

# Diabetes and amputation: are we making progress?

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## ABSTRACT

Diabetes remains the most common and important cause of lower limb amputation. Despite evidence that organised, multidisciplinary care can improve outcomes for diabetic foot problems, it is only in the last few years that evidence has started to emerge to suggest that amputation rates for people with diabetes may be starting to improve. Even within those regions that are showing improvements, there remains significant variation in amputation rates, suggesting variability in availability and standards of care. More work is required to make the highest quality of care available to all.

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Diabetes is by far and away the major cause of non-traumatic lower extremity amputation, accounting for 50–80% of all cases. The principal cause of amputation is not hyperglycaemia *per se*, but is the peripheral arterial disease and peripheral sensory loss that so often complicate diabetes. Other factors, such as autonomic neuropathy, altered biomechanics, abnormal wound healing and impaired responses to infection, also contribute to what is usually a complex cascade of events and risk factors. Although the management of a chronic, non-healing wound can be very challenging, and is an area in which the ratio of evidence to management options is not favourable, there are many simple things, such as foot care education, multidisciplinary services, and good access to skilled vascular surgery, that can prevent ulceration and amputation in many cases. In light of this, in 1989, the St Vincent's Declaration set a target for a 50% reduction in amputation rates among people with diabetes in Europe<sup>1</sup>. Similar plans and targets were subsequently set by other regional diabetes bodies around the world. For a number of years, there was little sign of any progress. Part of the barrier has been lack of data. Collecting information on rates of amputation requires assembling information from multiple data sources, often with different methods of coding, and across different segments of health care (for example, private and public), and including all providers within a large jurisdiction, such as a county, state or country. It also requires some knowledge of the size of the diabetic population from which the amputations have been drawn, in order to accurately calculate the proportion of the diabetic population that has undergone amputation. Not surprisingly, studies of adequate quality have been infrequent, and so tracking changes over time have been very difficult.

In recent years, several reports have emerged indicating that, in some countries, at least, the rate of lower limb amputation has begun to fall. Collating national statistics from a number of different data sources,

Gregg *et al.*<sup>2</sup> recently reported reductions in the incidence of each of the major complications of diabetes across the United States. They found that between 1990 and 2010, there was an approximate halving in the annual rate of amputation, falling from 58 to 28 per 10,000 people with diabetes. Little change was observed in the amputation rate in the non-diabetic population, but the absolute annual rates in the non-diabetic population were much lower at about 3 per 10,000 people. Hospital discharge data from Spain showed a fall in the incidence of amputation from 2001 to 2008 among people with type 1 diabetes, but a small rise in the incidence in type 2 diabetes<sup>3</sup>. Unfortunately, they could only relate the number of amputations to the total population, rather than to the diabetic population, and so the increasing prevalence of type 2 diabetes likely explains the small apparent increase in numbers of amputations. Similar data were reported from England between 1996 and 2005, with a fall in the number of amputations in people with type 1, and a rise in amputations in type 2 diabetes<sup>4</sup>. However, a later publication from the same authors<sup>5</sup> showed that from 2004 to 2008 the total number of amputations in people with diabetes continued to rise, but once the rising prevalence of diabetes was accounted for the annual incidence of amputations within the diabetic population fell from 27.5 to 25 per 10,000 people with diabetes, though the change was not significant. In Australia, data on hospital discharge codes and estimates of the prevalence of diabetes suggested a fall in the annual incidence of hospitalisation for lower limb amputation from 48 to 41 per 10,000 people with diabetes between 2001 and 2008<sup>6</sup>.

There are several possible explanations for the probable indications that amputation rates are starting to fall. Many years of emphasis on the need for regular foot examinations, and the development of multidisciplinary foot care teams may have had an impact on the detection of the high-risk foot, and the management of foot ulceration. More aggressive management of vascular risk factors may have slowed the development of vascular disease. Evidence for this is not strong, but there are suggestions of benefits of ACE inhibitors on peripheral arterial disease<sup>7</sup> and of lipid-modifying drugs on amputation rates<sup>8</sup>. Another important factor to be considered is the improved screening for diabetes. As diabetes screening has improved, the number of people within the population with known diabetes whose diabetes is of short duration has increased. This inevitably reduces the apparent incidence of diabetic complications, as there are more people with 'early' diabetes. However, the

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suggestion that the incidence is falling in type 1 diabetes, where screening for diabetes is not an issue, indicates that this is probably not a major factor.

However, all is not rosy. In Australia, the risk of a major amputation is nearly 40 times greater for an Indigenous person with diabetes, compared to a non-Indigenous person with diabetes<sup>9</sup>. Data from North America have also indicated the much higher risk among the Indigenous population. Another key limitation on the downward overall trends in amputation rates is the variation in rates within a country. Data from the United States examining the incidence of amputation in each of the country's 306 health care regions showed an almost 9-fold variation in incidence between the highest and lowest rates<sup>10</sup>. The significant variation in access to health care within the United States makes it tempting to suggest that such variation could be the major reason why amputation rates vary. Poor preventative care and limited access to high-quality vascular surgery and foot ulcer management services might be expected to lead to high amputation rates in some of the poorer regions. However, similar analyses across 151 Primary Care Trusts (PCT) in the UK produced similar findings<sup>11</sup>. In addition to reporting that diabetes was associated with a 23-fold increased risk of amputation, and accounted for 49% of all amputations, there was also an approximate 10-fold variation in amputation incidence across the 151 PCTs within the diabetic and non-diabetic populations. It was noteworthy that there was a strong correlation between the diabetic and non-diabetic populations in regard to amputation rates, and that although smoking rates, socio-economic status and ethnicity varied across the PCTs, accounting for these differences explained very little of the observed variation in amputation rates. Thus, within a system of universal access to health care, major variation in amputation rates was seen. Further analysis of these data<sup>12</sup> suggests that the extent of variation may have been somewhat overestimated. Nevertheless, there is clear evidence that variation exists. How much this relates to management of risk factors and how much relates to management of foot ulcers and limb-threatening infection and ischaemia is not clear. The similarity between the US and the UK suggests that differential availability of care is not a major player — if it were, we would expect to see more variation in the US than in the UK.

An important consideration is the attitudes to amputation of the treating clinicians. A low amputation rate could be the result of an excellent and aggressive multidisciplinary foot service, but could also result from a conservative approach towards undertaking an amputation. Since the mortality among diabetic patients with critical limb ischaemia is high, whether or not amputation is performed<sup>13</sup>, a decision not to amputate at any point in time will not automatically lead to a later amputation, as death may occur first. In support of the concept that the beliefs of the treating health care professionals may be important, recent data from the USA showed that within the variation in amputation rates, there was significant geographical clustering, which was not explained by measures of provision of foot ulcer care<sup>14</sup>. The authors suggested that beliefs of individual practitioners about the precise indication for an amputation may be geographically patterned (perhaps due to common training backgrounds). This may be particularly relevant in the UK analysis, since some of the smaller PCTs may have only had a very small number of surgeons responsible for such decision making. If this is an important contributor, the absence of widely accepted guidelines on the indication for amputation may be a major gap in the management of limb-threatening disorders.

We appear to be starting to make progress in reducing the risk of amputation for people with diabetes. However, we need significant improvement in our data collection techniques, as almost all published studies suffer from at least one of the limitations noted above. Importantly, we need better coordination of services and more equality of treatment options. The outcome of a diabetic foot problem should not depend on where a person lives and on what part of the health service they make initial contact with. Organisation of care and availability of appropriate treatment guidelines should be such that every patient can expect high-quality management of diabetic foot problems.

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