Costs and cost effectiveness of health checks conducted by nurses in primary care: the Oxcheck study

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Abstract

***Objective*—To measure the costs and cost effectiveness of the Oxcheck cardiovascular risk factor screening and intervention programme.**

***Design*—Cost effectiveness analysis of a randomised controlled trial using clinical and economc data taken from the trial.**

***Setting*—Five general practices in Luton and Dunstable, England.**

***Subjects*—2205 patients who attended a health check in 1989-90 and were scheduled for re-examination in 1992-3 (intervention group); 1916 patients who attended their initial health check in 1992-3 (control group). Participants were men and women aged 35-64years.**

***Intervention*—Health check conducted by nurse, with health education and follow up according to degree of risk.**

***Main outcome measures*—Cost of health check programme; cost per 1 % reduction in coronary risk.**

***Results*—Health check and follow up cost £29.27 per patient. Estimated programme cost per 1% reduction in coronary risk per participant was between £1.46 and £2.25; it was nearly twice as much for men as women.**

***Conclusions*—The cost to the practice of implementing Oxcheck-style health checks in an average sized practice of 7500 patients would be £47 000, a proportion of which could be paid for through staff pay reimbursements and Band Three health promotion target payments. This study highlights the considerable difficulties faced when calculating the costs and benefits of a health promotion programme. Economic evaluations should be integrated into the protocols of randomised controlled trials to enable judgments to be made on the relative cost effectiveness of different prevention strategies.**

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Introduction

The Oxcheck trial has reported the effectiveness of health checks based in general practice and conducted by nurses in reducing cardiovascular risk factors after one and three years of follow up.[1 2] The results indicated self reported beneficial dietary change and reduction in cholesterol concentrations, sustained over three years, but no change in smoking prevalence. It was estimated that health checks conducted by nurses in this trial reduced the long term risk of myocardial infarction in men by 5-12% and in women by 13-20%. The British family heart study reported a similar reduction in coronary risk.[3 4]

To determine the appropriateness of undertaking such health checks in the population their cost effectiveness must be considered in relation to other activities competing for limited resources in primary care. A recent modelling exercise concluded that maximum benefit from health checks would be gained by targeting high risk groups, but it did not use trial based evidence of effectiveness or review the actual costs of health checks.[5]

This report, and the accompanying report from the Family Heart Study Group,[6] estimates the cost of health checks and relates the cost to changes in the relative risk of cardiovascular disease. Comparisons of these two studies with other primary care interventions aimed at reducing the burden of cardiovascular disease are considered in the accompanying commentary paper,[7] where outcomes have been converted into life years gained to provide an estimate of the longer term benefits of health checks.

Methods

OXCHECK DESIGN

The Oxcheck study design, methods, and results have been reported previously.[1 2 8] Briefly, a lifestyle questionnaire was sent to all registered patients aged between 35 and 64 years in five general practices in Luton and Dunstable. Those who responded (80%) were randomised to the offer of a health check in one of each of the four study years (1989-93). Health checks took an average of 45 minutes and were performed by nurses, who worked with a defined protocol. The patient's personal and family medical history and lifestyle characteristics (diet, smoking, alcohol intake, and physical activity) were recorded. Blood pressure, height, and weight were measured and blood was taken for estimation of serum total cholesterol concentration. Patients with risk factor levels above cut offs defined in the trial protocol as indicating high risk were invited to attend for follow up with the nurses. Follow up visits lasted 10-20 minutes.

This paper analyses the cost effectiveness of the programme after three years of follow up. The intervention group comprised the 2205 patients (45% men and 55% women) who attended for their first health check in year one of the trial (1989-90). Of these, 1660 attended a 30 minute re-examination in the fourth year (1992-3), enabling re-examination of diet, lifestyle, and risk factors. The control group comprised the 1916 patients who attended for their first health check in the fourth year.[2]

MEASUREMENT OF OUTCOME

The primary outcome measure was the mean cost per 1% reduction in the relative risk of cardiovascular disease, derived from the Dundee risk score,[9] which is a measure of modifiable coronary risk based on systolic blood pressure, cholesterol concentration, and smoking. This outcome measure was used to calculate a cost per life year gained, which can be used to assess the benefits of health checks relative to other primary care interventions, as outlined in the commentary paper.[7]

For the purposes of this analysis, Dundee risk scores were calculated for participants in the intervention and control groups. The scoring method[9] derived for the analysis of the results of the British family heart study[4] was used. The method estimates cardiovascular risk as a negative number between −1 and −5. The relative risk between the intervention and control groups

was calculated by determining the mean difference in scores, correcting for bias, and then converting from an individual to a population based risk.[4] Results are presented for the patients who attended for re-examination and also for all patients scheduled to attend on the assumption that non-attenders showed no change from their initial visit or last re-examination.

MEASUREMENT OF COST

Cost data were extracted from detailed financial records kept during the trial, which listed actual expenditure over the four year study. Using these data, costs were calculated for practice nurses, equipment, consumables, nurse support and supervision, recruitment and training of nurses, and administration. The cost of space (overheads) required to carry out health checks was estimated from external sources (see footnotes to table 2). The accuracy of the nurse costs calculated from the financial records were checked by using invoices sent by the five participating general practices that requested reimbursement for nurse hours spent on the Oxcheck study.

Most of the expenditure occurred in the first year of the trial; since the financial records could not be divided by year of health check, total programme costs were calculated for the four years combined (1989-90 to 1992-3). A cost per patient for the programme was then calculated by dividing the total programme expenditure by the total number of patients (8109) who attended a health check over the four year period.

Costs relating to the research aspects of the trial were excluded from this analysis. Trial coordinators were asked to identify the expenditure in the financial records that related to research costs, which were defined as any expenditure that would not occur if health checks were carried out in normal clinical practice. These costs included research staff; conferences, meetings, and data handling; equipment that would not be used in normal clinical practice—for example, the type of sphygmomanometer used; and hospital based laboratory estimations of cholesterol, as we assumed that cholesterol concentrations would normally be estimated using desk top analysers (Reflotrons).

The costs of the re-examinations determined by the protocol were also considered to be research costs as these were conducted exclusively for the purposes of the trial. It was not possible to separate these out from the programme costs in the financial records, therefore these were costed by considering the proportion of nurses' time they consumed relative to time spent on health checks and follow ups (assuming that time spent on administration and recruitment was evenly spread across all visits). Nurse time spent on each health check, follow up and re-examination was 45, 20, and 30 minutes respectively, as estimated by the Oxcheck study group.[1] The proportion of nurse costs estimated to be for re-examinations was subtracted from the total costs (excluding other research costs) to derive a total programme cost.

Limited data were collected during the trial on the additional health service costs and savings that may have resulted from the health checks. Two aspects of these additional costs and savings—general practice consultations and drug prescriptions—can be assessed from two audits carried out by the Oxcheck study group, described previously.[2] These audits were conducted only on the intervention group and therefore no comparisons can be made. Briefly, the notes of 215 consecutive participants entering the first year of the study were examined to assess general practice consultation rates before and after the initial health check, and the notes of 1100 patients in the intervention group with raised blood pressure (≥160 mm Hg systolic or ≥90 mm Hg diastolic) and 90 with cholesterol concentration (≥8.0 mmol/l) identified at the health check were examined at the end of the study to calculate the number of drugs prescribed.

The additional health service costs were estimated by using these data. As it was assumed that the controls would show no change in the number of drugs prescribed, the estimated cost represents the maximum additional cost.

Table 1—*Dundee risk scores (and percentage reductions in coronary risk) in controls and after three years of intervention, Oxcheck study*

		Intervention		Difference from control	
	Controls	Attenders only	All participants	Attenders only	All participants*
Men and women					
Number of participants	1916	1660	2205		
Number with scores†	1711	1398	1877		
Dundee risk score:					
Mean	−3.03	−3.18	−3.12	−0.15	−0.09
Adjusted difference				−0.225	−0.135
Relative risk				0.80	0.87
% Reduction in risk‡				20.0	13.0
Men					
Number of participants	885	738	987		
Number with scores†	782	619	837		
Dundee risk score:					
Mean	−3.01	−3.14	−3.06	−0.13	−0.05
Adjusted difference				−0.195	−0.075
Relative risk				0.82	0.93
% Reduction in risk‡				18.0	7.0
Women					
Number of participants	1031	922	1218		
Number with score†	929	779	1040		
Dundee risk score:					
Mean	−3.04	−3.22	−3.16	−0.18	−0.12
Adjusted difference				−0.27	−0.18
Relative risk				0.76	0.83
% Reduction in risk‡				24.0	17.0

*Last value from health check or re-examination for non-attenders.
†Dundee risk scores were not available for all participants: scores cannot be calculated for participants aged over 65 years or for those who did not have all measurements (smoking, blood pressure, and cholesterol) taken.
‡Calculated as 1 − relative risk × 100.

Table 2—*Total programme costs (£), Oxcheck study, after three years of follow up*

	Total costs	Health check*	Follow up*	Re-examination*	Total programme cost†
Equipment ‡ including quality assurance	10 189.82	4 891.11	2 445.56	2 853.15	7 336.67
Consumables	21 197.73	10 174.91	5 087.46	5 935.36	15 262.37
Overheads§	40 000.00	19 200.00	6 600.00	11 200.00	28 800.00
Nurse support and supervision¶	69 141.75	33 319.08	16 659.54	19 436.13	49 978.62
Recruitment and training of nurses‡	6 516.67	3 128.00	1 564.00	1 824.67	4 692.00
Practice nurses	142 749.00	68 519.52	34 259.76	39 969.72	102 779.28
Administration	39 618.26	19 016.77	9 508.38	11 093.11	28 525.15
Total	329 686.23	158 249.39	79 124.70	92 312.12	237 374.09
Cost per patient attending					29.27

*Health checks, follow ups, and re-examinations were assumed to constitute 48%, 24%, and 28% of total costs respectively (see table 3).
†Health check plus follow up.
‡A discount rate of 6% over five years was used to calculate an annual equivalent cost, which was then multiplied by four to derive a four year cost.
§Based on the cost of a dedicated serviced room (10 m^2) at £2000 per year.
¶Includes salary of one nurse coordinator plus other expenses such as travel and administration.

Results

The overall reduction in coronary risk was 20% for attenders of the final examination only and 13% if non-attenders were also included (table 1). The likely effect of health checks lies between the two estimates. The effect was greater for women (24%; 17%) than for men (18%; 7%).

Total costs of health checks, follow up, and re-examinations over four years were £329 686 (table 2).

Table 3—*Nurses' time spent on health checks, re-examinations, and follow ups, Oxcheck study*

Years	Health check*		Re-examination†		Follow up‡		
	No of subjects	Hours	No of subjects	Hours	No of subjects§	Hours	Total hours
Year 1	2205	1654	0	0	2514	838	2 492
Year 2	2080	1560	850	425	2371	790	2 775
Year 3	1908	1431	1582	791	2175	725	2 947
Year 4	1916	1437	3244	2433	2184	728	4 598
Total	8109	6082	5677	3649	9244	3081	12 812
Proportion (%) of nurses' time¶	48		28		24		

*Nurses' time for each health check was assumed to be 45 minutes.
†Nurses' time for each re-examination was assumed to be 30 minutes.
‡Nurses' time for each follow up was assumed to be 20 minutes.
§Number of patients attending follow up was derived from audit data. Each health visit was assumed to create 1.14 follow ups.
¶Administration time assumed to be spread evenly across all visits.

Table 4—*Mean cost effectiveness, Oxcheck cardiovascular risk factor screening and intervention programme*

	Mean effect			Cost (£) per 1% reduction in coronary risk	
	Attenders only	All participants*	Mean cost (£)	Attenders only	All participants*
Men	18.0	7.0	29.27	1.63	4.18
Women	24.0	17.0	29.27	1.22	1.72
All	20.0	13.0	29.27	1.46	2.25

*Last value from health check, or from re-examination for non-attenders.

Practice nurses spent 48%, 24%, and 28% respectively on these activities (table 3). After exclusion of the 28% of time spent on these trial outcome re-examinations, the total service costs of the programme (excluding all research elements) amounted to £237 374. The mean cost per patient attending for screening, with an average amount of follow up, was then calculated to be £29.27 (table 2). The major contributory cost (64%) was nurses' time.

As the total costs of the health check were derived from records of actual expenditure, extensive sensitivity analyses of the results were not necessary, except for the specific assumptions made when separating out the re-examination research costs. It was assumed that nurses spent 45 minutes on each health check, 20 minutes on follow up, and 30 minutes on re-examination. Although the time spent on re-examinations was constant throughout the study, the time spent on initial health checks was found, by an audit, to vary from 45 to 60 minutes and the time spent on follow ups from 10 to 20 minutes. If nurses spent 60 minutes with each patient on their initial health check instead of 45 minutes, the cost per patient rose to £30.49. Alternatively, if the nurse only spent 10 minutes on each follow up the cost decreased to £27.65.

The cost per patient of a 1% reduction in coronary risk was £1.46 when calculated on the basis of attenders only and £2.25 when calculated for all patients scheduled to attend for re-examination (table 4). The mean cost per 1% reduction in coronary risk was lower for women (£1.22; £1.72) than for men (£1.63; £4.18).

The two audits, used to determine the likely magnitude of the additional resource costs or savings of health checks to the general practice, showed, firstly, that health checks did not affect the frequency of visits to a general practitioner and, secondly, that the prescribing of drugs for patients with high blood pressure or high cholesterol increased after a health check. Fourteen per cent (23) of those audited with high blood pressure were prescribed antihypertensive drugs and 31% (28) with high cholesterol were prescribed lipid lowering drugs.

The calculated cost per health check would increase if the cost of drugs attributable to attendance were included, assuming no change in the number of these prescriptions for controls. To calculate a crude cost per patient of this increase in prescribing, the total number of additional anti-hypertensive and lipid lowering drugs prescribed was calculated and multiplied by the mean cost of a prescription.[10] If the same proportion of patients with high blood pressure and high cholesterol in the total trial sample (8109) were prescribed these drugs as in the audit sample (1100), and if all patients prescribed these drugs had 12 such prescriptions over one year, the increase in prescribing would add, on average, £11.00 per patient to the programme costs. As controls are unlikely to show no change in the number of these drug prescriptions, this cost is likely to be an overestimate. Furthermore, this cost is likely to be offset by savings made in other areas of the health service.[6]

Discussion

Economic evaluation of health promotion strategies is essential to identify programmes which maximise health gain at least cost to society. Currently there is little information on the cost effectiveness of different primary care interventions. Health checks tested in the Oxcheck trial were shown to be effective in promoting dietary change that was sustained over three years, but there was no impact on rates of smoking or excessive alcohol intake. Oxcheck's protocol for health checks based in general practice and conducted by nurses was more cost effective than the protocol used in the British family heart study[6]; reasons are outlined in the accompanying paper.[7]

It is important to recognise the uncertainties surrounding the estimated cost. Discrimination between the programme costs and the research costs in the Oxcheck accounts was not always easy, and some assumptions had to be made. Some research costs may have been included in the programme costs, and some programme costs may have been omitted along with the research costs. The estimated costs represent only those incurred in carrying out the general practice health checks and therefore do not include the personal expenditure of patients or those costs that might have arisen in relation to other subsequent health care. Though the expected magnitude of the costs resulting from subsequent health care (increased consultations and prescriptions) was assessed, without data on the control group and information on other aspects of health service use, an accurate estimate of the additional costs or savings attributable to attendance at a health check cannot be made.

Practice nurses were the major resource utilised in the Oxcheck trial, and it may be that a similar reduction in coronary risk could be achieved at a lower cost by shortening the time nurses spend on each health check. However, audit data show that practice nurses spend only half their time face to face with patients, and as the costs of follow up, tests, recruitment, administration, and overheads would remain unchanged, reducing the time nurses spend on each health check is unlikely to have an appreciable impact on the overall cost per patient.

The immediate cost of implementing Oxcheck-style health checks in an average sized practice of 7500 patients, which would have 2700 eligible men and women, would be £47 000.[11] With a response rate similar to that in the trial, the practice would expect 1610 health checks and 2254 follow ups. Total costs would be reduced if lower grade nurses were used or if the response rate to invitations for a health check were

Key messages

- Little is known about the cost effectiveness of general practice based, nurse conducted health checks in reducing cardiovascular risk factors
- Research was undertaken to estimate the cost of the health checks and relate the cost to changes in the relative risk of cardiovascular disease
- The immediate cost of implementing Oxcheck-style health checks in an average sized practice of 7500 patients would be £47 000, which is comparable with the immediate cost of a cervical screening programme
- The actual costs to the practice would be substantially reduced by staff pay reimbursements and health promotion target payments
- Further research is required to estimate the wider costs of health checks resulting from the additional use of health care services

lower. Although the effect of using lower grade staff is unknown, clearly a lower response rate would reduce the effectiveness of the programme.

The actual costs to the practice would be reduced by staff pay reimbursements (70% of nurses' costs would be covered by the family health service authority) and health promotion target payments. If, for example, the practice took three years to carry out health checks on this cohort of patients, £21 000 would be paid for by the family health service authority and potentially £25 000 could be paid through health promotion payments.

The recurrent annual cost to the general practice of implementing health checks is unknown. It is not clear how many new patients joining the practice would be eligible for a health check or how often patients would be recalled for additional health checks. However, it is reasonable to assume that once everyone in the initial practice population had been offered health checks, annual costs to the practice would be considerably reduced.

By comparison, the immediate cost of a cervical screening programme for a practice with 7500 patients would be approximately £48 000. This cost assumes that the average cost per smear is £27[12] and that 80% of the 2250 women (aged 20-64 years) eligible for screening[11] would be targeted by the practice in order to achieve the highest band of target payments. Again, staff pay reimbursements and target payments would substantially reduce the cost of cervical screening to the practice.

CONCLUSIONS

This study has calculated the cost effectiveness of health checks in terms of the cost per percentage reduction in the relative risk of cardiovascular disease. To judge whether health checks are a cost-effective use of resources the estimates presented in this paper should be converted to a cost per life year gained and then compared with estimates from other potential primary health care activities. These comparisons are presented in the accompanying commentary paper.[7]

This analysis shows the considerable difficulties in assessing the costs of such programmes from a retrospective analysis of cost data even when detailed financial data are available. Cost data are crucial in evaluating the cost effectiveness of an intervention, and economic evaluation should become a routine part of all trial protocols. Funding agencies should be playing a central role in ensuring that future trial protocols include such analyses.

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Conflict of interest: None.

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MANNERS MAKYTH MAN

When I was an anaesthetic registrar I inevitably had many patients to anaesthetise for a simple cystoscopy. The operating lists usually proceeded without any timewasting. One day I went to anaesthetise the next patient on the list and, in the patronising nature of which I was unaware at the time, said to the elderly gentleman, "Let's have your arm then, Dad." After I had wheeled the patient into the operating theatre the consultant anaesthetist said, "Oh, I was going to anaesthetise this patient myself. Did he introduce himself?" When I replied in the negative the consultant told me that the patient was an eminent consultant physician. I told him of my faux pas and was advised that, in future, it was a simple matter of good manners always to address male patients as "sir" and I would never find myself embarrassed again. Although I followed this advice until I retired, the episode had a happy ending. When paying a postoperative visit to the patient I apologised for my bad manners. I was assured that it was most reassuring to be treated as an "ordinary patient" and was presented with a small gift, which I still have. It was a very useful lesson in good manners.—JOHN S M ZORAB *is a retired consultant anaesthetist in Bristol*