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Implementing intensive control of blood glucose concentration and blood pressure in type 2 diabetes in England: cost analysis (UKPDS 63)

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Abstract

Objective To estimate the incremental cost of implementing policies for more intensive control of blood glucose concentration and blood pressure for all patients with type 2 diabetes in England.

Design Extrapolation of resource use and cost data derived from a randomised controlled trial.

Setting General practice, outpatient care, and inpatient care.

Population Trial population with diagnosed type 2 diabetes in England extrapolated to the population of England.

Main outcome measures Total costs based on use of healthcare resources including costs of management, treatment, and hospitalisation.

Results The incremental net annual cost of implementing more intensive control of blood glucose and blood pressure to all people with diagnosed type 2 diabetes in England is estimated to be £100.5m (\$156m; €159m), which is equivalent to less than 1% of the proposed additional annual expenditure on the NHS in 2001-5. This estimate varied in sensitivity analyses from £67m to £121m.

Conclusions Policies to improve control of blood glucose and blood pressure of people with type 2 diabetes are effective in reducing complications

associated with the disease and are also cost effective. The total cost represents a small fraction of the NHS's spending plans.

Introduction

The United Kingdom prospective diabetes study (UKPDS) has established that a policy for more intensive control of blood glucose concentration (aiming for a fasting plasma glucose concentration < 6 mmol/l) is a cost effective means of increasing the time free of complications in patients with type 2 diabetes, with the cost per year free of complications less than £1200 (\$1862; €1903).¹ Similarly, data from the UKPDS show that tighter control of blood pressure (aiming at a blood pressure of less than 150/85 mm Hg) in hypertensive patients with type 2 diabetes has a cost effectiveness ratio of £720 per year of life gained.² However, adopting a new intervention requires either identifying within a fixed budget a range of other activities that are less cost effective, have similar total costs, and can be halted, or funding the new intervention from additional resources. In either case, it is important to know not only the cost effectiveness of the new intervention but also the total cost of implementing it.

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We set out an approach, using evidence from a large randomised controlled trial, to estimate the total costs and potential savings in England of fully implementing two interventions that have been shown to be cost effective: intensive control of blood glucose concentrations and blood pressure in patients with type 2 diabetes. The method could also be used to assess the total cost impact of other cost effective interventions.

Methods and data

Type of analysis and perspective

The purpose of the analysis was to estimate the total incremental cost of implementing the policies of intensive control of blood glucose concentrations and blood pressure reported by the UKPDS for all patients with diagnosed type 2 diabetes in England. The perspective taken was that of the healthcare system, and only direct costs to health services were considered.

Population, setting, and comparison

The UKPDS study population consisted of 5102 patients with newly diagnosed type 2 diabetes recruited between 1977 and 1991 when aged 25-65 years, who had a fasting plasma glucose concentration >6 mmol/l on two occasions.³ To account for differences between the trial population and the general population with diagnosed type 2 diabetes in England we adjusted for duration of diabetes, age, and sex in all our analyses. The ethnic composition of the UKPDS patients was broadly in line with the 1999 health survey for England, which indicated a prevalence of diabetes in ethnic groups of about three times that in the general population.⁴

We used the results of the 1998 health survey for England as our preferred estimate of the population of England with diagnosed type 2 diabetes.⁵ Age and sex specific rates from this survey were then applied to the 1999 population of England. We then estimated the proportions of patients with type 2 diabetes who have hypertension, whose glycated haemoglobin concentration is currently in the normal range, and who might be unwilling to change to a more intensive regimen.

To generalise the results obtained in a controlled trial, costs incurred by the protocol must be removed: for example, all patients participating in the UKPDS, regardless of their randomised allocation, attended clinics three or four times a year. We removed these costs and substituted the likely pattern of visits required to implement UKPDS levels of intensive control of blood glucose concentrations and blood pressure. This was based on responses to a survey of the opinions of general practitioners and clinical specialists.

The comparator for intensive control of blood glucose was conventional control (defined as maintenance of a plasma glucose concentration <15 mmol/l without symptoms of hyperglycaemia, primarily through diet).³ For tighter blood pressure control the comparator was less tight control (defined as aiming for a blood pressure below 180/105 mm Hg but avoiding treatment with angiotensin converting enzyme inhibitors or β blockers).⁶ Many patients in the UKPDS progressed to complex multiple treatments and doses

reflecting modern patterns of clinical care; this was captured in our standardisation for duration of diabetes. Current guidelines recommend tighter control of blood glucose and blood pressure than was the policy in the control arms of the UKPDS. In our sensitivity analysis we varied the proportion already treated to "intensive" standards of care.

As a proportion of people with diagnosed type 2 diabetes will already have a blood glucose concentration in the range considered normal for people without diabetes, intensive treatment will not have to be initiated. One current estimate is that 43% of people with diagnosed type 2 diabetes are in the normal range.⁷ The HbA_{1c} concentration that is considered normal has changed from 7% to 6.5%. In our baseline analysis we set the proportion already in the normal range at 25%, but we examined other proportions in a sensitivity analysis.

Resource and cost data

We took patient specific data on the incremental resources required for more intensive control of blood glucose and blood pressure and the resources associated with treatment of complications from previously published trial data.^{1,2} Treatment resources included doses of drugs used for treating diabetes, antihypertensive drugs, other drugs, blood glucose tests, self monitoring resources such as test strips, and visits to general practitioners, practice nurses, and clinics. Resources associated with complications included the number, duration, and specialty of admissions to hospital; outpatient consultations; procedures such as renal photocoagulation; and day case episodes.

We then attached the most recent available unit costs to these resource volumes, pricing all drugs using 1999 information, and costing all inpatient days using the average of specialty based NHS financial returns from 1997-8 and 1998-9.

As the inclusion criteria for the UKPDS were patients with newly diagnosed diabetes aged 25-65 years who had not had major complications, the trial population differs from patients with type 2 diabetes in the general population. We performed indirect standardisation to adjust costs of treatment and complications to the English population and regression analyses to estimate the effects of age, sex, and duration of diabetes on costs of treatment and complications by using patient specific data for all patients in the UKPDS. We then estimated the average cost for each age group standardised by sex after adjusting for the average duration of diabetes by age. The estimated incremental cost per person by age, sex, and duration of diabetes was then applied, and the total costs of treatment and complications for the England population were obtained by multiplying these costs per person by the number of people with type 2 diabetes in England.

We performed a sensitivity analysis on several key variables that were subject to uncertainty. All results are reported as total costs in pounds at 1999 prices.

Results

In total, 2.5% of the population aged 16 and over, or 1.011 million individuals, are estimated to have

Table 1 Estimated total cost of adopting policies for intensive control of blood glucose and blood pressure control, England (at 1999 prices). Values are £m unless otherwise indicated

Age group (years)	Management	Treatment	Complications	Total
<45	16.8	7.4	-3.9	20.3
45-49	8.9	4.3	-2.4	10.9
50-54	9.6	4.7	-3.6	10.7
55-59	14.8	7.6	-8.0	14.3
60-64	13.1	7.1	-10.5	9.7
65-70	18.1	10.4	-17.6	10.9
>70	50.6	31.3	-58.2	23.7
Total	132.0	72.8	-104.2	100.5
Total per person treated (£)	193	107	-153	147

Table 2 Estimated total incremental resource impact of adopting policies for intensive control of blood glucose and blood pressure, England, 2001

Resource	Incremental No per year	Estimated No of patients seen per session	No of staff in whole time equivalent posts required*
General practice nurse visits	339 348	8	92
Specialist nurse visits	927 507	6	336
General practice clinic visits per year	1 211 103	18	146
Doctor at clinic	611 386	12	148
Hospital inpatient days (at 85% bed occupancy rate)	-342 921	—	-1105 beds

*Based on each whole time equivalent post providing 10 sessions per week over 46 weeks. In the category "general practice nurse visits," for example, it is assumed that 92 additional general practice nurses would be required to provide 10 sessions a week over 46 weeks per year, and see on average 8 patients per session.

diagnosed type 2 diabetes and are included in this analysis.

Costs of management and treatment

The main changes in annual resources per patient, compared with current practice, that are needed to control blood glucose and blood pressure better are visits to hospital doctors and an increased frequency of home glucose tests. Patients receiving more intensive control of blood glucose and blood pressure are estimated to require three additional visits per year.

Incremental costs of management and treatment for blood glucose control were partly offset by cost savings due to fewer complications related to diabetes. We assumed that patients requiring more intensive control of their blood pressure would also be receiving intensified control of blood glucose concentrations, and so the reductions in cost associated with fewer complications would largely offset the costs of added management and treatment and, in older age groups, exceed them.

Table 1 shows the results of applying these per person data to the estimated population with type 2 diabetes in England. The central estimate is that the additional management costs of implementing these policies would be £132m per year, plus an additional £73m in drugs and extra insulin supplies. The consequence of better control of blood glucose and blood pressure would be to reduce the costs of hospitalisation associated with treating complications by around £104m per year. Consequently, the net cost of this programme would be £100.5m per year.

The figure shows how these additional management costs would be broken down, indicating that the main elements of additional management costs would be more frequent visits to hospital clinics and more frequent home glucose testing. Implementing a policy on this scale would have staffing implications, and table

2 gives estimates, based on the number of patients staff could see in a typical session and the number of sessions that could be provided over a year. We estimate that the policy would require an additional 336 whole time equivalent specialist nurses, and also large numbers of additional general practitioners, practice nurses, and hospital based clinicians. Set against these additional staff, the number of inpatient days required for treatment of complications related to diabetes would fall by 343 000 each year, equivalent to 1100 beds if the occupancy rate is 85%.

A sensitivity analysis reporting the impact of changes in main variables on the estimated total cost shows that the total cost estimate does not alter by more than £30m upwards or downwards.

Discussion

Strengths and weaknesses of the study

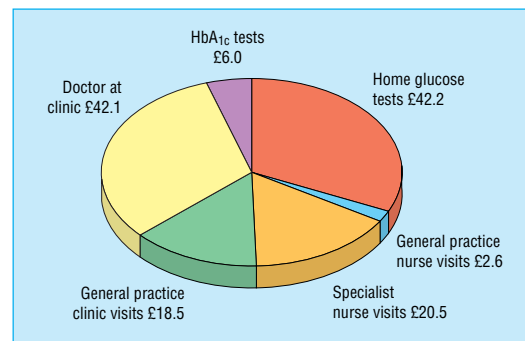
The analysis presented here is concerned exclusively with the treatment of people who have diagnosed type 2 diabetes and not with screening for undiagnosed diabetes. Neither does it estimate the potential impact of wider use of treatment with metformin for overweight patients with type 2 diabetes, for which there is good evidence.^{8 9}

We used self reported data from the health survey for England 1998 to estimate the total number of people with diagnosed type 2 diabetes. Self reported numbers may underestimate the true number of people with diagnosed disease, but the overall prevalence of 2.5% among people aged 16 or older is higher than the 1.5% reported from primary care audit groups or the 1.7% from record linkage data.^{10 11}

We incorporated only direct healthcare costs of type 2 diabetes and not the societal costs and benefits of implementing the programme outlined here.¹²

Unanswered questions

The costs identified in this study will be borne primarily by general practitioners, whereas the benefits in terms of lower complications will accrue mainly to the hospital sector. In some future well functioning model of primary care trusts buying packages of care from hospitals for their patients, this need not be a major problem. In the immediate future some of these savings could be transferred back to general practitioners by the partnership arrangements envisaged in the national service framework for diabetes.



Estimated additional management costs (£m, at 1999 prices) of adopting policies in England for more intensive control of blood glucose and blood pressure by category of resource use (total=£132m)

What is already known on this topic

The United Kingdom Prospective Diabetes Study (UKPDS) has shown that policies of intensive control of blood glucose concentration and blood pressure for people with type 2 diabetes are cost effective interventions

Current levels of diabetes care in England need to be improved, but the total cost and the implications for NHS staffing are unknown

What this study adds

Implementing the main findings of the UKPDS to all people with diagnosed type 2 diabetes in England would have a net annual cost of around £100m, which equates to 1% of the planned increase in annual expenditure on the NHS over the period 2001-5

About 720 additional staff would be required to implement these control policies, especially specialist nurses and practice nurses

The advent of primary care trusts and the national service framework for diabetes should create new incentives and mechanisms to adopt these improved standards

Existing incentive payments for the management of chronic diseases in primary care are unlikely to lead to further improvement without adaptation.

Economic analyses reporting cost savings from reduced bed use are sometimes criticised because savings are unlikely to be realised in practice, but such reductions provide opportunities to reduce bed numbers or use the capacity for other purposes and do represent an economic benefit. The staff resources we have estimated are strictly the incremental changes associated with improved control of blood glucose concentration and blood pressure and will not remedy the marked staffing variations and deficiencies in existing primary and secondary diabetes services that were identified in recent surveys.^{13 14} Individual practices might experience greater difficulties than primary care trusts.

Finally, the net annual cost of implementing the main findings of the UKPDS to all people with diagnosed type 2 diabetes in England as estimated in this analysis (£100.5m, with the sensitivity analysis varying from £67m to £121m) is less than 1% of the proposed increase in annual expenditure on the NHS over the period 2001-5 set out in the government's expenditure plans.¹⁵ Although many claims are made on these additional resources, it seems reasonable that one guiding principle should be to allocate funds to interventions of proved effectiveness and cost effectiveness that will benefit many people.

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Endpiece

An evil fate

Never to grow old is a very, very, evil fate, though the twaddle of our world says otherwise.

Robertson Davies (1913-95), *What's bred in the bone*, London: Penguin, 1986