proliferative reaction to tissue microdeformation (52). It is important to discontinue use of caustic desloughing agents as soon as the wound is clean as they will destroy granulation tissue and neo-epithelium as adeptly as they destroy slough.

7. Discharge procedures

Recommendation: In addition to the usual arrangements for outpatient clinic follow-up and dressings, patients should be provided with an educational brochure for reference, with the features previously described and, where possible, counselling by a dietician and health promotion trainer.

Rationale and Evidence: The time of discharge from hospital provides a particularly opportune educational moment.

8. After-discharge care

8.1. Wound care

Recommendation: At least thrice weekly dressings should continue following discharge from hospital. Dressings should consist mostly of bland solutions or creams, such as normal saline, as most wounds would be clean and relatively free of slough by the time of discharge. Ambulatory NPWT devices are recommended if available and affordable.

Rationale and Evidence: See rationale for wound care during hospitalization above.

8.2. Criteria for discontinuing antibiotics

Recommendation: Patients should be discharged from hospital on oral antibiotics as indicated. Antibiotics may be discontinued when signs of infection have abated, usually within two to three weeks of starting treatment for most moderate-to-severe infections (7).

Rationale and Evidence: Terminating antibiotics must be a conscious decision by treating physicians; what too commonly happens is that antibiotic prescriptions are repeated routinely and indefinitely until the wound is completely healed. Prolonging antibiotic treatment beyond resolution of active infection (as opposed to mere contamination, which does not require antibiotics) does not improve outcome, does not accelerate wound-healing and

encourages evolution of antibiotic resistance (53).

8.3. Off-loading

Recommendation: Off-loading with total contact cast or irremovable walking boot is recommended for patients with persistent neuropathic ulcers after infection or with open wounds from debridement for infections associated with pre-existing neuropathic ulcers.

Rationale and Evidence: Neuropathic ulcers will not usually heal without off-loading of plantar pressure (54). There is also evidence that open wounds created by debridement or open partial foot amputation of wounds caused by infection of neuropathic ulcers may not heal or at best are slow to heal without off-loading (20), ostensibly because the conditions predisposing to evolution of the ulcer in the first place are still present.

Off-loading has not been popular among practitioners in Jamaica and has not usually been offered to patients. So, the usual history of patients with a neuropathic ulcer is that they keep coming to the surgical outpatient clinic or the health centre with a non-healing plantar wound, often for years, with the foot becoming repeatedly re-infected *via* the ulcer, with eventual amputation. This needs to change. Total contact casts are not only the most effective treatment for neuropathic ulcers (55) but they are also easy to apply and material is readily available.

Admittedly, there is some anecdotal evidence of patient resistance to total contact casting where it has been offered but this is likely to diminish when application of the method becomes routine and good results become manifest.

8.4. Referral for orthoses and prostheses

Recommendation: Patients should be referred at a suitable time after discharge from hospital for prostheses or orthoses, as indicated.

Rationale and Evidence: Amputation prostheses improve quality of life and orthoses reduce the risk of recurrence of foot infection (54). Unfortunately, the only public amputation prosthetics centre in Jamaica is in Kingston and even there, prostheses are expensive. Amputation prostheses and orthoses for diabetic feet are also available

in the private sector. The need for more accessible and affordable prosthesis and orthosis services is obvious.

8.5. Discharge to primary care

Recommendation: Treating specialists in hospitals should discharge patients with a referral letter to their local health centre or family practitioner in the interest of continuity of patient care. Criterion for discharge to primary care should be complete or near complete healing of non-dependent wounds and complete healing of plantar wounds.

Rationale and Evidence: Too often patients return to the doctor who referred them to the hospital without any information as to what was done and what is expected of the doctor by way of follow-up.

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Guideline Algorithm

