

# Diagnosing Type 2 diabetes before patients complain of diabetic symptoms—clinical opportunistic screening in a single general practice

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In the UK, patients normally see their general practitioner first and 86% of the health needs of the population are managed in general practice, with 14% being referred to specialist/hospital care. Early diagnosis is the privilege of general practice since general practitioners make most medical diagnoses in the NHS. Their historic aim has been to diagnose as early as possible and if possible before patients are aware of symptoms. Over time, diagnoses are being made earlier in the trajectory of chronic diseases and pre-symptomatic diagnoses through tests like cervical screening. Earlier diagnosis benefits patients and allows earlier treatment. In diabetes, the presence of lower HbA1c levels correlates with fewer complications. Methodologically, single practice research means smaller populations but greater ability to track patients and ask clinicians about missing data. All diagnoses of type 2 diabetes, wherever made, were tracked until death or transfer out. Clinical opportunistic screening has been undervalued and is more cost-effective than population screening. It works best in generalist practice. Over 19 consecutive years, all 429 patients with type 2 diabetes in one NHS general practice were analysed. The prevalence of type 2 diabetes rose from 1.1% to 3.0% of the registered population. Since 2000, 95.9% were diagnosed within the general practice and the majority (70/121 = 57.9%) of diagnoses were made before the patients reported any diabetes-related symptom. These patients had median HbA1c levels 1.1% lower than patients diagnosed after reporting symptoms, a clinically and statistically significant difference ( $P = 0.01$ ).

## Introduction

Diabetes is a disease of international importance. It is increasing in prevalence,<sup>1</sup> is a lifelong condition, is associated with serious complications and shorter life expectation.<sup>2</sup> Type 2 diabetes mellitus (T2DM) forms 90% of new diagnoses.<sup>3</sup> Most diagnoses of diabetes are now made in general practice,<sup>3</sup> and over two-thirds of patients with diabetes are now managed in general practice.<sup>4</sup> Diabetes has therefore become a disease of general practice. Treatment can only follow diagnosis, so an important research question is how early in the disease can the diagnosis be made?

## Aims

There were three aims of the study:

- (i) To identify where diagnoses of diabetes were made, in particular to ascertain how many were made in general practice.
- (ii) To determine if diagnoses of T2DM could be made before patients complained of any diabetes-related symptom.
- (iii) To determine, if such pre-symptomatic diagnoses can be made, whether the patients' HbA1c levels are then significantly lower.

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## The Practice and the method used

This retrospective cohort study was undertaken in the St Leonard's Research General Practice (Exeter, UK) which has 6791 registered National Health Service (NHS) patients. Each patient diagnosed since 1987 was entered into the cohort and then followed until transfer out of the Practice, death, or continuing registration. The age–sex composition of the population is representative, but the proportion of ethnic minority patients is lower than the UK average. The Practice was approved as a Research Practice in 1998. Personal lists<sup>5</sup> which foster patient–doctor relationships and clinical responsibility have been used since 1974. Medical records have been computerized since 1983. The median duration of registration of all registered patients in the Practice is 9 years 2 months. Previous publications from this Practice have been on diabetes<sup>6</sup> and its risk factors.<sup>7</sup>

### Diagnosis of diabetes

The criteria for making a diagnosis of diabetes followed internationally accepted criteria. From 1988 onwards, diabetes was diagnosed by an oral glucose tolerance test.<sup>8</sup> In addition, since 1997, the American Diabetes Association criteria of two fasting blood glucose tests of 7 mmol/l or more has also been used.<sup>9</sup> Patients were considered to have T2DM if patients presented after the age of 35 and not needing insulin for at least a year after diagnosis (as in our previous study).<sup>6</sup>

Clinical opportunistic screening in the Practice consisted of blood glucose tests for patients at risk of T2DM, i.e. with coronary heart disease, hypercholesterolaemia, hypertension, obesity, skin infections and those with a positive family history of diabetes.

### Data analysed

The Practice database (Vision) was searched for patients diagnosed with diabetes between January 1, 1987, and April 1, 2006. Data included date of birth, date registered, gender, family history of diabetes, date of diagnosis, recorded symptoms at diagnosis, body mass index at diagnosis and HbA1c result. The data were validated (from clinical notes) and information was added to the records within an Access database including classification as Type 1 or Type 2 diabetes, whether previously diagnosed as having diabetes before entering the Practice, whether diagnosed after registration within the Practice or elsewhere (e.g. hospital) and year of transfer out of the Practice or death. Prevalence was calculated as a point prevalence using the list size each January 1.

### Subgroup analysis

The local pathology laboratory started using the Diabetes Control and Complications Trial (DCCT)

corrected internationalized form (Read code 42w.00) of HbA1c after April 1, 2000. To compare HbA1c levels at diagnosis, a subgroup was identified of all patients whose HbA1c was reported after 2000. An HbA1c reading within 60 days of diagnosis was required for inclusion. Each patient with T2DM was classified as symptomatic or asymptomatic according to the symptoms recorded in the NHS medical record. Any single symptom associated with diabetes in standard medical texts led to the categorization of 'symptomatic'.

Five patients, whilst registered, whose diagnosis had been made outside the Practice whether by a hospital or a pharmacist, were separately identified and classified as a symptomatic presentation of the disease.

Using a representative SD of 2.2% for HbA1c in patients with newly diagnosed diabetes,<sup>10</sup> it was estimated that 64 patients in each group (symptomatic and asymptomatic) would be needed to give 80% power at a 5% significance level to detect a difference of 1.1% which was considered to be clinically meaningful. Analyses were conducted using statistical tests of inference dependent on the data distribution (Table 1). We used chi-square or Mann–Whitney tests for non-parametric data and *t*-tests for parametric comparisons.

## Results

A total of 483 people with diabetes were identified over the 19 years. Of these, 429 (88.8%) had T2DM and were eligible for the cohort (Fig. 1).

### Prevalence of T2DM in the Practice

A total of 2303 patient-years were available for analysis. The prevalence of patients with T2DM rose from 1.1% in 1987 to 3.0% in 2006 (Fig. 2). The annual incidence of T2DM also rose three-fold from a rate of 0.6 per 1000 registered patients in 1987 to 1.9 per 1000 patients in 2005.

TABLE 1 Characteristics of patients diagnosed in the Practice with T2DM (April 2000–March 2006)

	Asymptomatic, <i>n</i> = 52	Symptomatic <sup>a</sup> , <i>n</i> = 36	<i>P</i> -value
Male (%)	32 (70)	14 (30)	0.061 <sup>b</sup>
Median (IQR) age at diagnosis (years)	64 (20.5)	63 (16)	0.78 <sup>c</sup>
Median (IQR) body mass index at diagnosis (kg/m <sup>2</sup> )	30.8 (9)	32.1 (6.8)	0.78 <sup>c</sup>
Median (IQR) HbA1c (%)	7.45 (IQR = 1.98)	8.2 (IQR = 4.2)	0.01 <sup>c</sup>

<sup>a</sup>Excludes the five patients diagnosed outside the Practice.

<sup>b</sup>Statistical test types: chi-square, Yates' continuity correction

<sup>c</sup>Mann–Whitney.

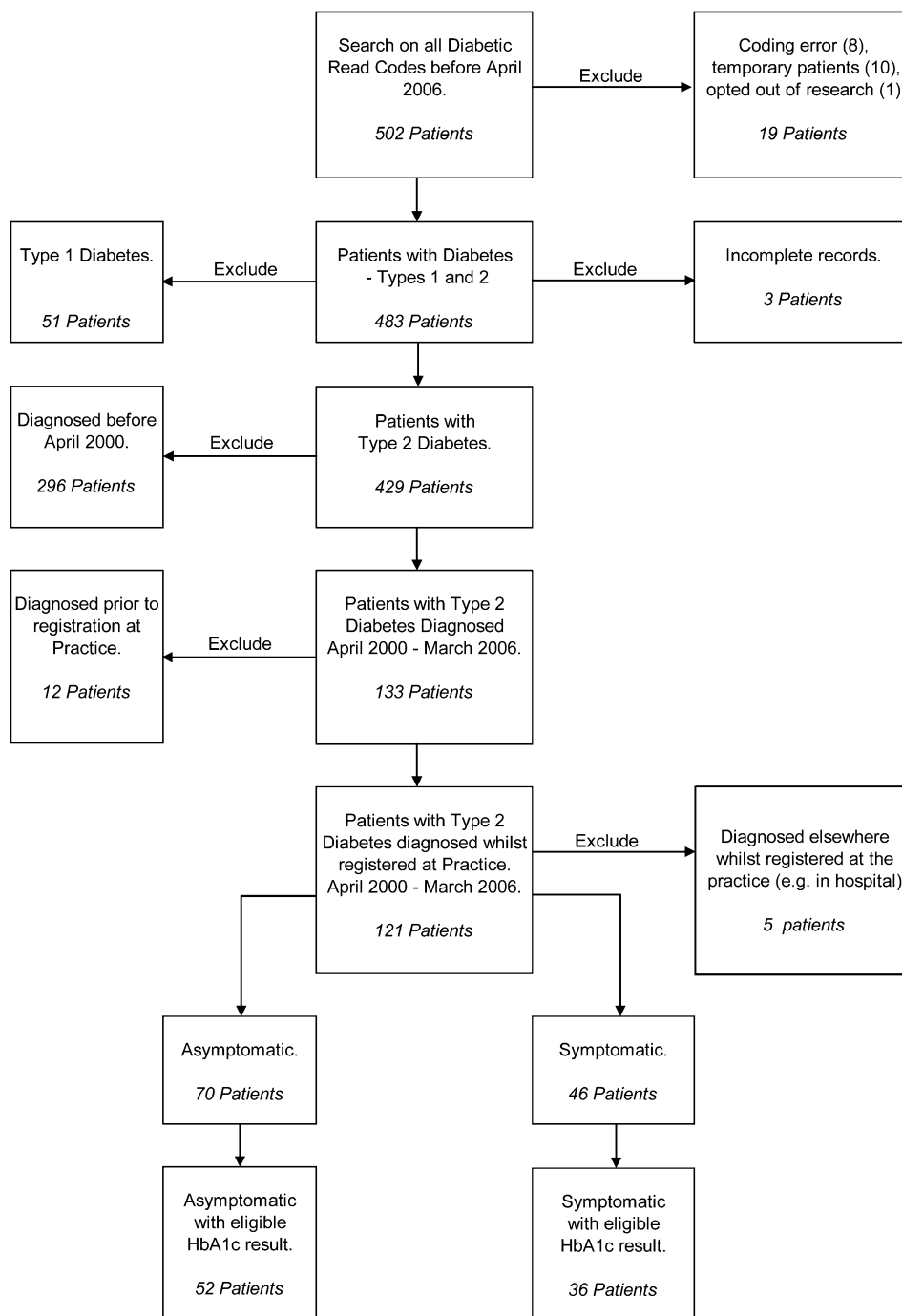


FIGURE 1 Categories of patients used in analysis

*Asymptomatic diagnosis within the subgroup*

Since April 1, 2000 (when internationalized HbA1c levels were available), 121 registered patients were diagnosed with T2DM. Of these, 116 (95.9%) were diagnosed within the Practice and 70 were diagnosed without symptoms (57.9%). Of these 121, 88 (76%) had an eligible HbA1c, there being 46 males and 42 females with a mean age at diagnosis of 62.5 years (95% CI = 59.7–65.3). Those diagnosed without any symptoms of diabetes were in the majority (52/88 = 59.1%).

Although we did not obtain the sample size identified theoretically in the power calculation, we nevertheless found statistically significant differences in HbA1c between the two groups. The median HbA1c level at diagnosis for those patients presenting with symptoms was 8.2% [interquartile range (IQR) = 4.2]. The median HbA1c for those diagnosed before symptoms was 7.45% (IQR = 1.98). The median difference was 1.1% (95% CI = 0.3–2.3%; *P* = 0.01). No other significant differences were seen between the two groups.

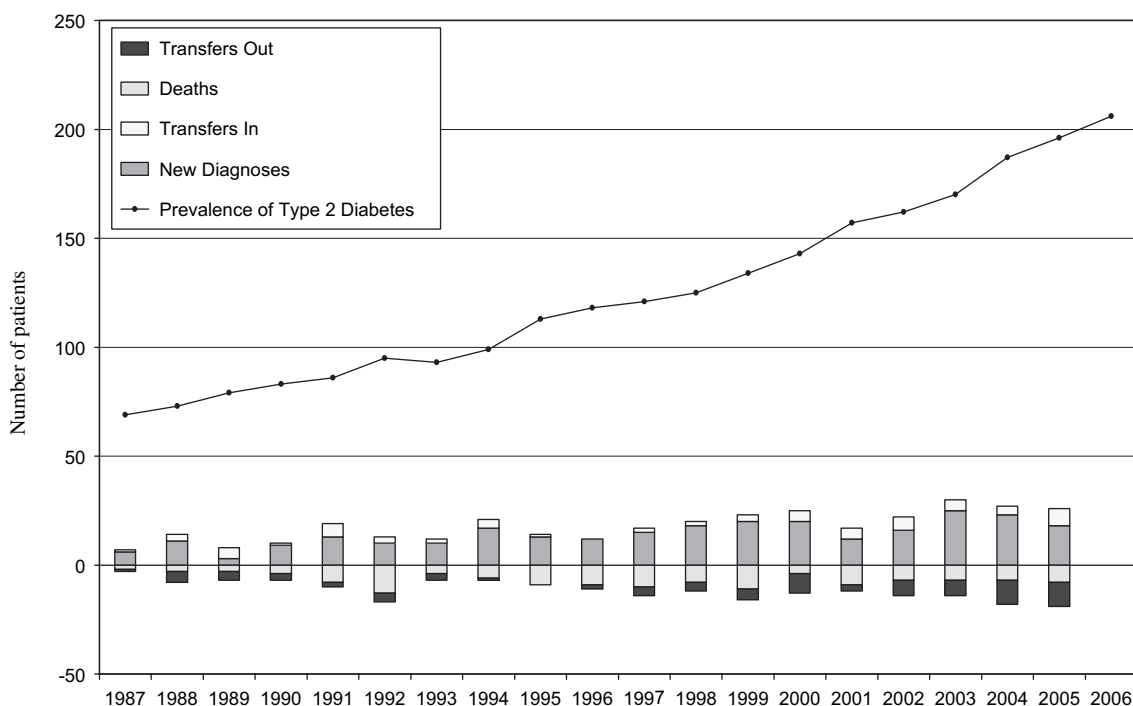


FIGURE 2 Factors determining the prevalence of Type 2 diabetes in the Practice

## Discussion

There are two perspectives on this work: the role of research in single general practices and clinical opportunistic screening. Both are undervalued, yet both are important to the discipline of general practice.

### *Research in single general practices*

Many recent general practice studies report from multiple large databases, which are essential for rarer conditions. Concern has been expressed to DPG (MRC Committee Chairman, personal communication) that single-practice studies may not be generalizable. This is true but some well-known single-practice studies researched local problems<sup>11,12</sup> and hypotheses which were later confirmed in bigger studies. For example, a single-practice study showing adverse consequences of loss of continuity<sup>13</sup> was later confirmed by Menec *et al.*<sup>14</sup>

Single general practices have several advantages for research as, for common conditions, there can be several hundred patients available for analysis. Clinicians can add useful information such as two women with different names being sisters, clinicians can be asked to complete missing values and additional information, e.g. from death certificates, can be available. The concept 'living epidemiology', coined in this Practice in 1994, embraces these features.<sup>15</sup>

### *Clinical opportunistic screening*

Clinical opportunistic screening is defined as a clinical process in which a health professional uses a consultation

with a patient to consider the possibility of the patient having a condition other than that for which advice was sought. It is of particular importance in relation to serious conditions like alcoholism, depression, diabetes and hypertension. Clinical opportunistic screening can be used in any clinical setting. For example, some hospital departments have screened in-patients for alcoholism using the CAGE (Cut down, Annoyed, Guilty, Eye-opener) questionnaire.<sup>16</sup>

However, clinical opportunistic screening is most efficient and probably more cost effective in primary rather than secondary or tertiary care, for several reasons. First, because of the high-contact UK general practice has with the population as a whole, 13% of the population attends a general practice every fortnight and the average contact between citizens is now as high as five consultations per person per year.<sup>17</sup> Also, average general practice contacts with the over-75s are as high as seven consultations per year and T2DM is an age-related condition.<sup>18</sup> Thirdly, GPs are medical generalists and, alone amongst clinicians, are as concerned with mental as with physical conditions, e.g. treating depression and diabetes in the same consultation. Generalists can manage the widest range of medical conditions and are less likely than a specialized department to need to refer to another setting, increasing the efficiency of the process. Fourthly, diagnosis in general practice/primary care works on the basis of probabilities and clinical opportunistic screening fits this approach.

### *Comparison with population screening*

Population screening is a process whereby people are invited for screening on the basis of address, geographical area or list. This process is more expensive per person screened as people have to be identified, invited (some decline) and then informed of the result. Population screening requires a referral of those who test positive to their general practitioners. Some patients do not attend and many of those testing positive will not have the disease in question. Screening teams do not provide care or follow-up.

Population screening has been tried for T2DM on several occasions and in several places. It always finds some cases but at relatively high cost. Population screening for diabetes is not currently recommended in either the UK or the US.

By comparison, clinical opportunistic screening has no costs in making the initial appointment which is made by the patient for some other reason, there is only marginal extra time taken and the additional cost is only the extra blood glucose tests (which are very cheap). The cost of informing the patient of negative results falls to the usual practice system (such as the patient telephoning for the result). There are extra costs in contacting the patient if the glucose is reported to be raised, but now this is usually in the context of an early diagnosis. Furthermore, the patient is informed by their own doctor, whom they know and treatment, once the diagnosis has been confirmed, can start at once managed by the patient's usual doctor.

Clinical opportunistic screening requires high professional morale and interested, confident clinicians. These doctors are doing more than is usual in their consultations. It has recently been made more practical by the lengthening of the average consultation in general practice in the UK NHS to 13 minutes.<sup>17</sup>

Clinical opportunistic screening is a more cost-effective approach and one working within the main NHS system. It has not received much academic attention, perhaps, because there have been few reports like this showing its potential. Clinical opportunistic screening in UK general practice can approximate to population screening in terms of coverage since 90% of the population sees a GP every year.<sup>19</sup>

### *Diagnosing diabetes before symptoms*

Diagnosing diabetes before symptoms occur is a particularly important form of pre-symptomatic diagnosis.

Diabetes is a common and important disease which produces serious clinical complications and shortens life by an average of 20 years.<sup>2</sup> The large UK Prospective Diabetes Study reported some new diagnoses of diabetes by screening.<sup>20</sup> Patients with symptoms had a mean HbA1c at diagnosis of 9.6% and those patients with diabetes detected by screening 8.1%. Both levels are higher than reported here, suggesting that continuous, clinical opportunistic screening in primary care

may have advantages. The difference between mean HbA1c levels in the two groups of 1.5% was slightly larger than that reported in this study.

A different result was reported from the Netherlands in the Hoorn screening study.<sup>21</sup> This found that screening-detected patients had a mean HbA1c of only 6.7% and compared these with new diagnoses in general practices where the mean HbA1c was 9.1%. However, two different populations were used rather than the same population as in this study and they did not describe the diagnostic processes or state of computerization of the general practices. Their screened group comprised volunteers who may not be typical of a local population. Thus, when first diagnosed, people in Europe with symptoms of T2DM commonly have an HbA1c as high as 9.1–9.6%.

### *Comments on findings*

Since the local laboratory did not adopt DCCT methodology until the year 2000, numbers are limited. The clinical records did not include HbA1c in the time stipulated for 33 patients, further reducing numbers available for analysis. The main findings of diagnosis before symptoms and significantly lower HbA1c with asymptomatic diagnosis, exciting though they are, cannot be generalized without further studies.

## Conclusions

This preliminary report from one general practice shows that

- (i) Over 19 consecutive years, the prevalence of T2DM rose from 1.1% to 3.0% of the registered population.
- (ii) Of all the diagnoses of T2DM made since 2000, 95.9% were made by general practitioners within the practice.
- (iii) Of 121 new diagnoses of T2DM since 2000, a majority 70 (57.9%) were made, by clinical opportunistic screening, i.e. before the patients complained of any diabetes-related symptom.
- (iv) Those patients diagnosed before reporting any diabetic symptoms with eligible HbA1c results had median HbA1c levels 1.1% lower than patients who were diagnosed with symptoms. This is a new finding and is both statistically and clinically significant.

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## Declaration

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Ethical approval: Not relevant.

Conflicts of interest: None.

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