Screening for type 2 diabetes: literature review and economic modelling

Screening for type 2 diabetes: literature review and economic modelling

N Waugh,[1*] G Scotland,[2] P McNamee,[2] M Gillett,[3] A Brennan,[3] E Goyder,[4] R Williams[5] and A John[5]

[1] Department of Public Health, University of Aberdeen, UK
[2] Health Economics Research Unit, University of Aberdeen, UK
[3] Department of Health Economics and Decision Science, ScHARR, University of Sheffield, UK
[4] Department of Public Health, University of Sheffield, UK
[5] Department of Public Health, University of Swansea, UK

* Corresponding author

Executive summary

Health Technology Assessment 2007; Vol. 11: No. 17

Health Technology Assessment
NHS R&D HTA Programme
www.hta.ac.uk

How to obtain copies of this and other HTA Programme reports.
An electronic version of this publication, in Adobe Acrobat format, is available for downloading free of charge for personal use from the HTA website (http://www.hta.ac.uk). A fully searchable CD-ROM is also available (see below).

Printed copies of HTA monographs cost £20 each (post and packing free in the UK) to both public **and** private sector purchasers from our Despatch Agents.

Non-UK purchasers will have to pay a small fee for post and packing. For European countries the cost is £2 per monograph and for the rest of the world £3 per monograph.

You can order HTA monographs from our Despatch Agents:

– fax (with **credit card** or **official purchase order**)
– post (with **credit card** or **official purchase order** or **cheque**)
– phone during office hours (**credit card** only).

Additionally the HTA website allows you **either** to pay securely by credit card **or** to print out your order and then post or fax it.

Contact details are as follows:

HTA Despatch
c/o Direct Mail Works Ltd
4 Oakwood Business Centre
Downley, HAVANT PO9 2NP, UK

Email: orders@hta.ac.uk
Tel: 02392 492 000
Fax: 02392 478 555
Fax from outside the UK: +44 2392 478 555

NHS libraries can subscribe free of charge. Public libraries can subscribe at a very reduced cost of £100 for each volume (normally comprising 30–40 titles). The commercial subscription rate is £300 per volume. Please see our website for details. Subscriptions can only be purchased for the current or forthcoming volume.

Payment methods

Paying by cheque
If you pay by cheque, the cheque must be in **pounds sterling**, made payable to *Direct Mail Works Ltd* and drawn on a bank with a UK address.

Paying by credit card
The following cards are accepted by phone, fax, post or via the website ordering pages: Delta, Eurocard, Mastercard, Solo, Switch and Visa. We advise against sending credit card details in a plain email.

Paying by official purchase order
You can post or fax these, but they must be from public bodies (i.e. NHS or universities) within the UK. We cannot at present accept purchase orders from commercial companies or from outside the UK.

How do I get a copy of *HTA on CD*?

Please use the form on the HTA website (www.hta.ac.uk/htacd.htm). Or contact Direct Mail Works (see contact details above) by email, post, fax or phone. *HTA on CD* is currently free of charge worldwide.

The website also provides information about the HTA Programme and lists the membership of the various committees.

Executive summary

Background

The National Screening Committee (NSC) is responsible for providing advice on screening policy to all parts of the UK. A review of policy on screening for type 2 diabetes is due shortly, and this document was commissioned by the NHS R&D HTA Programme in order to support that review.

It is known that a proportion of people with type 2 diabetes are undiagnosed. Blood glucose levels can rise to diabetic levels with little or nothing in the way of symptoms. Sometimes by the time people are diagnosed with diabetes, they have developed complications such as the eye damage known as retinopathy, due to an effect of diabetes on small blood vessels (microvascular disease). However, the main risk to health in undiagnosed type 2 diabetes is an increased risk of cardiovascular disease, in particular ischaemic heart disease, because of damage to the arteries (macrovascular disease). Early detection of diabetes would lead to measures to reduce the risk of heart disease, such as the use of statins to lower cholesterol, and also reduction of blood glucose levels by, initially, diet and exercise, supplemented with hypoglycaemic drugs if necessary.

Microvascular disease such as retinopathy is specific to diabetes. However, the macrovascular disease seen in diabetes is broadly the same disease as seen in people without diabetes; the difference in diabetes is the increased risk. An important issue when considering whether there should be screening for diabetes is that unlike with retinopathy, the increase in risk starts below the level of blood glucose used to define diabetes. There are groups of people who have higher than normal blood glucose levels but who are not diabetic. They are classified according to whether their blood glucose level is raised when fasting [impaired fasting glucose (IFG)] or is normal when fasting but raised after meals, or after testing with a 75-g glucose drink. The second group are said to have impaired glucose tolerance (IGT).

The risk of heart disease is increased slightly in IFG but by about 60% in IGT.

Hence if reduction of heart disease is one of the aims of screening, then we should consider screening not just for diabetes, but also for IGT.

Objectives

The objectives of this review were as follows:

- to reconsider the aims of screening for undiagnosed diabetes, and whether screening should be for other abnormalities of glucose metabolism such as IGT, or the 'metabolic syndrome'
- to update the previous review for the NSC on screening for diabetes, including reviewing choice of screening test
- to consider what measures would be taken if IGT and IFG were identified by screening, and in particular to examine evidence on treatment to prevent progression to diabetes in these groups
- to examine the cost-effectiveness of screening, by a review of previous economic models, and by new modelling to take account of recent developments in treatment such as the use of statins
- as part of the economic analysis, to consider groups at higher risk at which screening might be targeted
- to identify research needs.

Methods

The literature searches (carried out up to the end of June 2005) and review concentrated on evidence published since the last review of screening, both reviews and primary studies. The review of economic studies included only those models that covered screening. The new modelling extended an existing diabetes treatment model by developing a screening module.

The NSC has a set of criteria, which it applies to new screening proposals. These criteria cover the condition, the screening test or tests, treatment and the screening programme. Screening for diabetes was therefore considered using these criteria.

▶

Results

As was known before this review, undiagnosed diabetes can be detected by screening several years before it would become apparent after the development of symptoms. Earlier detection and treatment reduces the development both of specific diabetes problems such as eye disease and of cardiovascular disease. Treatment to reduce the risk of cardiovascular disease has become much less costly since the arrival of generic statins, which are now very cheap.

Detection of lesser degrees of glucose intolerance such as IGT is worthwhile, partly because the risk of cardiovascular disease can be reduced by treatment aimed at reducing cholesterol level and blood pressure, and partly because some diabetes can be prevented. Several trials have shown that both lifestyle measures and pharmacological treatment can reduce the proportion of people with IGT who would otherwise develop diabetes.

Screening could be two-stage, starting with the selection of people at higher risk, based on primary care records of age, weight and other indicators of metabolic risk such as hypertension. Screening might be targeted at those above a certain body mass index threshold, while recognising that any cut-off would be an arbitrary line on a continuum of risk. The second-stage choice of test for blood glucose remains a problem, as in the last review for NSC. All of fasting plasma glucose, the oral glucose tolerance test and glycated haemoglobin would be acceptable, but none is perfect. The best test is the oral glucose tolerance test (OGTT), but it is the most expensive, is inconvenient and has weak reproducibility. Fasting plasma glucose would miss people with IGT. Glycated haemoglobin does not require fasting, and may be the best compromise. It may be that more people would be tested and diagnosed if the more convenient test was used, rather than the OGTT.

A review of previous economic models showed that screening for diabetes appeared to be cost-effective. The models differed in some aspects but reached broadly similar conclusions. The strongest and most comprehensive came from the USA, and there were some doubts over their applicability to the UK.

Five previous modelling studies examined the costs and benefits of identification and screening of people with IGT. All predicted that diabetes prevention measures would provide good value for money. One was conducted from a UK perspective. Diet and exercise treatment is the most cost-effective option. Treatment with metformin may be less cost-effective than lifestyle changes, but would be appropriate in some groups. To some extent, the models may have underestimated benefit by focusing mainly on prevention of diabetes, and not taking full account of the benefits of lifestyle changes on risk factors for cardiovascular disease.

Five economic studies assessed the costs and short-term outcomes of using different screening tests. None examined the long-term impact of different proportions of false negatives. All considered the costs that would be incurred and the numbers identified by different tests, or different cut-offs. Results differed depending on different assumptions. They did not give a clear guide as to which test would be the best in any UK screening programme, but all recognised that the choice of cut-off would be a compromise between sensitivity and specificity; there is no perfect test.

The modelling exercise concluded that:

- Screening for diabetes appears to be cost-effective for the 40–70-year age band, more so for the older age bands than the 40–49-year band, but even in the 40–49-year age group, the incremental cost-effectiveness ratio for screening versus no screening is only £10,216 per quality-adjusted life-year.
- Screening is more cost-effective for people in the hypertensive and obese subgroups.
- The costs of screening are offset in many groups by lower future treatment costs.
- The cost-effectiveness of screening is determined as much by, if not more than, assumptions about the degree of control of blood glucose and future treatment protocols than by assumptions relating to the screening programme.
- The very low cost now of statins is an important factor.

Although the prevalence of diabetes increases with age, the relative risk of cardiovascular disease falls, reducing the benefits of screening.

Screening for diabetes meets most of the NSC criteria, but probably fails on three:

- criterion 12, on optimisation of existing management of the condition
- criterion 13, which requires that there should be evidence from high-quality randomised ▶

controlled trials showing that a screening programme would reduce mortality or morbidity
- criterion 18, that there should be adequate staffing and facilities for all aspects of the programme.

It is uncertain whether criterion 19 – that all other options, including prevention, should have been considered – is met. The issue here is whether all methods of improving lifestyles in order to reduce obesity and increase exercise have been sufficiently tried. The rise in overweight and obesity suggests that health promotion interventions have not so far been effective.

Conclusions

The case for screening for undiagnosed diabetes is probably somewhat stronger than it was at the last review, because of the greater options for reduction of cardiovascular disease, principally through the use of statins, and because of the rising prevalence of overweight and hence type 2 diabetes. However, there is also a good case for screening for IGT, with the aim of preventing some future diabetes and reducing cardiovascular disease.

Research needs

One key uncertainty concerns the duration of undiagnosed diabetes, and whether the rise in blood glucose levels is linear throughout or whether there may be a slower initial phase followed by an acceleration around the time of clinical diagnosis. This has implications for the interval after which screening would be repeated.

Another uncertainty is the natural history of IGT, and in particular what determines progression to diabetes.

Research needs include the above, and

- Research into ways of reducing the prevalence of insulin resistance. For example, what forms and amounts of exercise are required to prevent or reduce insulin resistance?
- How can public health campaigns on lifestyle measures be made more effective? Most cases of type 2 diabetes are preventable. What balance should be struck between the public health, prevention by lifestyle approach, and the more medical model of care focused on the individual?
- If screening were to be introduced, should it be repeated, and, if so, at what interval? More data on the natural history of IGT may emerge from current research.
- If a decision were taken in principle that selective screening should commence, further modelling as suggested in Chapter 5 could help with selection.
- A trial in which populations were cluster randomised by practice to different screening tests, with economic evaluation built in, might be useful for showing which test was best in terms of both screening parameters and practicality.

A randomised controlled trial of the type required by NSC criterion 13 is under way but will not report for about 7 years.

Publication

Waugh N, Scotland G, McNamee P, Gillett M, Brennan A, Goyder E, *et al*. Screening for type 2 diabetes: literature review and economic modelling. *Health Technol Assess* 2007;**11**(17).

NIHR Health Technology Assessment Programme

The Health Technology Assessment (HTA) programme, now part of the National Institute for Health Research (NIHR), was set up in 1993. It produces high-quality research information on the costs, effectiveness and broader impact of health technologies for those who use, manage and provide care in the NHS. 'Health technologies' are broadly defined to include all interventions used to promote health, prevent and treat disease, and improve rehabilitation and long-term care, rather than settings of care.

The research findings from the HTA Programme directly influence decision-making bodies such as the National Institute for Health and Clinical Excellence (NICE) and the National Screening Committee (NSC). HTA findings also help to improve the quality of clinical practice in the NHS indirectly in that they form a key component of the 'National Knowledge Service'.

The HTA Programme is needs-led in that it fills gaps in the evidence needed by the NHS. There are three routes to the start of projects.

First is the commissioned route. Suggestions for research are actively sought from people working in the NHS, the public and consumer groups and professional bodies such as royal colleges and NHS trusts. These suggestions are carefully prioritised by panels of independent experts (including NHS service users). The HTA Programme then commissions the research by competitive tender.

Secondly, the HTA Programme provides grants for clinical trials for researchers who identify research questions. These are assessed for importance to patients and the NHS, and scientific rigour.

Thirdly, through its Technology Assessment Report (TAR) call-off contract, the HTA Programme commissions bespoke reports, principally for NICE, but also for other policy-makers. TARs bring together evidence on the value of specific technologies.

Some HTA research projects, including TARs, may take only months, others need several years. They can cost from as little as £40,000 to over £1 million, and may involve synthesising existing evidence, undertaking a trial, or other research collecting new data to answer a research problem.

The final reports from HTA projects are peer-reviewed by a number of independent expert referees before publication in the widely read monograph series *Health Technology Assessment*.

Criteria for inclusion in the HTA monograph series

Reports are published in the HTA monograph series if (1) they have resulted from work for the HTA Programme, and (2) they are of a sufficiently high scientific quality as assessed by the referees and editors.

Reviews in *Health Technology Assessment* are termed 'systematic' when the account of the search, appraisal and synthesis methods (to minimise biases and random errors) would, in theory, permit the replication of the review by others.

The research reported in this monograph was commissioned by the HTA Programme as project number 05/02/01. The contractual start date was in March 2005. The draft report began editorial review in October 2005 and was accepted for publication in October 2006. As the funder, by devising a commissioning brief, the HTA Programme specified the research question and study design. The authors have been wholly responsible for all data collection, analysis and interpretation, and for writing up their work. The HTA editors and publisher have tried to ensure the accuracy of the authors' report and would like to thank the referees for their constructive comments on the draft document. However, they do not accept liability for damages or losses arising from material published in this report.

The views expressed in this publication are those of the authors and not necessarily those of the HTA Programme or the Department of Health.

ISSN 1366-5278

Published by Gray Publishing, Tunbridge Wells, Kent, on behalf of NCCHTA.
Printed on acid-free paper in the UK by St Edmundsbury Press Ltd, Bury St Edmunds, Suffolk.