

# Current practice in the assessment and management of acute diabetes-related foot complications

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## Abstract

A retrospective audit of client histories from 1 April 2004 to 31 March 2005 was conducted. Assessment, investigations on admission, management, length of stay and outcomes were assessed and compared with evidence-based guidelines. A total of 62 clients with 115 admissions were identified. The finding that HBA<sub>1c</sub> (glycated haemoglobin) levels were measured on admission 50% of the time suggested there is significant variability in assessment, investigation and management of acute diabetes-related foot complications. There is a need to better utilise evidence-based clinical guidelines, and for greater emphasis on linking individuals who are at risk of hospitalisation into appropriate outpatient services to improve outcomes.

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**DIABETES MELLITUS** is a chronic disease associated with high morbidity, mortality and chronic foot complications.<sup>1,2</sup> People with diabetes mellitus have a 15 times increased risk of undergoing a lower extremity amputation when compared with those without diabetes.<sup>1</sup> In Australia, between 1995 and 1998 there were 2629 lower extremity amputations performed on those with diabetes annually, equating to 13.97 amputations per 100 000 population.<sup>2</sup> In the United States, this

## What is known about the topic?

Until recently, there was a lack of Australian data identifying the current methods for assessing, investigating and managing acute diabetes-related foot complications in hospital environments. In 2004, a study that identified high variability in assessments, investigations and management was conducted at a major metropolitan acute care hospital in Melbourne.

## What does this paper add?

This study provides further research to support that current assessment and management of acute diabetes-related foot complications in acute hospitals frequently does not follow widely accessible evidence-based protocols and guidelines.

## What are the implications for practitioners?

Our study found a need to improve our methods of assessment, investigations and management in order to improve outcomes for clients with diabetes-related foot complications.

rate is considerably higher at 25.2 per 100 000 population.<sup>3</sup> The mortality rate within a month of amputation is 10% and median life expectancy post-amputation is 22 months.<sup>4</sup>

The most common reason for hospital admission among people with diabetes is for foot-related conditions such as ulceration and infection.<sup>5</sup> At the Royal Melbourne Hospital (RMH), it has been shown that at any given time about 25% of inpatients have diabetes, and 20% of these have a foot condition requiring management.<sup>6,7</sup> On any given day, three beds are occupied at RMH by patients with diabetes-related foot complications.<sup>6</sup> Hospital admission estimates show that 50% of patients with a foot ulcer and cellulitis and 75% of patients with a foot ulcer and osteomyelitis become hospital inpatients.<sup>8</sup>

It is well accepted that foot ulceration precedes amputation in most cases in people with diabetes.

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### I Reviewed International Classification of Diseases diagnosis codes

Diagnosis code	Description
E11.73	Type 2 "Diabetic Foot"
E10.73	Type 1 "Diabetic Foot"

Focusing specifically on the type of amputations performed, Gordoys and colleagues showed that 39% undergo toe amputations, while 12% and 47% of clients respectively undergo foot and leg amputations.<sup>8</sup> In about 44% of cases, people who undergo partial foot amputations require revisions at a later date.<sup>9</sup>

Prevention of amputation has been the focus of the World Health Organization health promotion strategies for over a decade.<sup>10</sup> With a goal to reduce the prevalence and incidence of end-stage complications of Type 2 diabetes mellitus, particularly lower extremity amputations, numerous clinical guidelines and action plans have been developed in recent years.<sup>9,11-13</sup> The aim of this audit was to provide an overview of the current management of acute diabetes-related foot complications at a major metropolitan hospital in Melbourne.

## Methods

This audit formed part of a quality improvement project, and therefore ethics approval was not sought. The audit included:

- Individuals admitted for management of acute diabetes-related foot complications from 1 April 2004 to 31 March 2005. Only clients coded under International Classification of Diseases (ICD) codes outlined in Box 1 were included in the audit.
- Identifying retrospectively the clinical management for these individuals relative to evidence-based best practice guidelines.
- Identifying the outcomes for individuals presenting with acute diabetes-related foot complications from 1 April 2004 to 31 March 2005.

A retrospective audit of the medical history for each client admitted under one of the included

ICD codes was conducted. Each admission was reviewed to identify the following:

- Number of admissions
- Reasons for each admission
- Timing of each admission during the audit period
- Admitting unit
- Length of stay
- Medical history, including common diabetes-related comorbidities
- Number of wounds on admission/developed during inpatient stay
- Documentation of wound on admission
- Documentation of wound during admission
- Management, including surgical interventions
- Inpatient referrals
- Outpatient referrals
- Discharge destination

Pathology and radiology investigations were identified during the audit and then cross-referenced against an online clinical results program to ensure all investigations were captured. Clinical podiatry staff conducted the audit, using an agreed protocol and audit tool.

## Results

A total of 62 clients totalling 99 admissions were originally identified through the routine medical records coding system. However, when the audit was conducted, these 62 patients experienced 115 admissions where the presence of an acute diabetes-related foot condition was documented in the medical history. Only 55 clients had a diabetic foot ICD code as all or part of the reason for admission. A total of 16 (14%) admissions specifically for management of severe diabetes-related foot conditions were not coded as a "Diabetic Foot". These admissions were also included in the audit.

In terms of ethnicity and country of origin, 35 (56%) of the 62 individuals audited were English speaking, and 39 (63%) were born outside Australia. Admission as an inpatient for a diabetes-related foot complication could be to any one of 16 different units, however the most common admitting unit was vascular (40% of admissions).

**2 Number of admissions over 12 months**

<b>No. of admissions</b>	1	2	3	4	5	6
<b>No. of individuals</b>	29	21	9	1	1	1

**3 Comorbidities recorded for audited admissions (n = 115)**

<b>Comorbidity</b>	<b>No. (%) of admissions</b>
Retinopathy	22 (19%)
Nephropathy	20 (19%)
Macrovascular disease	66 (57%)
Microvascular disease	2 (2%)
Neuropathy	28 (24%)
Hypertension	61 (53%)
Dyslipidaemia	18 (16%)
Cerebral vascular accident	22 (19%)
Cardiovascular disease	59 (51%)
Obesity	5 (4%)
Smoker	28 (24%)
Alcohol abuse	21 (18%)
Connective tissues disorder	1 (1%)
Cognitive issues	12 (10%)

**4 Investigations recorded for audited admissions (n = 115)**

<b>Investigation</b>	<b>No. (%) of admissions</b>
HbA <sub>1c</sub> (glycated haemoglobin)	56 (50%)
Full blood examination	100 (88%)
Liver function tests	67 (59%)
Random blood glucose level	11 (10%)
Urea and electrolytes	100 (88%)
Fasting lipids	9 (8%)
24-hr urine	3 (3%)
Wound swab	58 (51%)
Plain film x-ray	50 (44%)
Arterial ultrasound	46 (41%)
Electrocardiography	27 (24%)
Computed tomography scan	4 (4%)
Bone scan	14 (12%)
Biopsy	2 (2%)

The mean length of stay per admission was 16 days (range 1–87 days). An outlier of 121 days was excluded from these data, as the primary reason for admission was not related to their foot condition. The 115 admissions accounted for 1923 bed-days, equating to just over five beds occupied per day, every day of the year. Fifty-three percent of individuals had multiple admissions (Box 2). The average time between admissions was 22 days (range 1–200 days). Eleven individuals were readmitted less than 14 days following discharge.

Sixteen (14%) of the admissions were immediately followed by a subacute admission, and one individual (0.9%) was discharged to an alternative acute care hospital. Eleven of the subacute admissions were at another campus of Northern Health so that their length of stay could be assessed. The average length of stay for the subacute admission was 21 days (range 4–51 days).

Diabetes history, including related complications, was often poorly reported in admission notes. Most individuals presented with Type II diabetes (81%). Duration of diabetes was recorded in only 35 admissions (30%) and method of control was reported in 28 cases (24%). Box 3 and Box 4 provide an outline of the documented clinical information and investigations conducted for the 115 admissions audited.

The rate of lower limb assessment at time of admission was poor. Box 5 provides an outline of the percentage of the 115 admissions where a lower limb assessment was undertaken and documented. Box 6 outlines the percentage of individuals referred for either inpatient or outpatient interventions by relevant members of the treating team. Vascular surgeons had the highest level of contact, with 49 out of the 62 individuals being assessed by a vascular surgeon during the 12 months.

Each individual had between 1 and 4 wounds on admission. Thirteen of these individuals (21%) developed at least one new wound during their inpatient stay (2 developed 2 wounds, and 1 developed 3 wounds). During the 115 admissions, 21% were prescribed oral antibiotics, while 57% were prescribed intravenous antibiotics.

### 5 Number of audited admissions for which lower limb assessment was undertaken and documented ( $n = 115$ )

Assessment	No. (%) of admissions
Pulse palpation	67 (58%)
Ankle brachial pressure index	23 (20%)
Neurological assessment (10g monofilament)	20 (17%)
Skin integrity assessment	13 (11%)
Footwear assessment	5 (4%)
Foot deformity	8 (7%)
Charcot neuroarthropathy	3 (3%)

### 6 Percentage of individuals referred for either inpatient or outpatient interventions ( $n = 62$ )

Referred to	Inpatient assessments*	Post-discharge follow-up
Endocrinologist	9%	7%
Vascular surgeon	64%	24%
Podiatrist	18%	13%
Diabetes nurse educator	37%	3%
Dietician	38%	5%
Orthotist	13%	0
Wound clinic (plastics)	4%	11%
Infectious diseases	17%	2%
Psychologist	2%	0

\* Includes hospital admitting unit.

A significant number of the 62 individuals under investigation required surgical management of their diabetes-related foot condition. Twenty-one (34%) underwent surgical debridement. Twenty-nine individuals (47%) underwent vascular surgery. A small number of individuals had reconstructive surgery (1; 2%) and skin grafts (5; 8%). A total of 15 individuals underwent a minor amputation of the foot or toes (24%). Nine individuals underwent a major amputation below

or above the knee (15%). The overall amputation rate was 39%. In 3 of the 62 cases (5%), the individual died in hospital.

## Discussion

There are several limitations associated with this audit and the results presented. In particular, admissions classified under the codes other than the two ICD codes listed were not assessed. The authors suggest that this study only captures a sample of admissions for acute diabetes-related foot complications, and that admission rates for this diagnosis group may be underestimated. Furthermore, it is also probable that the individuals audited required another admission after the audited period, thus the representation and readmission rates are for the audited year only and do not reflect overall readmission rates for this group.

In 2004, Lawrence and colleagues published a study reviewing the assessment and management of inpatients with acute diabetes-related foot complications.<sup>6</sup> The authors identified that despite extensive literature supporting preventative management of diabetes-related foot complications, many individuals still require acute inpatient management.<sup>6</sup> The audit presented here further supports their findings.

The average length of stay per admission for each client in this audit was 17 days, comparable with Lawrence and colleagues' reported average of 16.8 days.<sup>6</sup> This rate is more than twice the reported rate for clients who routinely attend targeted outpatient services, who report mean length of stay of only 7.1 days when hospitalisation is required.<sup>5</sup> Furthermore, targeted outpatient services reduce the need for a subacute stay, with only 10% of admissions ( $n = 31$ ) requiring a subacute stay post acute admissions, compared with 14% in the audit presented here, and 17% reported by Lawrence and colleagues.<sup>6</sup> This mounts a persuasive argument for the provision of targeted outpatient services to individuals with diabetes-related foot complications to reduce both the necessity and length of hospital admissions, and to improve client outcomes.

The readmission rate identified in this audit was 53%, compared with a 20% readmission rate reported by Lawrence and colleagues.<sup>6</sup> Total bed-days for the year were in excess of 1900, equating to five beds per day occupied by individuals for management of their foot condition — two beds more than the Lawrence study.<sup>6</sup> It is probable that these differences may be explained by the significant differences in ethnicity and socioeconomic status between the two catchments serviced by each of the audited hospitals, factors which have been found to play a significant role in delaying access to services, and ultimately resulting in more end-stage complications at presentation.<sup>9,13</sup> In the Lawrence study, 82% of individuals were English speaking and 66% were born outside Australia.<sup>6</sup> In the audit presented here, only 56% of individuals were English speaking, and 63% were born outside Australia. In terms of socioeconomic factors, four of the six local government areas serviced by the hospital represented in this audit are placed on the lowest level on the Index of Relative Socio-Economic Disadvantage, an index derived from census attributes such as low income, low educational attainment, high unemployment and proportion of workforce in relatively unskilled occupations.<sup>14</sup>

This study strengthens Lawrence and colleagues' argument that there is need for improvement in the management of people with diabetes and related complications on admission. Hospitalisation provides an ideal opportunity to address gaps in current management and improve diabetes care.<sup>13</sup> Hospitalisation enables the collection of clinical information including diabetes type, duration, control, and past and current treatments for both diabetes and associated complications. It also provides an ideal opportunity to undertake a thorough lower limb and wound examination that includes: past history of ulcerations and amputations; wound history (initiating event, duration, previous management); causative and contributing factors (neurovascular, skin integrity, foot deformity and footwear assessments); wound presentation including size, depth, level of exudate, odour, description of appearance; presence of clinical

signs of infection; or osteomyelitis (ability to probe to bone).<sup>13</sup> Investigations required to compliment these assessments should include HbA<sub>1c</sub>, urea, electrolytes and creatinine fasting lipid profile, 24-hour urine collection for creatinine clearance and protein excretion, and electrocardiogram.<sup>13</sup> Referrals to all relevant members of the treating team should follow the initial assessment and investigations. Rates of referral in the audit presented here were low, with the exception of vascular surgeons who saw almost 80% of all people with diabetes-related foot admissions. The poor referral rate to other members of the treating team is largely attributable to the high demand and low availability of services. In particular, there was no endocrinology service until early 2005, and the podiatry inpatient service only operated one day a week. Furthermore, orthotist services are outsourced, thus limiting availability.

At a time where continuous quality improvement is important within every health care organisation, it is noteworthy that the findings of this review have led to significant change. A High Risk Foot Service targeting outpatients was established at the hospital represented in this audit in 2004 with Hospital Admission Risk Program funding. Until recently, this service ran primarily as a podiatry service, accessing input by the orthopaedic and vascular specialists as required. However, this study has provided the impetus for the service to grow, and the team now includes a medical consultant, diabetes nurse educator and a health psychologist. In the next year, the inpatient podiatry service will be increased to a full-time service, and will be integrated into the High Risk Foot Service. In the future, any individuals admitted for management of an acute diabetes-related foot complication will be flagged on the patient management system and subsequently admitted to the High Risk Foot Service. They will be reviewed and managed by the multidisciplinary team, initially as inpatients, then followed up as outpatients to minimise the risk of re-admission. This audit will be repeated in 12 months time to review the effect these changes have on client outcomes.

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## Competing interests

The authors declare that they have no competing interests.

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