

## Perspective

# Diabetic Foot - An African Perspective

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## Abstract

Diabetes is the most, non-communicable chronic disease globally. In African countries where incidence rates are increasing diabetic foot complications, such as ulceration, infection, or gangrene lead to considerable morbidity, long term disability and premature mortality. Published reports show variable prevalence rates (4%-19%) of foot ulcers among African diabetic patients. Although peripheral neuropathy is the underlying cause of most such complications in these patients (4%-84%), the occurrence of peripheral arterial disease (0%-78.7%) is rising parallel with increasing urbanisation. The frequency of patients presenting with gangrenous foot ulcers (Wagner score  $\geq 4$ ) ranges from 0.6-69% among patients attending diabetic clinics across the African continent. Foot amputation rates from various parts of Africa, although high by any standard (0.3-45%), are almost certainly lower than they should be, and may be related to cultural factors and the reluctance of patients to give consent for surgery that leads to limb amputation. Cost-effective education should be targeted at both healthcare workers and patients. One of these programs is the Step by Step Foot Project, which was piloted and carried out in Tanzania and India. In conclusion, prevention, control and educational programmes are needed to stem the rising occurrence of diabetic foot complications in Africa. Early presentation by patients and prompt surgical intervention during less severe rather than during later stages of an ulcer may improve patients outcome and reduce mortality rates.

## Keywords

- Developing world
- Amputation
- Diabetes
- Foot ulcer
- Africa
- Peripheral neuropathy, peripheral arterial disease
- Preventive program
- Step by step foot project
- Education
- Foot care

## INTRODUCTION AND EPIDEMIOLOGY

Diabetes mellitus is a serious chronic condition with devastating implications for affected patients across the globe [1-3]. With little discrimination, it affects rich and poor, young and old, and industrialized or the economically less-developed in equal measure. In 2015, the global prevalence of diabetes was estimated at 415 million [3]. This figure is predicted to reach 642 million by 2040—a consequence of longer life expectancy, sedentary lifestyle, and changing dietary patterns [3]. In China, the Middle East, and in countries across the African continent, the number of people with diabetes has increased significantly and is expected to more than double during the coming decades. In 2015, it was estimated that there were 14.2 million persons with diabetes in Africa and, should current trends continue, the overall prevalence is projected to increase to 34.2 million by 2040 [3].

Africa, the second largest continent in the world, is approximately three times the size of Europe, and is home to some 1000 ethnic groups living in 54 nations, speaking more than 1000 languages [1]. With 1.1 billion population of Africa as of 2013, it accounts 15% of the world human population [1].

Not surprisingly, diabetes remains a leading cause of morbidity and mortality in both developed and less-developed countries, and imposes a heavy burden on health services in these

nations [4-16]. Among all the various, serious complications, including kidney failure or blindness, which can affect individuals with diabetes mellitus, complications related to the foot and rest of the lower limb are associated with the highest morbidity and mortality [14-16]. Across the globe, 40-60% of all lower extremity non-traumatic amputations are performed in patients with diabetes [17]. Foot complications, especially serious ones like the septic limb, can be serious and costly [4-20].

‘Time is tissue’ in the diabetic foot [17,21] - means that early recognized and treatment of the diabetic foot ulcer could avoid minor and / or major amputation and even death of the patients [17,21]. Time is not tissue means that these feet have long history of weeks or months of ulcer, are not able to walk, already sustained infection, misdiagnosed by health care workers and not properly treated [17,21].

Typical sequential timeline of patients to make decision to seek help in most of the developing world are as follow: Firstly patient will initiate treatment at home for example using simple shaving bald (we call it bathroom surgery), applying homemade solutions or powered on diabetic foot ulcers. Secondly, patient will visit faith or herbal healer if above treatment at home does not work [21]. Thirdly, patient will go primary health care centre [21]. Fourthly, visit to the district health care centre. Fifthly visit

to regional health care centre [21]. By the time patient is referred to referral hospital or specialised diabetic foot centre it is often too late to save foot or even prevent death [21].

Epidemiological studies published indicated that over one million amputations were being performed annually on persons with diabetes globally [17]. Those estimates also suggested that a leg was being lost to diabetes somewhere in the world every 30 seconds [17]. When the estimates of morbidity are calculated using the relatively more recent prevalence data of 2011, it works out that a lower limb is lost as a complication of diabetes every 20 seconds across the world. The majority of these amputations are preceded by ulcers [17].

## ECONOMIC BURDEN OF DIABETIC FOOT ULCERS

Present knowledge of the cost of treating a diabetic foot ulcer is drawn primarily from western industrialized countries including the United States, Sweden and The Netherlands. We estimated the cost to the patient and to society of treating foot ulcers in five countries with widely varying health care practices, reimbursement policies, and gross domestic products [18]. The cost of treating the same ulcer to the same endpoints in all five countries was estimated at \$ 3,060, in Tanzania which is only 1.6% of the US cost of \$188,645 [18]. In African countries medical insurance or reimbursement of medical expenses are not available, and the management of a complex diabetic foot ulcer can cost more than 2 years of average income for the patient. For example in Senegal the cost of an amputation has been estimated to be about 3,200 USD not including the orthopedic equipment [22]. It is devastating and catastrophic if a patient is the only bread earner in an extended family and is very common in Africa. [6-9,18]. The loss of productivity caused by unemployment or sick leave during the foot ulcer management is an added cost to the family, relatives, friends and community that largely remains un-quantified in low income countries [18].

## DIABETIC PERIPHERAL NEUROPATHY

Published data from western world suggest that peripheral neuropathy is the most common complication of diabetes, occurring in 5-80% of patients with diabetes [23,24] and generally associated with age, duration of diabetes, male gender, alcohol intake, glycaemic control or smoking [23]. The epidemiology of the diabetic foot appears to be similar for patients in African countries. For example, a study conducted in Tanzania established that 25% of diabetes patients attending a large diabetic clinic in Tanzania had varying degrees of symptoms or signs of peripheral neuropathy [11]. However, the data from this study also suggested that the severity of symptoms or signs of peripheral neuropathy were not associated with type or duration of diabetes, gender, age, peripheral vascular disease, alcohol consumption, literacy, or educational status [11]. Studies conducted across Africa have documented a wide range in the occurrence of diabetic peripheral neuropathy ranging from 4% in 1960's from Zimbabwe, 40% in 1970's from Ethiopia, 47% in 1980's from Ethiopia, 68% in 1990's from Nigeria and 84% in 2000 from Algeria [25-29]. There is no difference in ethnicity where ever you are in the world [12-13].

Neuropathic ulcers located on pressure points of the foot,

become portals of entry for bacteria that cause infection (often polymicrobial), which spread rapidly through the foot causing overwhelming tissue destruction and osteomyelitis—the primary reason for major amputation in the neuropathic foot. It is not therefore surprising that diabetic foot ulcers have become the most frequent cause of prolonged hospital admission in diabetic patients [1-9, 12-14,16] and contributes significantly to attributable morbidity associated with the development of foot complications in diabetes patients [1-9,12-14,16 ].

## DIABETIC PERIPHERAL ARTERIAL DISEASE

Peripheral arterial disease (PAD) causes considerable morbidity in diabetes patients and is defined clinically in patients with a history of intermittent claudication, rest pain, absence of the pedal pulses or abnormalities on non-invasive arterial assessment (e.g., using Doppler studies) consistent with impaired circulation or the presence of new collateral circulation [17].

Published reports suggest that foot complications in African patients are generally infective and/or neuropathic in origin rather than due to PAD, but the pattern is changing: as communities across Africa become more urbanized and affluent, the prevalence of PAD is rapidly increasing in the diabetic population [12,21,29,30]. Published rates of PAD shows an increase trend in rates from 0% in 1960's from Zimbabwe, 1.1% in 1970' from Ethiopia, 2.9% in 1980' from Tanzania, 54% in 1990's from Nigeria and 78% in 2000 from Algeria [26-29,31]. Recent data from an urban population in Tanzania show a similarly high prevalence of PAD at 26% [12]. Overall PAD is under diagnosed and under treated in Africa and there is a good case for a more frequent measurement of Ankle Brachial Index in symptomatic subjects with absent foot pulses [12,21,31].

## DIABETIC FOOT ULCERATION

In Africa, peripheral neuropathy is the principal underlying risk factor in the pathogenesis of foot ulcers in patients with diabetes [5,7,8]. A study of clinical outcome of patients with foot ulcers in Tanzania showed that 15% of diabetic admissions are due to foot ulcers, 80% of which have occurred for the first time [9]. Amputation is a frequent outcome in people with foot ulcers. 33% of these amputations are associated with neuro-ischemic lesions and/or progressive infection. The hospital mortality rate can be as high as 54% in those with severe foot ulcers (Wagner score >4) managed without surgery or amputation [9]. Similar findings with high mortality and morbidity have been recorded in other parts of the Africa [5,9,29,32-34]. Similar findings have been recorded in other parts of Africa. Amputation rates may also be lower than expected, possibly related to the difficulty in obtaining consent for surgery [9]. Sadly, some patients with severe diabetic foot ulcers discharge themselves from hospital against medical advice, thus putting themselves at increased risk of severe sepsis and death at home [9,31].

The reason for this reluctance lies in part on cultural factors where loss of limb may be considered worse than loss of life [9,35]. Data from Dar es Salaam suggest that foot ulcers in patients, who refuse amputation as part of the management and return home, usually progress in severity in the home setting and frequently results in these patients having to be readmitted

to hospital [9]. Patients with severe diabetic foot ulcers, who discharge themselves against medical advice, put themselves at increase risk of severe sepsis and death at home [9,28].

Poverty and unhygienic conditions may be associated with foot ulceration [11-14]. Other major factors contributing to development of the diabetic foot in Africa include walking barefoot or delay in reporting to the medical centre for clinical assessment. Barefoot walking a common practice in rural Africa is commonly related to low income but may be cultural as well [6,21]. For diabetes patients living at or below poverty line, the purchase of appropriate footwear might not be affordable, feasible or of high priority. Inappropriate footwear means flip flop slippers which are rubber made and very cheap or cost effective commonly used in developing world. Masai and too some extent others have tendency of producing a foot wear from worn out motor car tyres [21].

Barefoot walking substantially increases the risk of diabetic foot ulcers in those with neuropathy. Moreover, those with neuropathy who habitually sleep on the floor or outdoors may suffer painless rodent bites on the toes [8,14]. Neuropathy masks such injuries until the patient finally becomes symptomatic and presents with diabetic foot ulcers that has progressed to fulminating foot sepsis. Patients who do not have access to ongoing foot care, advice, or education are most at risk of developing infected foot ulcers generally not available at regional, district or primary health care centre [7,8]. Abbas and colleague introduced step by step foot project in Tanzania targeting at district and regional level.

## DIABETIC FOOT INFECTION

Diabetic foot infections constitute a common, complex and serious problem in diabetes patients and usually begin in foot ulcers that are sequelae of existing neuropathy, macro-vascular diseases, or certain metabolic disturbances [35]. Patients in Africa often present to hospital only after the onset of gangrene or during stages of sepsis that may not respond to conventional supportive treatment with antimicrobials, intravenous fluids and insulin, resulting in progression to systemic infection with significant mortality [1-15]. Infected diabetic foot ulcers may thus present with acute limb-threatening conditions leading to foot or leg amputations in 25-50% of diabetic patients [16]. Fungal foot infections are also common resulting in infection of the toenails, between the toes, or in cracks and fissures on the sole of the feet [11-14]. These skin lesions lead to secondary bacterial infection [15]. Initial antimicrobial therapeutic regimens are usually selected empirically and then modified as appropriate once the results of culture and antimicrobial susceptibility testing become available [36]. Cultures of superficial swab specimens are not very useful since they tend to yield polymicrobial growth. Deep tissue biopsy would yield more useful data, but many microbiology services in Africa do not have the resources to provide or maintain such routine culture services. In Africa culture and sensitivity are available only at tertiary level of the hospitals [36]. Published data showed that the utility of Gram staining is equally sensitive compare to cultures in the management of diabetic foot ulcer [36].

Thus, new or additional treatment strategies for the

prevention and management of diabetic foot infections are urgently needed in low-income countries [18,36]. Although reported rates of amputation resulting from infected feet vary widely by geographic regions [1-9,11-15], the true incidence rate of amputations following foot infections in Africa diabetes patients remains underestimated [1-9,11-15]. Of the many indications for amputation in diabetic patients [11-15], gangrene and infection are the most commonly cited reasons, often occurring simultaneously [11-15].

Because patients with infected foot ulcers frequently feel no pain due to neuropathy and many have no systemic symptoms until a later stage in the condition, medical providers often presume (incorrectly) a degree of self-neglect among affected patients. Infection, ulceration, and limb amputation are preventable through organised foot care programmes. A multidisciplinary approach with an emphasis on a comprehensive, preventive strategy, including patient and staff education, and multi-factorial treatment of diabetic foot ulcers has been reported to reduce amputations by more than 50% [37-40].

It is not surprising, therefore, that foot infections are especially common where such services are especially scarce in Africa. Chiropractic services are non-existent in Africa. Consequently, lesions are either ignored or detected relatively late in the course of the infection after unsuccessful home therapy, such as soaking in hot water or application of unproven home remedies. Foot infections of this nature culminate in the onset of gangrene or infection with ensuing limb amputation or death from overwhelming sepsis [4-15,21]

## PREVENTION

The exact incidence of infection and ulceration in the feet of diabetes patients will vary from country to country and also within the countries themselves. However, the two most significant risk factors and common denominators for occurrence of foot infection and ulceration are social deprivation and limited access to health care. Various studies have suggested that simple care; motivation, education, and action by diabetes patients are essential in protecting the feet from complications. The most important intervention for the prevention of diabetic foot ulcers is education of the patient about appropriate foot care [38-40]. It is now well recognised that the establishment of foot clinics has resulted in the reduction of amputations. In low-income countries, the inadequacy of foot services results in increase in the number of needless amputations. Preventative strategies for diabetic foot ulcers are virtually non-existent in many countries in Africa. Moreover, research into preventative aspects pales into insignificance compared to the body of evidence for treatment. Many of the current practice guidelines are based on consensus and tradition rather than research-based evidence. Education remains the most powerful preventive tool in underdeveloped countries, and should be an integral part of prevention programs, and be simple and repetitive [38-43].

Several educational programs aimed at preventing diabetic foot complications have been carried out and executed successfully in both developed and less-developed countries [38-43]. A comprehensive foot-care program should include education, regular foot examination, identification of high-risk

patients, and educational programs for diabetes patients and their health care providers. One of these programs is the Step by Step Foot Project, which was piloted and carried out in Tanzania and India [38-40]. This program showed that infection, ulceration, and limb amputation are potentially preventable through organized foot care programs, and approaches that encompass comprehensive, preventive strategies, including patient and staff education, joint medical and surgical management of foot ulcers, appropriate use of microbiology resources, and regular follow-up [38-43]. Importantly, the project was found to be associated with greater than a 50% reduction in amputation rates [38-43].

## CONCLUSION

The pathogenesis of foot lesions in diabetes patients in Africa is similar to that of patients in the industrialized West. Ulcers, fissures, and cracks that develop in feet as a result of underlying peripheral neuropathy are the most important risk factors for lower limb infection. Thus, prevention of peripheral neuropathy through aggressive glycaemic control might be the single most significant primary preventive measure for lower limb ulceration or infection. While it may be impossible to totally prevent foot ulceration, it is certainly feasible to prevent the progress of small ulcers to infection, sepsis, osteomyelitis, or gangrene. Education remains the most important preventive tool in Africa and should be an integral part of preventive programs: simple and repetitive, and targeted at both healthcare workers and patients alike. Lower limb amputation rates in diabetic patients can be reduced by >50% if the following strategies are implemented: (i) regular inspection of foot and footwear at patient's regular clinic visits; (ii) preventive footwear prescribed for patients with high-risk feet; (iii) implementation of a multidiscipline approach to the management of foot ulcers in diabetic clinics; (iv) early diagnosis of peripheral neuropathy and peripheral vascular disease; (v) continuous follow-up of patients with previous foot ulcers and registration of amputation and foot ulcers for affected patients. Diabetes patients must be educated on the importance of foot care and of consulting a doctor during the early stages of foot-related symptoms. Ultimately, success will depend on the ability of healthcare providers to inculcate the motivation and self-help that is so necessary for diabetic patients themselves.

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## REFERENCES

1. Abbas ZG. The Global Burden of Diabetic Foot. In: Pendsey S, editor. *Contemporary Management of Diabetic Foot*. 1<sup>st</sup> Edn. JP Medical Ltd. 2013; 24-30.
2. Abbas ZG, Archibald LK. Recent International Development: Africa. In: Boulton AJM, Cavanagh P, Rayman G, editors. *The Foot in Diabetes*. 4<sup>th</sup> Edn. John Wiley & Sons Ltd. 2006; 379-385.
3. International Diabetes Federation. *Diabetes Atlas*. Sixth Edn. 2015.
4. Abbas ZG, Archibald LK. Challenges for management of the diabetic foot in Africa: doing more with less. *Int Wound J*. 2007; 4: 305-313.
5. Abbas ZG, Archibald LK. Epidemiology of the diabetic foot in Africa. *Med Sci Monit*. 2005; 11: RA 262-270.
6. Abbas ZG, Viswanathan V. The diabetic foot in Africa and India. *Int Diab Monitor*. 2007; 19: 8-12.
7. Abbas ZG, Gill GV, Archibald LK. The epidemiology of diabetic limb sepsis: an African perspective. *Diabet Med*. 2002; 19: 895-899.
8. Abbas ZG, Archibald LK. The diabetic foot in Sub-Saharan Africa: a new management paradigm. *Diab Foot J*. 2007; 10: 128-134.
9. Abbas ZG, Lutale JK, Morbach S, Archibald LK. Clinical outcome of diabetic patients hospitalized with foot ulcers, Dar es Salaam, Tanzania. *Diabet Med*. 2002; 19: 575-579.
10. Tesfaye S, Gill G. Chronic diabetic complications in Africa. *African journal of diabetes medicine* 2011; 19: 4-8.
11. Abbas ZG, Archibald LK. Foot complications in diabetic patients with symptomatic peripheral neuropathy in Dar es Salaam, Tanzania. *Diabetes Int*. 2000; 10: 52-56.
12. Abbas ZG, Lutale JK, Archibald LK. Diabetic foot ulcers and ethnicity in Tanzania: a contrast between African and Asian populations. *Int Wound J*. 2009; 6: 124-131.
13. Morbach S, Lutale JK, Viswanathan V, Mollenberg J, Ochs HR, Rajashekart S, et al. Regional difference in risk factors and clinical presentation of diabetic foot lesions. *Diabet Med*. 2004; 21: 91-95.
14. Abbas ZG, Lutale JK, Archibald LK. Rodent bites on the feet of diabetic patients in Tanzania. *Diabet Med*. 2005; 22: 631-633.
15. Hennis AJ, Fraser HS, Jonnalagadda R, Fuller J, Chaturvedi N. Explanation for the high risk of diabetes related amputation of black African descent and potential for prevention. *Diab Care*. 2004; 27: 2636-2641.
16. Abbas ZG, Gill GV, Archibald LK. The epidemiology of diabetic limb sepsis: an African perspective. *Diabet Med*. 2002; 19: 895-899.
17. Bakker K, Schaper NC, International Working Group on Diabetic Foot Editorial Board. The development of global consensus guidelines on the management and prevention of the Diabetic Foot 2011. *Diabetes Metab Res Rev*. 2012; 116-118.
18. Cavanagh P, Attinger C, Abbas ZG, Bal A, Rojas N, Xu ZR. Cost of treating diabetic foot ulcers in five different countries. *Diabetes Metab Res Rev*. 2012; 28: 107-111.
19. Shobhana R, Rama Rao P, Lavanya A, Vijay V, Ramachandran A. Cost burden to Diabetic patients with foot complications- a study from Southern India. *J Assoc Physicians India*. 2000; 48: 1147-1150.
20. Ali SM, Fareed A, Humail SM, Basit A, Ahmedani MY, Fawwad A, et al. The personal cost of diabetic foot diseases in the developing world – a study from Pakistan. *Diabetes Med*. 2008; 25: 1231-1233.
21. Abbas ZG. *Pocket Guideline of diabetic foot*. 2014. 1st Edn. The SUN Pharma.
22. Etude descriptive du pied diabétique au Sénégal: à propos de 105 cas. Ndour mbaie N. M., Sarr A. Diop S.N., Diedhiou D., KA-Cisse M., Camara Y, Sidibe E.H., Sow A.M. *Dakar Médical*. 2008; 53: 205-212.
23. Edmonds M, Boulton A, Buckenham T, Every N, Foster A, Freeman D, et al. Report of the diabetic foot and amputation group. *Diabet Med*. 1996; 13: S27-S42.
24. Jeffcoat WJ, Harding KG. Diabetic Foot Ulcers. *Lancet* 2003; 361: 1545-1551.
25. Gelfand M, Forbes JI. Diabetes mellitus in the Rhodesian Africa. *S Afr Med J*. 1963; 37: 1208-1213.
26. Belcher DW. Diabetes mellitus in Northern Ethiopia. *Ethiop Med J*. 1970; 8: 73-84.
27. Lester FT. Long-standing diabetes mellitus in Ethiopia: a survey of 105

- patients. *Diabetologia* 1983; 25: 222-225
28. Akanji AO, Adetuyidi A. The pattern of presentation of foot lesions in Nigerian diabetic patients. *West Afr J Med*. 1990; 9: 1-5.
  29. Benotmane A, Mohammedi F, Ayad F, Kadi K, Azzouz A. Diabetic foot lesions: etiologic and prognostic factors. *Diabetes Metab*. 2000; 26: 113-117.
  30. Samson Okello, Alexander Millard, Rogers Owor, Stephen Bambeihha Asimwe, Mark Jacob Siedner, Joselyn Rwebembera, et al. Prevalence of lower extremity Peripheral artery disease among adult diabetes patients in Southwestern Uganda. *BMC Cardiovasc Disord*. 2014; 14: 75.
  31. Mhando PA, Yudkin JS. The pattern of diabetic complications in African patients in Dar es Salaam. *Trop Geogr Med*. 1980; 32: 317-323.
  32. Lester FT. Amputations in patients attending a diabetic clinic in Addis Abeba, Ethiopia. *Ethiop Med J*. 1995; 33: 15-20.
  33. Muyembe VM, Muhinga MN. Department of Surgery, Central Provincial Hospital, Nyeri, Kenya. Major limb amputation at a provincial general hospital in Kenya. *East Afr Med J*. 1999; 76: 163-166.
  34. Sano D, Tieno H, Drabo Y, Sanou A. Management of the diabetic foot, apropos of 42 cases at the Ougadougou University Hospital Center. *Dakar Med*. 1998; 43: 109-113.
  35. Lipsky BA. A current approach to diabetic foot infections. *Curr Infect Dis Rep*. 1999; 1: 253-260.
  36. Abbas ZG, Lutale JK, Ilondo MM, Archibald LK. The utility of Gram stains and culture in the management of limb ulcers in persons with diabetes. *Int Wound J*. 2012; 9: 677-682.
  37. Abbas Z, Morbach S. Diabetes foot damage in developing countries: the urgent need for education. *Diabetes Voice*. 2005; 50: 15-17.
  38. Abbas ZG, Lutale JK, Bakker K, Baker N, Archibald LK. The 'Step by Step' Diabetic Foot Project in Tanzania: a model for improving patient outcomes in less-developed countries. *Int Wound J*. 2011; 8: 169-175.
  39. Bakker K, Abbas ZG, Pendsey S. Step by step, improving diabetic foot care in the developing world. A pilot study for India, Bangladesh. *Pract Diab Intern*. 2006; 23: 365-369.
  40. Pendsey S, Abbas ZG. The Step-by-Step program for reducing diabetic foot problems: a model for the developing world. *Curr Diab Rep*. 2007; 7: 425-428.
  41. Abbas ZG. Preventing foot care and reducing amputation: a step in right direction for diabetes care. *Diabetes Management*. 2013; 3: 427-435.
  42. Abbas ZG. Reducing diabetic limb amputations in developing countries. *Expet Rev Endocrinol Metabol*. 2015; 10: 425-434.
  43. Abbas ZG. The Diabetic Foot Chapter 39 Preventive foot care programs. Edited by Hinchliffe RJ, Schaper NC, Thompson MM, Tripathi RK, Timaran CH. 1st Edition JP Medical Ltd., 2014: 24-30.

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