

Short Report

Matching the numerator with an appropriate denominator to demonstrate low amputation incidence associated with a London hospital multidisciplinary diabetic foot clinic

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Abstract

Aims To establish a method to assess amputation incidence that addresses the problems matching a numerator with an appropriate denominator in London and to demonstrate low amputation incidence associated with the activity of our multidisciplinary diabetic foot clinic.

Methods Hospital-coded inpatient data was examined to derive the numerator: the number of non-traumatic amputations performed on subjects with diabetes each financial year where the Primary Care Trust commissioner code was our main local Primary Care Trust. Denominators were derived from the main local Primary Care Trust's Quality and Outcomes Framework data sets. Not all Primary Care Trust subjects with diabetes receive inpatient care at our hospital, so that the denominators were corrected for the hospital's percentage market share for the provision of inpatient diabetes care for the Primary Care Trust each financial year, derived from the Dr Foster database.

Results Between April 2004 and April 2009, 44 Primary Care Trust subjects with diabetes underwent 34 minor and 10 major amputations at the hospital. Although the Primary Care Trust populations with and without diabetes increased, the hospital's Primary Care Trust percentage market share decreased, so that overall denominators decreased. The mean annual incidence of minor, major and total amputations over the five financial years was 14.7, 4.2 and 18.9 per 10 000 subjects with diabetes, respectively, and 3.9, 1.1 and 5.0 per 100 000 of the general population, respectively.

Conclusions We report for the first time amputation incidence in a London population. Acknowledging the limitations of accurately defining incidence in London, we demonstrate low amputation incidence associated with our multidisciplinary diabetic foot clinic.

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Keywords amputation, diabetic foot

Abbreviation QOF, Quality and Outcomes Framework

Introduction

A London centre was the first to demonstrate that a multidisciplinary diabetic foot clinic can reduce major amputations at that hospital [1]. However, there have been no

reports that establishing such a clinic in London can reduce amputation incidence at the population level. While problems assessing amputation incidence have been described previously [2,3], there are additional difficulties deriving both the numerator and the denominator in London. Furthermore, because of recent comprehensive interventions nationally, such as the National Service Framework for Diabetes [4] and the Quality and Outcomes Framework (QOF) [5,6], demonstrating that improvements in outcomes are attributable to a single local service development can be problematic.

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The difficulties establishing a denominator are:

- (i) There is a lack of a one-to-one relationship between any Acute Trust/hospital and its main commissioning Primary Care Trust in London. As distances between hospitals are short and transport links good, any central London Primary Care Trust refers patients to several different Acute Trusts and any central London Acute Trust will see patients from many different Primary Care Trusts. The diversity of referrals has been encouraged through patient choice and the system of Choose and Book [7]. Hence, although the main commissioning Primary Care Trust for St Mary's Hospital in West London is Westminster Primary Care Trust only between 62 and 84% of subjects with diabetes in Westminster receive their inpatient care at St Mary's, and between 20 and 54% of the amputations performed at St Mary's involve Westminster Primary Care Trust patients, with significant year-on-year variation for both parameters.
- (ii) In central London, the turnover of the local population is high: in Westminster Primary Care Trust up to 10% per annum (approximately 10% inflow, 7% outflow and 3% increase in population).
- (iii) Under-ascertainment of numbers with diabetes is significant. In Westminster Primary Care Trust the QOF data for the financial year 2004–2005 suggested 6211 with diabetes. The estimate based on the Yorkshire and Humber Public Health Observatory diabetes prevalence model for 2005 was 9415 [8].
- (iv) Earlier diagnosis through increased awareness and recent requirements for Primary Care Trusts to screen cardiovascular risk, often including a glucose parameter, in those aged 40–75 years increases the denominator with subjects of shorter diabetes duration and without complications, resulting in an apparent lower amputation incidence. Amputation incidence in the Netherlands fell 34% (55 to 36 per 10 000 people with diabetes), yet amputation numbers remained relatively unchanged because the population with diabetes had increased 50% [9]. Many studies therefore report amputation incidence per 100 000 of the general population [10–12].

The difficulties establishing a numerator are:

- (i) Not all Acute Trusts have multidisciplinary foot clinics and access to vascular surgery can differ; for clinics incorporating a vascular surgeon, referrals come from more distant Primary Care Trusts which often constitute more difficult cases more likely to result in amputation.
- (ii) Inaccuracy of hospital-coded data, compounded by recent improvements in coding because of financial incentives for Acute Trusts to correctly code secondary diagnoses such as diabetes, has resulted in an apparent increase in amputations in those with diabetes.
- (iii) Retrospective methods assessing amputation numbers fail to identify all of those identified by prospective surveys,

although collection of amputation data prospectively requires additional resource [13].

The Multidisciplinary Diabetic Foot Clinic at St Mary's Hospital was established in 2002. In 2007–2008 St Mary's merged with Charing Cross and Hammersmith Hospitals to form Imperial College Healthcare NHS Trust, although the close relationship for provision of diabetes care between the St Mary's site and Westminster Primary Care Trust was maintained. Having demonstrated low rates of amputation for specific cohorts of patients treated at the clinic [14], we aimed to demonstrate low amputation incidence at the population level associated with the activity of the clinic by establishing a method to assess incidence in London.

Subjects and methods

Amputation data had not been collected prospectively. We examined hospital-coded inpatient data to establish the numerator: the number of inpatient episodes each financial year in which a primary or secondary diagnosis of diabetes, based on International Classification of Diseases, 10th revision (ICD-10) codes, was recorded in a subject who underwent a non-traumatic amputation, based on Operating and Coding Procedures, 4th revision (OPCS-4) codes and where the Primary Care Trust commissioner code was Westminster. Referrals from other Primary Care Trusts, which may have represented more difficult cases, were not included. A minor amputation was defined as any lower extremity amputation distal to the ankle joint; a major amputation was defined as any lower extremity amputation through or proximal to the ankle joint. When a revision occurred within 3 months, only the later procedure was recorded.

We examined Westminster Primary Care Trust QOF data sets to establish two denominators for each financial year: per 10 000 subjects with diabetes; and per 100 000 of the general population. As not all subjects with diabetes in Westminster Primary Care Trust receive inpatient care at St Mary's, we corrected both denominators for the hospital's percentage market share for the provision of inpatient diabetes care for Westminster Primary Care Trust each financial year, derived from the Dr Foster database [15,16]. The QOF was introduced in England in the 2004–2005 financial year, so that denominators could be derived for five financial years from April 2004.

We calculated mean annual incidence for minor, major and total amputations in subjects with diabetes from Westminster Primary Care Trust who received treatment at St Mary's Hospital. Other studies have used more than one source for retrospective data to ascertain amputation number, including operating theatre records and limb-fitting centre records [10]. We were not able to derive a Primary Care Trust commissioner code from operating theatre records; limb-fitting centre records could not produce information on minor amputations.

Table 1 Characteristics of subjects with diabetes and a Westminster Primary Care Trust general practitioner who underwent amputation at St Mary's Hospital between April 2004 and April 2009

	All amputations	Minor amputations	Major amputations
Number	44	34	10
Sex, <i>n</i> (%) male	32 (73)	26 (76)	6 (60)
Age, mean (SD)	69 (11)	68 (11)	72 (10)
Age group, <i>n</i> (%)			
16–44 years	0 (0)	0 (0)	0 (0)
45–64 years	15 (34)	11 (32)	4 (40)
> 65 years	29 (66)	23 (68)	6 (60)

Results

Between April 2004 and April 2009, 44 subjects with diabetes and a Westminster Primary Care Trust general practitioner underwent amputation at St Mary's Hospital; 34 had minor and 10 major amputations (Table 1). Thirty-nine (89%) were coded as having concurrent peripheral vascular disease, 16 (36%) coronary heart disease, five (11%) cerebrovascular disease and six (14%) renal failure. Over the five financial years, the number with diabetes in Westminster Primary Care Trust increased from 6211 to 7139. However, the hospital's percentage market share for the provision of inpatient diabetes care for Westminster Primary Care Trust decreased from 84 to 62%, so that the denominator expressed per 10 000 subjects with diabetes decreased overall from 5217 in 2004–2005 to 4426 in 2008–2009 and per 100 000 of the general population from 205 118 to 150 997.

Figure 1 demonstrates amputation incidence per 10 000 subjects with diabetes each financial year. The mean annual incidence of minor, major and total amputations over the five financial years was 14.7, 4.2 and 18.9 per 10 000 subjects with diabetes, respectively, and 3.9, 1.1 and 5.0 per 100 000 of the general population, respectively.

Discussion

We report for the first time amputation incidence in a London population and demonstrate low amputation incidence associated with our multidisciplinary diabetic foot clinic. Our method for calculating amputation incidence attempts to address many of the difficulties matching a numerator with an appropriate denominator in London. Unlike other studies, there was a fall in the denominator with time. This was not matched by a corresponding increase in amputation incidence; there was a tendency for incidence, particularly major amputation incidence, to fall with time. Our clinic was established prior to the period of observation, so that significant reductions in incidence may have already been achieved. A recent study has suggested a significant increase in the number of amputations in subjects with Type 2 diabetes in England [17]; this was not our experience.

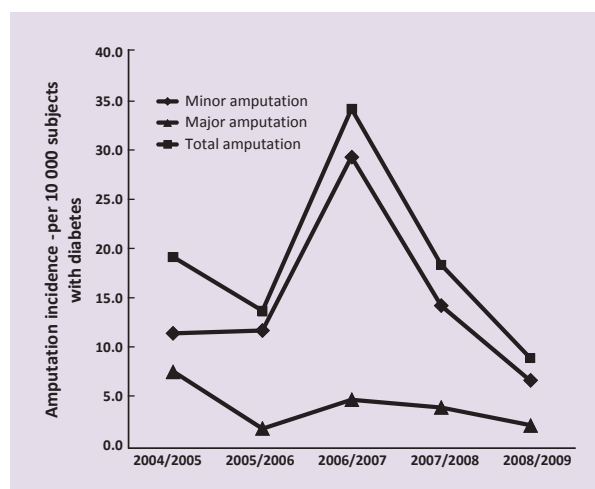


FIGURE 1 Amputation incidence—number of minor, major and total amputations performed at St Mary's Hospital derived from inpatient coded data where the Primary Care Trust commissioner code was Westminster, per 10 000 subjects registered with diabetes in Westminster Primary Care Trust and corrected for the hospital percentage market share for the provision of inpatient diabetes care for Westminster Primary Care Trust, for each financial year.

The relatively small number of amputations performed on subjects with diabetes in any single hospital or Primary Care Trust can result in large and bidirectional year-on-year changes in amputation incidence [18–21]. For example, the peak in minor amputation incidence in the 2006–2007 financial year cannot be easily explained by clinical, organizational or coding factors. We therefore describe the mean amputation incidence over the 5-year period.

Our major amputation incidence of 1.1 per 100 000 of the general population is lower than the previously lowest published incidence of 2.2 per 100 000 from Madrid [11] and is lower than the major amputation incidence from other United Kingdom centres: Leeds, Leicester, Middlesbrough and Newcastle report 15.4, 5.8, 18.0 and 14.9, respectively [10], and Ipswich 2.8 [12] per 100 000. Our total amputation incidence expressed per 10 000 subjects with diabetes similarly compares favourably with other groups [12,18,22,23].

While the particularly low amputation incidence in a population served by our multidisciplinary diabetic foot clinic may reflect the effectiveness of care, the fact that the incidence is so much lower than that reported by others does raise doubts about the validity of the method used. Under-ascertainment of amputation number has been shown to be significant when using hospital-coded data compared with prospectively collected data, with 4.2–8.7% of amputations missed [13]. Furthermore, the reliable capture of diagnoses such as diabetes through coding is not assured, although the proportion of amputees coded as having peripheral vascular disease and coronary heart disease (89% and 36%, respectively) was very similar to that recorded in greater Manchester (92 and 38%, respectively) where, like ours, the population is of diverse ethnicity [24]. It is possible that

subjects who attended our foot clinic subsequently presented to other hospitals and underwent amputation. However, this may have been balanced by patients who attended other hospital foot clinics and then presented as emergencies to our hospital requiring amputation. Primary Care Trusts, and indeed individual general practices in London, refer patients to more than one hospital, so that deriving data on amputation number from general practice data sets may not necessarily reflect the effectiveness of an individual hospital foot clinic. Correcting for the hospital's annual percentage market share for the provision of inpatient diabetes care for the Primary Care Trust in order to derive the population from whom the amputees are drawn is an approximation and clearly subject to significant error. While the prospective collection of hospital amputation data would more accurately define the numerator [13], matching this with an appropriate denominator in London will continue to be difficult.

Competing interests

Nothing to declare.

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