Diabetes care in general practice: an approach to audit of process and outcome

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SUMMARY. As a chronic condition in which the major adverse outcomes only occur after many years, diabetes poses special problems for continuing medical audit. The feasibility of continuous audit of process and outcome in diabetes care has been tested in four general practices with organized diabetes care in Newcastle upon Tyne. For all patients with previously diagnosed non-insulin dependent diabetes, the data already collected according to published protocols were assembled into a single database. The time and resource costs of this exercise, together with measures of process, complications, risk factors, and metabolic outcomes were analysed. Data were successfully collected at minimal cost where structured records were completed. Recommended processes had been completed in a high percentage of patients, adverse patient outcomes were limited, and metabolic output measures not unsatisfactory. Nevertheless, attention has been directed to areas where care could be improved. Continuing diabetes audit in primary health care is feasible and helpful, and can use the same measures as in the hospital setting.

Keywords: non-insulin dependent diabetes; mangement of disease; medical audit; outcome; quality of health care.

Introduction

NON-INSULIN dependent diabetes is a common condition beyond middle age, affecting 10% of the population before the end of their lives.[1] The 750 000 people with diabetes in the United Kingdom are recognized as bearing a major part of the impact of blindness and renal failure in all adult age groups.[2] They also have a risk of lower limb amputation as a result of neuropathy and peripheral vascular disease of some 50 to 100 times that of the general population.[2,3] Most of the ischaemic heart disease and cerebrovascular disease found in people with diabetes is attributable to the metabolic disturbance associated with the condition.[4] It is generally accepted that well organized care can improve the outcome for this large group of high risk patients, in detecting complications early and probably in their prevention.[5] To that end protocols for care have been developed locally, nationally, and by international consensus.[6,7]

Early studies of patients discharged from hospital to primary health care were disappointing in both process and outcome.[8,9] However, structured care seems to result in more successful health care delivery,[10,11] and in research studies the process of care approaches satisfactory levels.[11] The current enthusiasm for management of this chronic disease can be supported by such protocols, but assurance of quality can only be achieved by continued monitoring of the care delivered.

Audit of diabetes care can be problematic because the major patient outcomes (blindness, amputation, death) occur erratically, and are likely to be related to the metabolic state over many decades, rather than as a result of current care. Furthermore, current health status (quality of life) is difficult to assess because the best validated general health measures are heavily biased towards physical disability,[12,13] and are thus inappropriate to the average diabetic patient. On the other hand, the agreed protocols of care and the metabolic targets set by consensus discussions provide a valid basis against which to judge current care.[6] Such data are already gathered routinely as part of the health care process, usually on an annual basis, together with the results of screening for early complications.

The aim of this study was to see if data already being collected by general practitioners and other members of the practice team could be the basis of a useful continuing audit of diabetes care.

Method

Practices

The study was performed in 1990 in four urban group practices in Newcastle upon Tyne. One practice had six practice partners and a list size in 1990 of 11 100 patients. The second practice had five partners and 10 700 patients, the third practice had four part-time partners and 4270 patients, and the fourth practice had four part-time partners and 3600 patients. The practices were selected for their interest in diabetes care and audit. Two practices had been running a diabetes care scheme since 1985–86 using a locally prepared record card, and the other two practices had developed structured diabetes care schemes of their own. People with diabetes were seen by their own general practitioner in two practices, but mainly by just one practice partner in the other two practices. A pilot study was performed in one practice in 1988, and the study repeated with minor modifications in 1989 in three of the practices, and in 1990 in all four practices. During 1990 a revised diabetes record card was introduced under a separate initiative by the Newcastle diabetes facilitator, and was adopted by the four practices in the study. This new card drew heavily on experience with the earlier record card, and hence made little impact on the data being recorded.

Data collection and analysis

A working party of general practitioners, together with physicians from the Freeman Diabetes Service, agreed on the data items to be collected for audit purposes. These included patient characteristics (sex and age), relevant diabetes history (duration of diabetes and type of treatment), and measurements derived

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from regular annual review assessments. Measurements of metabolic outcome and risk factors included smoking status, body mass index (from height and weight), glycated haemoglobin levels and serum cholesterol and triglyceride levels. Measurement of markers of adverse health included blood pressure, foot pulses, proteinuria, creatinine levels, retinopathy and cataracts. Measures of outcome of patient health included visual acuity, prevalence of foot ulceration and amputation below the knee, and drug therapy.

Data collected prospectively onto the new record cards (or earlier cards) over the 12-month period were subsequently transferred onto a single data summary sheet for entry into a microcomputer. Where necessary, supplementary information was taken from the general medical record, prescription cards and hospital correspondence. Data were collated by two general practitioners, a practice nurse and the study investigator. Data were entered onto a database created within a commercial programme (*dBase III Plus®*, Ashton Tate) by the investigator and checked against the data transfer forms. Tables produced were included and discussed in a written report, supplied by one of the investigators to each practice. For the purposes of this paper, the data from the four practices for 1990 have been combined. The results are as presented to the provider general practitioners, and it was an intentional part of the communication process not to give percentages to one decimal place.

Analysis of data was undertaken for the patients receiving general practitioner care only. Data analysis of measured variables was by classification of patients into defined categories of normality or abnormality. For biochemical measures, blood pressure and body mass index this followed the guidelines of the European NIDDM Policy Group.[6] For visual acuity corrected vision was taken as impaired when 6/12–6/18 (0.50–0.33), severely impaired when 6/24–6/36 (0.25–0.17) and blind when 6/60 (0.10) or worse. The biochemical methods used for measuring glycated haemoglobin, serum cholesterol, triglyceride, and plasma creatinine levels were the standard methods in use in the hospital clinical biochemistry departments.

Patients

All non-insulin dependent diabetic patients registered with a practice on 1 January 1990 were included. A diagnosis of diabetes was accepted if a plasma glucose level greater than 11.0 mmol l^{-1} was documented in the records or if a patient had been formally treated as having diabetes (where no pre-diagnosis plasma glucose measurement could be found). The majority of patients were diagnosed within the last 10 years when plasma glucose levels have been accepted as mandatory for diagnosis in these practices, but the inclusion of patients without confirmed diabetes (or diagnosed at a time of metabolic stress) remains a possibility. Patients newly diagnosed during 1990 were not included in this study.

Results

Costs of data collection

The data being collected were already required by the protocols of care being followed by the practices concerned. Thus, no extra consultation time was needed. Where record cards had been adequately completed data transfer to the summary sheet took about six minutes per patient, while data entry onto the computer database took approximately 10 minutes per patient, as estimated from the number of records processed on sample occasions. Data checking for correct entry and analysis took between one and two hours per practice per year. Data analysis by the programme on a 8 MHz microcomputer with hard disk took 2.3 minutes for the smallest practice and 4.0 minutes for the largest. Writing an edited and critical report discussing the tables produced could take up to six hours per practice, although the tables proved self explanatory.

Where record card data fields were incomplete, or the record card not used, data collection from the standard medical record and other information sources could be time consuming, taking up to 15 minutes per patient.

Patient characteristics

There were 257 non-insulin dependent patients among the 29 670 patients at the four practices (prevalence 0.87%). Of these, 186 (72%) were receiving diabetes care from their general practitioner and 50 (20%) received hospital care for their diabetes (four patients moved away and 17 died in 1990). Of those receiving care from their general practitioner, nearly 60% were aged 65 years or more, with 31% aged 75 years or more (Table 1). Nearly 80% had been diagnosed less than 10 years ago. Forty two per cent were managed by diet only, 55% additionally with oral hypoglycaemic agents, and only 3% with insulin.

Annual review

Of the 186 patients under general practitioner care only, 136 (73%) had a formal annual review performed by a general practitioner and 10 (5%) by a hospital clinic which did not otherwise participate in their care. Thus there were 40 patients (22%) who had no formal annual review. This included 26 (14%) who had no regular diabetes care because of non-attendance, other serious illness, or long term residential care. In some cases recorded information was available separately and was included although formal annual review had not been performed.

Process measures completed

There were high recording rates for smoking status, blood pressure and glycated haemoglobin levels, and low recording rates for cholesterol levels and triglyceride levels (Table 2).

Patient outcomes and drug treatment

Of the 186 patients 47% had adequate visual acuity but six had severe impairment and five patients were blind in both eyes (Table 3). Four patients had foot ulcers requiring treatment at the time of the foot examination, and one patient had a below knee amputation. Treatment for angina and congestive heart failure was prescribed for 16% and 10% of patients, respectively.

Markers of adverse health

Thirty per cent of patients had a systolic blood pressure of 160 mmHg or greater and 15% a diastolic pressure of 95 mmHg or

Table 1. Characteristics of the patients under general practitioner care in the four practices in 1990.

Patient characteristics	% of patients (n = 186)
Men	50
Age (years)	
<65	41
65–74	28
75+	31
Years since diagnosis	
<10	78
10+	22
Management	
Diet only	42
Diet and oral hypoglycaemic agents	55
Diet and insulin	3

n = number of patients.

Table 2. Process measures completed for the non-insulin dependent patients under general practitioner care.

Process measures completed	% of patients (n = 186)
Blood pressure	87
Body mass index	72
Smoking status	87
Proteinuria	82
Creatinine level	75
Foot examination	72
Visual acuity	72
Fundoscopy	70
Glycated haemoglobin level	87
Cholesterol level	68
Triglyceride level	46

n = number of patients.

Table 3. Measures of outcome of health among the non-insulin dependent diabetic patients under general practitioner care.

Outcome measures	% of patients (n = 186)
Visual acuity (best eye)	
Adequate <6/12	47
Impaired 6/12–6/18	18
Severely impaired 6/24–6/36	3
Blind 6/60+	3
Unknown	28
Foot ulcer present	2
Below knee amputation	1
Medication for:	
Hypertension	27
Angina	16
Congestive heart failure	10
Hyperlipidaemia	3

n = number of patients.

greater (Table 4), including those on antihypertensive therapy (27%). There were 13% with no recorded blood pressure.

Only 11% of patients had absent foot pulses in one foot, but 28% had no recorded foot examination. Retinopathy (recorded as abnormal retinae, including proliferative retinopathy) was present in 11% of patients, with 19% having cataracts present or extracted. Impaired renal function was recorded in 11% with creatinine concentrations greater than or equal to 125 μmol l^{-1}, but 25% of patients had no recorded creatinine result.

Metabolic outcomes and risk factors

Glycated haemoglobin values were within the acceptable range for 62% of the 186 patients, but 15% had poor control and 13% had no result available (Table 5). For cholesterol levels, 32% were unknown, and 28% exceeded 6.5 mmol l^{-1}. Thirty three patients smoked, but for 25 there was no record. Only 25% of patients had a recorded body mass index within the acceptable range, and 47% a body mass index greater than 25. Of the 186 patients, 19% were obese (body mass index greater than 30). However, missing height data meant that for 28% body mass index could not be calculated.

Discussion

Assurance of the quality of health care can be addressed in a number of ways.[14] For example, availability, accessibility, and continuity of care receive much attention with regard to hospital medicine, but with the relatively uniform availability of primary health care in the UK these factors are not as relevant to general

Table 4. Markers of adverse health among the non-insulin dependent diabetic patients under general practitioner care.

Markers		% of patients (n = 186)
Blood pressure (mmHg)		
Systolic	<160	57
	160–199	27
	200+	3
Diastolic	<95	72
	95–119	13
	120+	2
Unknown		13
Absent DP and PT pulses (either limb)		11
Proteinuria		2
Creatinine level (μmol l^{-1})		
Acceptable	<125	64
Poor	125+	11
Unknown		25
Retinopathy (either eye)		11
Cataract (either eye)		
Present		14
Extracted		5

n = number of patients. DP = dorsalis pedis. PT = posterior tibial.

Table 5. Metabolic outcomes and risk factors among the non-insulin dependent patients under general practitioner care.

		% of patients (n = 186)
Glycated haemoglobin level (%)		
Good	<7.5	46
Acceptable	7.5–8.7	16
Poor	8.8–10.0	9
Very poor	>10.0	15
Unknown		13
Cholesterol level (mmol l^{-1})		
Acceptable	<5.2	16
	5.2–6.5	24
Poor	6.6–7.8	18
	>7.8	10
Unknown		32
Triglyceride level (mmol l^{-1})		
Acceptable	<3.0	28
Poor	3.0+	17
Unknown		54
Smoking status		
Smoker		18
Non-smoker		69
Unknown		13
Body mass index (kg m^{-2})		
Acceptable	<25.0	25
Poor	25.0–29.9	28
	30.0+	19
Unknown		28

n = number of patients.

practice. However, performance of specialist activities, including diabetes care, by primary health care teams calls into question whether the process of care is appropriate, relevant and coordinated, now that standards and protocols can provide the basis for the relevant judgements to be made.[6,7] Audit of the process of care is usefully complemented by the measurement of outcome. This partnership is particularly convenient in diabetes care, where obtaining the necessary outcome measures (retinal status, control of blood lipids) often implies that the required processes (their assessment) have been performed.

Outcome audit in the present study was limited by the desire to

minimize any extra costs of collecting data not already available in the diabetes record, and also by the limitations or absence of appropriate instruments for the assessment of quality of life, satisfaction with management, or changes in self-care. These areas are the subject of further research studies. In addition to regular review with the aim of preventing complications, a recognized standard of diabetes care includes an annual assessment for eye, foot and kidney complications, together with measurements of blood glucose and lipid control, and blood pressure, and assessment of smoking habits.[6,7] The most obvious omissions from the list of outcome measures are assessment of rates of serious hypoglycaemia (relevant to sulphonylurea- and insulin-treated non-insulin dependent diabetic patients), hospital admissions for metabolic decompensation, and assessment of peripheral neuropathy. These items are likely to be included in future quality assurance recommendations from UK and European working parties.[15–17]

The choice of data fields appears to have been justified by the relative ease of data collection. Although this was heavily dependent on the use of structured records, such systems are now generally accepted as being a necessary part of quality diabetes care in order to ensure the process is complete and data trends obvious.[5] From the time taken in the present study it can be estimated that if data for 87 non-insulin dependent diabetic patients in a 10 000 patient practice were transferred directly to the practice computer, the total time required would be less than 15 minutes per week. However, problems did arise in interpreting symbols and abbreviations personal to the person completing the form. Without a formal data recording technique (for example, normal = 0, abnormal = 1, not done = 9), an audit assistant rather than a clerical assistant would be required. The employment of such staff in a health district (by a medical audit advisory group) would allow comparisons of the performance of different practices. Structured records are particularly suitable for direct data entry at the time of clinical contact even by those not keyboard literate, and could offer further savings in time if it proved acceptable to health professionals and patients.

The performance of process measures cannot be expected to reach 100% in any year, given that defaults will occur for legitimate reasons such as hospital admissions. The process rates achieved are comparable with those achieved in a more structured research study.[11] The attention to determining smoking status and measurement of blood pressure and glycated haemoglobin levels (all 87%), suggests a satisfyingly high level of attention to preventive care, but this was tempered by the 70–72% of patients assessed for development of eye and foot complications. Given that interventions are now available to reduce the impact of sight-threatening retinopathy and peripheral vascular disease and peripheral neuropathy[18,19] the practices involved have recognized the need to improve complication screening further. The lower rates of measurement of serum lipid levels probably reflect some scepticism as to their usefulness in this generally elderly population.

Death rates are difficult to assess as an outcome measure in an elderly population with a chronic disease. All patients with diabetes will die with the condition still present. Even in this combined four practice analysis the number (17) was too small to allow a useful age–cause analysis against published statistics which are, in any case, notoriously unreliable in people with diabetes.[20] Similar problems can be observed for the important patient outcomes of amputation, foot ulceration, and blindness, where the prevalence is too low to allow meaningful comparisons between practices. Such statistics may, however, be useful in public health medicine in comparing health districts, or in large hospital clinics.

As expected, risk factors and complication markers were much more common than true adverse outcomes among the non-insulin dependent diabetic patients. Thus, the data on control of blood pressure, presence of retinopathy, and absence of foot pulses allow more meaningful assessments to be made of the output of health care. Given the age structure of the study population the distribution of recorded blood pressure (including the 27% on antihypertensive treatment) was encouraging. Little published data on the prevalence of absent foot pulses and background retinopathy in similar populations are available, but the results appear better than those in a local hospital series, but a degree of adverse bias may have been present (CASPE-Freeman outcomes study 1989, unpublished results).

Glycated haemoglobin and lipid measurements are useful as they bear a clear relation to the adverse health outcomes of micro- and macro-vascular disease,[21,22] and yet are sensitive to the success of relatively recent management of diabetes. When measurement of glycated haemoglobin levels was introduced in 1980 many clinics reported average levels of approximately 11% (the more specific assay HbA_{1c} approximately 8%), but by 1990 averages of below 9% (HbA_{1c} approximately 7%) were not uncommon.[23,24] This would appear to justify the choice of cut off points at the four and six standard deviations from the normal distribution adopted for analysis in this study. Indeed 72% of measured results were in the non-microvascular risk range. Nevertheless it has to be recognized in setting targets in this area that in some patients control will have recently deteriorated as part of the natural history of the disease, while a small proportion retain such glycated haemoglobin levels even when transferred to insulin therapy. Hyperlipidaemia was still common among patients in 1990, but this remains an area where management habits are still evolving, particularly for the more elderly patient.

While the data is population based, the number of patients is small in epidemiological terms, and the social and ethnic mixes may not be typical of those in other parts of the UK. Comparison of levels of blood glucose control, smoking rates, and other measures within different settings may not therefore be justified.

The study has shown that with structured diabetes care, including annual review, continuing diabetes audit is both feasible and useful in general practice. Indeed changes in diabetes management have already been made by the participating practices, and the preliminary results suggest an early beneficial impact on intermediate outcome measures.

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