

# Multidisciplinary Approach to the Management of Diabetic Foot Complications: Impact on Hospital Admissions, Limb Salvage and Amputation Rates

## Abstract

**Introduction:** According to Diabetes UK, it is now a requirement in the UK to commission a multidisciplinary (MDT) foot clinic with the primary objectives to reduce the number of minor and major amputations. It has been suggested that MDT foot clinic detect and optimise the complications due to diabetes at an early stage. The aim of this study is to assess the efficacy of running a MDT foot clinic on the early detection of diabetes related foot complications, hospital admissions, limb salvage and the rate of amputation.

**Method:** We set up a MDT Diabetic Foot clinic in July 2015. This is a one stop clinic, providing care and most of investigations on the same day. We retrospectively collected all patients admitted with diabetes prior to the set-up of the clinic and prospectively collected data from the commencement of the clinic. We also reviewed the literature supporting the efficacy of MDT clinic.

**Results:** Since the introduction of our MDT foot clinic, there has been a reduction in hospital admissions in diabetes related foot complications, there has also been an increase in limb salvage due to increased endovascular interventions, a rise in angioplasty and bypass operation. In addition, there has been a decrease in the rate of minor amputation. However, the rate of major amputations increased. Only 20% of all major amputations patients were unknown to us and the rest are due to delayed presentation

**Conclusion:** In summary, since the establishment of our MDT diabetic foot clinic we have been able to identify diabetic foot complications at an early stage and intervene and optimise the diabetes and its complications. However, more education and increased input into primary care is needed to prevent late referrals and a reduction in the major amputation rate.

**Keywords:** Diabetic foot; Multidisciplinary team; Foot protection service; Diabetic foot care pathway

## Mini Review

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**Abbreviations:** MDT: Multi-Disciplinary Team; NICE: National Institute of Health and Care Excellence; NPWT: Negative Pressure Wound Therapy; CT: Computerised Tomography; MRI: Magnet Resonance Imaging

## Introduction

The disease burden from diabetes is large and increasing and the associated morbidity significant, thus a multidisciplinary approach to patient management is essential. Diabetic foot care is a vital component of this and aims to reduce the effects associated with diabetes related foot problems. A patient with complicated diabetes has a 15-year reduction in their life expectancy and 75% of these will die of illness associated with the microvascular compromise caused by their diabetes [1].

Ischaemic and infective complications are common in diabetes with up to 10% lifetime risk of developing a diabetic foot ulcer and a significant proportion of those will further deteriorate and

ultimately require an amputation. Of the patients needing a major amputation, 80% will have had a preceding foot ulcer. According to the National Institute for Health and Care Excellence (NICE) guidelines updated in 2016, all patients should have access to a Foot Protection Service whose role is to prevent deterioration of diabetic foot complications; avoiding hospital admissions and the need for escalation of treatment [1].

It is also now a requirement in the UK to commission a multidisciplinary (MDT) foot clinic with the following objectives: to reduce the number of minor and major amputations arising from a 'foot attack'; to reduce unnecessary admissions to hospital in the event of a 'foot attack' and to provide a seamless care pathway with the Foot Protection Service in the community [1,2].

It is widely accepted that the development of a structured diabetic foot care pathway with robust protocols, helps the management of complex diabetic patients. The literature suggests that up to 80% of patients with diabetic vascular ulcers or

requiring major amputations will die within 5 years [3]. With this in mind, it is paramount to avoid amputations and improve diabetic foot care and have limb salvage procedures in a time critical fashion. Protocol driven optimal care pathways should be in place to guide the assessment, investigations and management of all patients with complicated diabetic foot disease [4,5].

### The diabetic foot clinic

In July 2015, we set up a MDT diabetic foot clinic comprising

of surgeons from vascular, orthopaedics and plastics specialities, diabetes and endocrinology physicians, interventional radiologists, microbiologists, podiatrists, the surgical appliance team, vascular scientists and diabetes specialist nurses. The format of this service is a one-stop clinic where patients with diabetic foot complications can be referred to by primary or secondary care professionals using a simple and clear referral pathway proforma to stratify the urgency of referral (Appendix A).

<input checked="" type="checkbox"/>	Risk	Definition	Referral
<input type="checkbox"/>	Low	Normal circulation and no risk factors	No referral. Management in primary care
<input type="checkbox"/>	Moderate	A degree of neuropathy alone	No referral. Management in primary care
<input type="checkbox"/>	Moderate	Non-palpable pulses <i>OR</i> at least one other risk factor	Virgin Care Podiatry Services. Dedicated telephone and email address supplied
<input type="checkbox"/>	High	Combination of Neuropathy <i>OR</i> non palpable pulses <i>OR</i> other risk factors <i>OR</i> history of foot disease	Refer <b>URGENTLY</b> to Diabetes Foot Clinic Dedicated telephone and email address supplied
<input type="checkbox"/>	<b>URGENT Diabetes Foot Clinic</b>	Systemically well patient with: <ul style="list-style-type: none"> <li>• ULCERATION</li> <li>• INFECTION</li> <li>• CHRONIC ISCHAEMIA</li> </ul>	Refer <b>URGENTLY</b> to Diabetes Foot Clinic Dedicated telephone and email address supplied
<input type="checkbox"/>	<b>URGENT Vascular</b>	Systemically unwell patient with: <ul style="list-style-type: none"> <li>• ACUTE ISCHAEMIA</li> <li>• ASCENDING CELLULITIS</li> <li>• SEVERE TISSUE NECROSIS</li> </ul>	Refer <b>IMMEDIATELY</b> to Ashford & St Peters NHS Trust Vascular Team Dedicated telephone and email address supplied
<input type="checkbox"/>	<b>URGENT Orthopaedic</b>	<b>SUSPECTED CHARCOT FOOT</b>	Refer <b>IMMEDIATELY</b> to orthopaedics team Dedicated telephone and email address supplied

Appendices: Appendix A: Ashford & St Peter’s Hospital Diabetic Foot Referral Proforma.

In clinic patients are assessed by the MDT and sent immediately for investigations to ensure that there is prompt recognition of significant pathology to plan early, definitive management strategies and prevent further deterioration. The imaging modalities used for suspected vascular compromise, which is reported to be in up to 50% of these patients, is duplex ultrasound and CT angiography [6]. An urgent MRI is performed on those where osteomyelitis or Charcot’s foot are suspected.

The clinic team offers expertise in complex dressings including negative pressure wound therapy (NPWT) which promotes healing of diabetic foot infections and aids granulation tissue formation and angiogenesis [1,7]. Larvae therapy with maggots for ulcers resistant to conventional management is also available to aid granulation of wounds and debride infected and necrotic tissue [8,9].

The MDT approach also accesses the podiatry and orthotic services that are available to allow offsetting of pressure areas so that there can be an immediate benefit to the patient and aid the recovery of tissues from diabetic foot complications. The important

input from our interventional radiologists at St Peter’s Hospital allows for rapid strategic planning and referral for angioplasty procedures: aiming correcting vascular occlusive complications that would otherwise hinder the healing of ulcers and infective foot complications and potentially lead to amputations [1].

### Aims

This study aims to assess the benefits from the establishment of a diabetic foot clinic as a tool to avoid hospital admissions, identify diabetic foot complications early and provide limb salvage procedures in a timely manner to ultimately attempt to avoid minor and major amputations.

### Method

This study was carried out in Ashford and St Peter’s Hospital Trust which is an NHS foundation trust comprising of two large British DGHs in North-West Surrey. Data was collected between September 2014 to September 2015 and September 2015 to September 2016. Initially the study looked retrospectively at the year (September 2014 to September 2015) prior to the

establishment of the diabetic foot pathway in 2015 to assess the baseline complications, procedures and management of the diabetic foot within this hospital trust.

The second phase of this study prospective collected data under the same broad categories as the first but this was gathered between September 2015 and September 2016 following the setup of the MDT foot clinic. The two sets of data were compared in order to analyse the effect the coordinated interdisciplinary diabetic foot service had on the outcomes of those patients with diabetic foot complications.

The information that was gathered related to the demographics of those with diabetic foot complications (Table 1) and looked at rates of hospital admission, limb salvage procedures (including surgical and interventional radiology) and rates of major and minor amputations. Only major interventional figures are displayed in the Table 1. In addition, we have also used special dressings (negative pressure wound therapy, larvae therapy) and minor surgery (incision and drainage, wound debridement).

**Table 1:** The information that was gathered related to the demographics of those with diabetic foot complications.

Demographics	Pre-MDT Admitted Patients	Post-MDT Admitted Patients
Age-Range(Average)	46-87 (67)	38-92(70)
Male: Female Ratio	4:1	5:1
<b>Risk Factors (% of Patients)</b>		
Diabetes -Diet Controlled	0	9.2
Diabetes - Type I	2.7	24
Diabetes- Type II	92	64
Hypertension	68	43.5
Hypercholesterolemia	5.4	7.4
Ischaemic Heart Disease	35	37
Stroke	11	7.4
Chronic Kidney Disease	8	14.8
Length of Stay (Days)	8	8.3
<b>Presenting Symptoms (% of Patients)</b>		
Gangrene	22	33
Infected Leg Ulcer	61	26
Neuropathic Leg Ulcer	0	7
Ischaemic Leg	9	27
Cellulitis	8	7

Interventional Procedures (% of Patients)		
Angioplasty	14	82
Toe Amputation	10	5
Trans metatarsal Amputation	3	1
Below Knee Amputation	3	9
Above Knee Amputation	2	4
Bypass	5	12
Mortality	1	0

## Results

We noted that since the introduction of our MDT foot clinic, there has been a reduction in hospital admissions in diabetes related foot complications (12%), there has also been an increase in limb salvage due to increased endovascular interventions [a rise in angioplasty (68%) and bypass operation (9%)]. In addition, there has been a decrease in the rate of minor amputation (7%). However, major amputations increased by 8%. There was no mortality in the later period.

Despite the increase in limb salvage, there has been an increase in the major amputation rate which is distressing. Further review of the major amputation patients revealed that 20% of major amputees are known us and they underwent major amputations due to progression of the disease or due to non-reconstructable disease. However, 80% of the major amputees were unknown to the vascular or MDT teams and presented late with diabetic foot sepsis.

## Discussion

The results demonstrate that there are 12% fewer hospital admissions of diabetic foot related complications during the time period immediately after the diabetic multidisciplinary foot clinic were set up. The clinic aims to see patients in a time suitable way using the referral proforma (Appendix A) and act to be a key point of contact for the foot protection service in the community to allow more patients to avoid hospital admission by having targeted care in the community. The synchronous running of the assessment clinic and the availability of the radiological investigations avoids delays and consequential deteriorations patients may have whilst awaiting diagnostic imaging. These factors all contribute to the resultant reduction in hospital admissions that we have seen with patients being managed through the MDT diabetic foot clinic.

All limb salvage procedures were increased in the study period that followed the establishment of the coordinated care diabetic foot clinic. These included interventional radiology angioplasty, which increased by 68% compared to prior to the clinic set up. The total number of bypass operations and minor amputations, which were mostly single toes, increased by 9% and 7% respectively once the new diabetic foot care management was initiated: due to

the availability and skills of the full interdisciplinary team. Limb salvage is a key aim and focus of the MDT diabetic foot service so that patients can maintain a good quality of life and avoid vascular complications and resulting major amputations [1,3].

Perhaps unexpectedly, we have identified an increased rate of major amputations by 8% in the study cohort following the establishment of the diabetic foot service. Although the diabetic one-stop clinic aims to reduce these, as it is in its infancy, knowledge of the service and pathway is not fully established. Another key point in interpreting this result is to appreciate that only 20% of the patients that required a major amputation had been through the MDT clinic therefore the vast majority of patients were unknown to the vascular or diabetic foot services and consequently presenting late with ischaemic or infective complications that had already deteriorated to a situation where limb salvage was impossible.

We carried out a literature review on the MDT diabetic foot clinic. As this a relatively new service, there is a paucity of published literature. The majority of these publications support the use of MDT foot clinic and reported an overall improvement of diabetic foot care [2,10,11,12].

Currently the education for referral from primary care by local GPs, community podiatrists and diabetic practice nurses needs significant improvements to allow patients to fully benefit from the diabetic foot services offered. Following the study findings, an educational scheme has been initiated that includes educational presentations at local GP meetings to increase the knowledge surrounding diabetic foot complications and the pathways and protocols for the MDT clinic [13].

## Conclusion

This study has highlighted the central role that a diabetic foot service has in the care and management of patients with diabetic foot complications. The initial results suggest that a fully established, one-stop, MDT-led diabetic foot clinic benefits patients and improves outcomes related to the avoidance of hospital admissions, limb salvage procedures and minor amputations, although, we recognise that time and education are needed to see its full effects.

## Conflict of Interest

No conflict of interest declared.

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