

Cost effectiveness of nurse led secondary prevention clinics for coronary heart disease in primary care: follow up of a randomised controlled trial

James P Raftery, Guiqing L Yao, Peter Murchie, Neil C Campbell, Lewis D Ritchie

Abstract

Objective To establish the cost effectiveness of nurse led secondary prevention clinics for coronary heart disease based on four years' follow up of a randomised controlled trial.

Design Cost effectiveness analysis.

Setting 19 general practices in north east Scotland.

Participants 1343 patients (673 in intervention group and 670 in control group, as originally randomised) aged under 80 years with a diagnosis of coronary heart disease but without terminal illness or dementia and not housebound.

Intervention Nurse led clinics to promote medical and lifestyle components of secondary prevention.

Main outcome measures Costs of clinics; overall costs to health service; and cost per life year and per quality adjusted life year (QALY) gained, expressed as incremental gain in intervention group compared with control group.

Results The cost of the intervention (clinics and drugs) was £136 (\$254; €195) per patient higher (1998-9 prices) in the intervention group, but the difference in other NHS costs, although lower for the intervention group, was not statistically significant. Overall, 28 fewer deaths occurred in the intervention group leading to a gain in mean life years per patient of 0.110 and of 0.124 QALYs. The incremental cost per life year saved was £1236 and that per QALY was £1097.

Conclusion Nurse led clinics for the secondary prevention of coronary heart disease in primary care seem to be cost effective compared with most interventions in health care, with the main gains in life years saved.

Introduction

Implementation of secondary coronary prevention in primary care is widely advocated. Several lifestyle measures such as smoking cessation and medical treatments can reduce the risk of coronary events and death in patients with coronary disease.¹ In the United Kingdom, general practitioners will be rewarded financially for achieving target standards.²

Several mechanisms to improve secondary prevention have been evaluated, the most successful to date being nurse led secondary prevention clinics.³⁻⁵ Between 1994 and 1995, we undertook one of the randomised trials of nurse led clinics and found them to improve implementation of secondary prevention and health related quality of life at one year.^{6,7} Running clinics, however, uses resources in primary care, especially nurses' time, and the clinics incur further costs from increased prescribing.^{6,7}

We assessed the costs and cost effectiveness of nurse led secondary prevention clinics, as practised in our previous randomised trial. The time frame for our study was 4.7 years, the mean duration of patient follow up.

Methods

The methods used in the randomised trial are described elsewhere.^{4,6,7} Briefly, the trial was set in a random sample of general practices in Scotland. Participants were a random sample of patients with coronary heart disease but without terminal illness or dementia and not housebound. Participants in the intervention group were invited to attend a nurse led secondary prevention clinic at their general practice for one year.

Data, extracted from general practice case notes at baseline, one year, and four years, included participants' attendances at secondary prevention clinics, cardiovascular drugs, cardiovascular events, and use of private health care. At the same intervals, we collected data by postal questionnaire on health related quality of life (SF-36).⁸ We obtained data on deaths, hospital admissions, and outpatient attendances from the Scottish Morbidity Records, and we linked these anonymously.

All analyses were by intention to treat. The perspective was societal, including both public and private health services. As most participants were older than working age, we ignored effects related to employment.

Editorial by Cullum et al

Health Economics Facility, Health Services Management Centre, University of Birmingham, Birmingham B15 2RT

James P Raftery
professor
Guiqing L Yao
research fellow

Department of General Practice and Primary Care, University of Aberdeen, Foresterhill Health Centre, Aberdeen AB25 2AY

Peter Murchie
Cancer Research UK research training fellow in primary care oncology

Neil C Campbell
senior lecturer

Lewis D Ritchie
Mackenzie professor of general practice

Correspondence to: J P Raftery
j.p.raftery@bham.ac.uk

BMJ 2005;330:707-10



This is the abridged version of an article that was posted on bmj.com on 16 February 2005: <http://bmj.com/cgi/doi/10.1136/bmj.38342.665417.8F>

We constructed Kaplan-Meier survival curves for total mortality, life years, and quality adjusted life years (QALYs), and analysed these curves using the log rank test. QALYs were estimated for each individual by weighting survival days by utility scores, derived from the SF-36 returns, leading to quality adjusted survival curves. It was not feasible for us to report on each type of item prescribed because of the large number of different items involved. The main difference related to the prescribing of statins.⁴

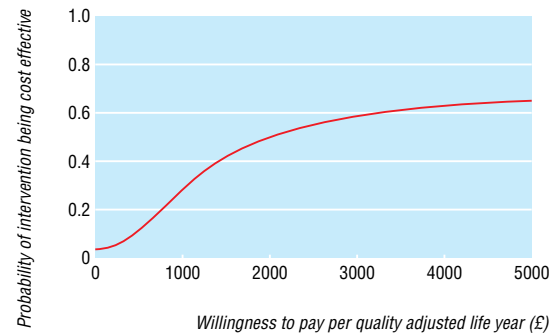
We calculated observed mean life years, discounted at 3.5% over four years as recommended by the National Institute for Clinical Excellence.⁹ We converted data on health related quality of life to overall quality of life scores and we used these scores to calculate QALYs.¹⁰ Overall costs to society comprised the costs to primary care, NHS hospitals, and private hospitals. We included hospital admissions related to cardiovascular disease only. Statistical analysis was based on *t* tests owing to the large volume of practically complete datasets, particularly for the most costly items (cardiovascular drugs in primary care, inpatient admissions).

On the basis of an audit of nurse time during the first year of the study and interviews with nurses and general practitioners after four years, those patients who attended in the first year of the clinics were attributed two visits and patients who attended in any of the subsequent years were attributed one visit. We have assumed that each visit lasted one hour. The costs of clinic materials and training were included at year 1. In the second, third, and fourth years we assumed that the only cost incurred in running the clinics was nurse time, which we put at £20 (\$37; €29) per hour.¹¹ We costed prescriptions for cardiovascular drugs on the basis of data at baseline, one year, and four years.¹² We calculated the mean cost per patient to primary care (cost of clinic and additional prescribing), discounted at 3.5% over four years.⁹

We calculated the cost of admissions to NHS hospitals by assigning the appropriate unit cost per case based on specialty and hospital and deriving costs per patient and total cost by group.¹³ Outpatient costs were based on the number of attendances multiplied by the relevant hospital unit cost. Missing data on outpatients were imputed on the basis of the average ratio of outpatient attendances per admission for cardiovascular disease for surviving patients. We costed admissions to private hospitals using NHS unit cost by specialty.

Results

Patients assigned to nurse led secondary prevention clinics for coronary heart disease showed significant improvements in all components at one year except smoking.^{6,7} At four years, these improvements were sustained except for exercise.⁴ By year 4, improvements were shown in the control group and differences were no longer significant, but the earlier differences had translated into significantly fewer deaths in the intervention group: 100 out of 673 (cumulative death rate 14.5%) compared with 128 out of 670 (19.1%) in the control group ($P = 0.038$).⁴ This improvement remained statistically significant after



Cost effectiveness acceptability curve for nurse led clinics for secondary prevention of coronary heart disease

adjusting for age, sex, general practice, and baseline secondary prevention. Thus the intervention group had 28 fewer deaths. Over the four year period this generated an incremental 0.110 life years per patient in the intervention group or 0.124 QALYs per patient (see bmj.com).

Costs to primary care and overall costs to society

The only differences in cost to primary care per patient were the direct costs of the intervention. The costs were £136 higher (1998-9 prices) in the intervention group (see bmj.com).

We have previously reported that total hospital admissions were lower in the intervention group, but part of this difference was accounted for by admissions for non-cardiovascular diseases.⁶ For this reason we considered alternative estimates of overall costs to society, one including all types of admissions, the other confined to cardiovascular admissions. Although both estimates were lower in the intervention group, neither difference was statistically significant. When the costs to primary care were combined with hospital costs, the higher cost to primary care was offset by the lower hospital costs in the intervention group, such that the differences between intervention and control groups were insignificant. We therefore discuss costs related to primary care.

Cost effectiveness

The cost effectiveness analysis was based on the difference between groups in total cost to primary care. The difference per patient was £136 (1998-9 prices). Combining the cost and outcome data gave an incremental cost per life year gained of £1236 and cost per QALY of £1097 (see bmj.com).

Sensitivity analysis

We used sensitivity analysis to explore increasing the cost difference only, on the basis that the benefits may have been underestimated owing to use of intention to treat analysis. We explored three changes in cost: (a) reducing the drug cost in the control arm to zero for all years, thus maximising the potential increment in drug cost attributable to the intervention; (b) increasing the cost of the secondary prevention clinic from the two visits in the first year and one visit in subsequent years to double that in the first year; (c) combining both of these, which led to an incremental cost per QALY of just over £9000.

The figure indicates a 70% probability of the intervention being cost effective if the NHS is willing to pay £5000 for an additional QALY, well below the putative NICE threshold of £30 000.¹⁴

Discussion

Nurse led clinics for the secondary prevention of coronary heart disease in primary care are relatively cost effective compared with the threshold of £30 000 attributed to NICE.¹⁴ The intervention group gained a mean 0.110 life years and 0.124 QALYs compared with the control group. The incremental cost per life year saved was £1236 and that per QALY was £1097.

In our original randomised trial we showed that improvements in processes of care and prescribing translated into reductions in total mortality in the medium term.⁴ The present study shows that the cost per life year gained is less than £1500. The key difference reported was the increased £136 cost of the intervention to primary care, owing to attendances at the clinics and increased prescribing.

The limitations of our study were, firstly, that just over half the control group attended at least one secondary prevention clinic after the initial study year.⁴ Rather than compare secondary prevention clinics with usual care, we evaluated the costs and benefits of having more patients attend secondary prevention clinics for longer. The total costs of running clinics to primary care will be higher than the cost difference between control and intervention groups in our study, as we used an intention to treat analysis, despite many patients in the control arm receiving the intervention in the period after the trial. Our estimates of cost effectiveness remain valid, however, as the benefits we found will also have been reduced by this cross over. The increase in both benefits and cost in practice depends on the pre-existing use of cardiovascular drugs, particularly statins, in the control group. Some of our data were incomplete, particularly attendances as hospital outpatients, but these had relatively little effect on overall costs to society—our data on high cost activities and important outcomes, such as mortality, were almost complete. Where we made assumptions, we tended to overestimate the cost of the intervention.

Similarly, we ignored benefits if there were doubts that they could be attributable to the intervention. We studied a random sample of general practices and patients, with good recruitment rates, so our sample should be representative of general practice at that time. We acknowledge that changes may have occurred in practice since the study began in 1995. The uptake that we reported for some secondary preventive drugs, especially statins, was lower than is likely in the current climate of national standards and incentives for general practitioners. Nevertheless, we found that the clinics improved uptake of secondary prevention by similar absolute amounts whatever the baseline levels, even for high uptake of activities at baseline such as blood pressure management and in practices with higher baseline levels of secondary prevention.^{6,7} Newly recommended interventions, such as smoking cessation clinics, may improve secondary prevention further but are unlikely to alter greatly the cost

What is already known on this topic

Nurse led clinics for the secondary prevention of coronary heart disease improve implementation of secondary prevention and reduce mortality

Clinics require primary care resources and to increase prescribing

General practitioners may be unwilling to implement clinics unless they are shown to be cost effective

What this study adds

Nurse led secondary prevention clinics for coronary heart disease resulted in 28 fewer deaths and an increased cost to primary care of £136 per patient over four years

The gain in mean life years per patient was 0.110 and the gain in QALYs was 0.124 at an incremental cost of £1236 and £1097, respectively

Nurse led clinics for the secondary prevention of coronary heart disease in primary care seem to be cost effective compared with most interventions in health care

effectiveness as these changes are likely themselves to be highly cost effective.¹⁵

Our study is the first to examine the cost effectiveness of secondary prevention clinics in primary care. Our findings are more consistent with current recommendations and practice on secondary prevention and provide a plausible explanation for the observed reduction in mortality.¹⁶ Whether or not the overall costs to society are statistically significant, practitioners in primary care are still faced with the real costs of providing the intervention, so we have gone further by calculating cost effectiveness on the basis of costs to primary care.

Other studies have evaluated the cost effectiveness of primary prevention clinics in primary care.^{8,17,18} Despite the limitations of these studies, some comparisons can be made with our study: the running costs for clinics per patient are reasonably consistent across the trials; running costs for a practice population would, however, be much higher for primary prevention clinics because the target population would be much larger; the estimated cost effectiveness is much better for secondary prevention (£1236 per life year gained) than for primary prevention (around £30 000 per life year gained).

Compared with the wider range of health interventions, the cost effectiveness of secondary prevention clinics remains favourable. The incremental cost per QALY of under £1000 that we found was due to the relatively small increase in cost per patient of £136, mainly due to modest increases in drug use, even the relatively costly statins. This pattern, however, is consistent with other complex health service interventions, where incremental improvements in process outcomes are more likely to be achieved than wholesale changes.³ None the less, these

relatively low increases in cost were linked to health gains that were considerable in terms of deaths, life years, and QALYs.

Contributors: JPR, PM, NCC, and LDR designed the study. PM and NCC collected the data. JPR, GLY, PM, and NCC analysed the data. JPR, GLY, PM, NCC, and LDR wrote the paper. JPR is guarantor.

Funding: The original trial and four year follow up study was funded by the Chief Scientist Office of the Scottish Executive. All researchers are independent of the Chief Scientist Office of the Scottish Executive.

Competing interests: None declared.

Ethical approval: The original trial and follow up study was approved by the Grampian research ethics committee.

- 1 Guideline 41. *Secondary prevention of coronary heart disease following myocardial infarction*. Edinburgh: Scottish Intercollegiate Guideline Network, 2000.
- 2 BMA/NHS Confederation. New GMS contract. www.bma.org.uk/ap.nsf/Content/NewGMSContract (accessed 22 Jun 2004).
- 3 McAlister FA, Lawson FME, Teo KK, Armstrong PW. Randomised trials of secondary prevention programmes in coronary heart disease: systematic review. *BMJ* 2001;323:957-62.
- 4 Murchie P, Campbell NC, Ritchie LD, Simpson JA, Thain J. Nurse led clinics for the secondary prevention of coronary heart disease: four year follow up of a randomised trial in primary care. *BMJ* 2003;326:84-7.
- 5 Moher M, Yudkin P, Wright L, Turner R, Fuller A, Schofield T, et al. Cluster randomised controlled trial to compare three methods of promoting secondary prevention of coronary heart disease in primary care. *BMJ* 2001;322:1338-42.

- 6 Campbell NC, Thain J, Deans HG, Ritchie LD, Rawles JM, Squair JL. Secondary prevention clinics for coronary heart disease: randomised trial of effect on health. *BMJ* 1998;316:1434-7.
- 7 Campbell NC, Ritchie LD, Thain J, Deans HG, Rawles JM, Squair JL. Secondary prevention in coronary heart disease: a randomised trial of nurse-led clinics in primary care. *Heart* 1998;80:447-52.
- 8 Ware JE. *SF-36 Health survey-manual and interpretation guide*. Boston: Nimrod, 1993.
- 9 National Institute for Clinical Excellence. *Guide to the methods of technology appraisal*. London: NICE, Apr 2004.
- 10 Brazier J, Roberts J, Deverill M. The estimation of a preference-based measure of health from the SF-36. *J Health Econ* 2002;21:271-92.
- 11 Netten A, Curtis J. *Unit costs of health and social care*. Canterbury: Personal Social Services Research Unit, University of Kent, 2000.
- 12 *Scottish drug tariff*. Edinburgh: Scottish Executive Health Department, NHS in Scotland, 1998.
- 13 *Scottish health service costs*. Edinburgh: Information and Statistics Division, NHS in Scotland, 1999.
- 14 Raftery J. NICE: faster access to modern treatments? Analysis of guidance on health technologies. *BMJ* 2001;323:1300-3.
- 15 National Institute for Clinical Excellence. *Guidance on the use of nicotine replacement therapy (NRT) and bupropion for smoking cessation*. Technology Appraisal Guidance No 39. London: NICE, 2002.
- 16 Lancaster T. The benefits of nurse led secondary prevention clinics continued after 4 years. [Commentary.] *Evid Based Med* 2003;8: 158.
- 17 Langham S, Thorogood M, Normand C, Muir J, Jones L, Fowler G. Costs and cost effectiveness of health checks conducted by nurses in primary care: the Oxcheck study. *BMJ* 1996;312:1265-8.
- 18 Wonderling D, Langham S, Buxton M, Normand C, McDermott C. What can be concluded from the Oxcheck and British family heart studies: commentary on cost effectiveness analysis. *BMJ* 1996;312: 1274-8.

(Accepted 17 December 2004)
doi 10.1136/bmj.38342.665417.8F

A memorable patient

A simple case of tetanus?

A 35 year old woman from a poor family was referred to our centre with complaints of dyspnoea, difficulty in opening her mouth, and spasms affecting the extremities for three hours. She had spent the previous week caring for her only cow, a major asset for the family. The patient did not habitually wear slippers while working. Neither the patient nor her relatives had any knowledge of tetanus or tetanus toxoid vaccine. On examination, she was thinly built, anxious, conscious, and well oriented. Her respiratory rate was 36 breaths per minute with rapid and shallow breathing. She had trismus and spasms of the extremities. Fissures were observed on the soles of both feet.

Considering the characteristic clinical picture, we diagnosed tetanus and admitted the patient to the intensive care unit, where she was given diazepam to control the muscle spasms and intravenous crystalline penicillin and metronidazole. We explained to her and her family the need for tracheostomy and mechanical ventilation, and the benefits of tetanus immunoglobulin. Because of financial constraints, her relatives requested six hours for the purchase of the immunoglobulin. We decided to observe her in the intensive care unit until further finances could be arranged.

Reassessment of the patient at one hour revealed a substantial reduction in trismus and spasms. Her respiratory rate had dropped to 20 breaths a minute and was regular. Within two hours of admission, she reported full improvement in symptoms with no recurrence.

A second interview with her relatives revealed that the cow the patient had been tending had been bought with a loan from a local bank and had died the

previous day. The patient had been much distressed by this and had worried about how the loan would be repaid. A reconstruction of events leading to her hospital admission could then be made as follows.

The grief caused by the death of the cow had triggered an episode of hyperventilation. This behaviour was reinforced by attention from anxious relatives and had launched a cycle of more hyperventilation, culminating in spasms and trismus. The withdrawal of this self-perpetuating stimulus after admission and the calming effects of diazepam had ensured the abatement of hyperventilation, with subsequent clinical improvement.

The patient was discharged the next morning after the first dose of tetanus toxoid, with strict instructions to complete the full course of immunisation at the local primary health centre.

We learnt to always consider hyperventilation even when tetanus seems the most obvious diagnosis.

Navin Paul *medical officer (navinpaul@yahoo.com)*, Tomy Joseph *Mannathukkaran consultant, Mar Baselious Medical Mission, Kothamangalam, Kerala, India*

We welcome articles up to 600 words on topics such as *A memorable patient*, *A paper that changed my practice*, *My most unfortunate mistake*, or any other piece conveying instruction, pathos, or humour. Please submit the article on <http://submit.bmj.com>. Permission is needed from the patient or a relative if an identifiable patient is referred to. We also welcome contributions for "Endpieces," consisting of quotations of up to 80 words (but most are considerably shorter) from any source, ancient or modern, which have appealed to the reader.