

Cost effectiveness of a general practice chronic disease management plan for coronary heart disease in Australia

Derek P. Chew^{1,5} MBBS, MPH, FRACP, FCSANZ, Edwards Heart Foundation
Senior Research Fellow, Professor of Cardiology

Robert Carter² BA (Econs)(Hons), GradDip Pop Health, M Admin St, PhD,
Foundation Chair in Health Economics, Director – Deakin Health Economics,
Deputy Director – Public Health Research Evaluation and Policy Cluster

Bree Rankin³ BComm, Research Assistant

Andrew Boyden⁴ BRuralSc(Hons) BMBS(Hons) MPH, FRACGP, Medical Affairs Manager

Helen Egan⁴ BAgSc(Hons), MBA, President

¹Flinders Medical Centre, Flinders University, Flinders Drive, Bedford Park, SA 5042, Australia.

²Deakin University, Burwood Campus, Burwood, VIC 3125, Australia.

³Centre for Health Policy, Programs and Economics, School of Population Health, University of Melbourne, Carlton, VIC 3053, Australia.

⁴Heart Foundation Australia, Deakin, ACT 2600, Australia.

⁵Corresponding author. Email: derek.chew@flinders.edu.au

Abstract

Background. The cost effectiveness of a general practice-based program for managing coronary heart disease (CHD) patients in Australia remains uncertain. We have explored this through an economic model.

Methods. A secondary prevention program based on initial clinical assessment and 3 monthly review, optimising of pharmacotherapies and lifestyle modification, supported by a disease registry and financial incentives for quality of care and outcomes achieved was assessed in terms of incremental cost effectiveness ratio (ICER), in Australian dollars per disability adjusted life year (DALY) prevented.

Results. Based on 2006 estimates, 263 487 DALYs were attributable to CHD in Australia. The proposed program would add \$115 650 000 to the annual national health expenditure. Using an estimated 15% reduction in death and disability and a 40% estimated program uptake, the program's ICER is \$8081 per DALY prevented. With more conservative estimates of effectiveness and uptake, estimates of up to \$38 316 per DALY are observed in sensitivity analysis.

Conclusions. Although innovation in CHD management promises improved future patient outcomes, many therapies and strategies proven to reduce morbidity and mortality are available today. A general practice-based program for the optimal application of current therapies is likely to be cost-effective and provide substantial and sustainable benefits to the Australian community.

What is known about this topic? Chronic disease management programs are known to provide gains with respect to reductions in death and disability among patients with coronary heart disease. The cost effectiveness of such programs in the Australian context is not known.

What does this paper add? This paper suggests that implementing a coronary heart disease program in Australia is highly cost-effective across a broad range of assumptions of uptake and effectiveness.

What are the implications for practitioners? These data provide the economic rationale for the implementation of a chronic disease management program with a disease registry and regular review in Australia.

Additional keywords: coronary heart disease management programs, coronary heart disease prevention.

Introduction

Improved medical therapies and an increased use of coronary revascularisation have been associated with a decline in the

acute mortality associated with acute coronary syndromes. However, the burden of chronic coronary heart disease (CHD) and other forms of cardiovascular disease remains high, with

CHD and stroke as the two leading single causes of death in Australia.¹

Clinical research is rich in evidence documenting the robust benefits of lifestyle and pharmacologic interventions for people with CHD.²⁻⁵ However, both international and local studies demonstrate that the application of these therapies is incomplete, and persistence of therapy is suboptimal.^{6,7} Therefore, a key strategic approach to improve the health and wellbeing of Australians living with CHD is to target the evidence-management gap by providing national supports and incentives to optimise the delivery of proven therapies and the achievement of treatment goals among these complex patients. Such an approach may be of particular benefit to populations which carry a greater CHD burden; specifically Aboriginal and Torres Strait Islander populations (who in 2000-02 died from CHD at 2.6 times the rate of other Australians⁸) and rural and regional populations, where rates of death from cardiovascular disease appear to be higher than in urban areas, and access to specialised medical services is more difficult.⁹

This type of initiative has been successfully implemented in diabetes, asthma and mental health management, immunisation and cervical cancer screening. To date, there has been no equivalent level of recognition for CHD care that is accessible to all general practices, although the Australian Primary Care Collaboratives is a positive initiative that has enhanced CHD care in several participating practices (see <http://www.apcc.org.au>, accessed 2009).

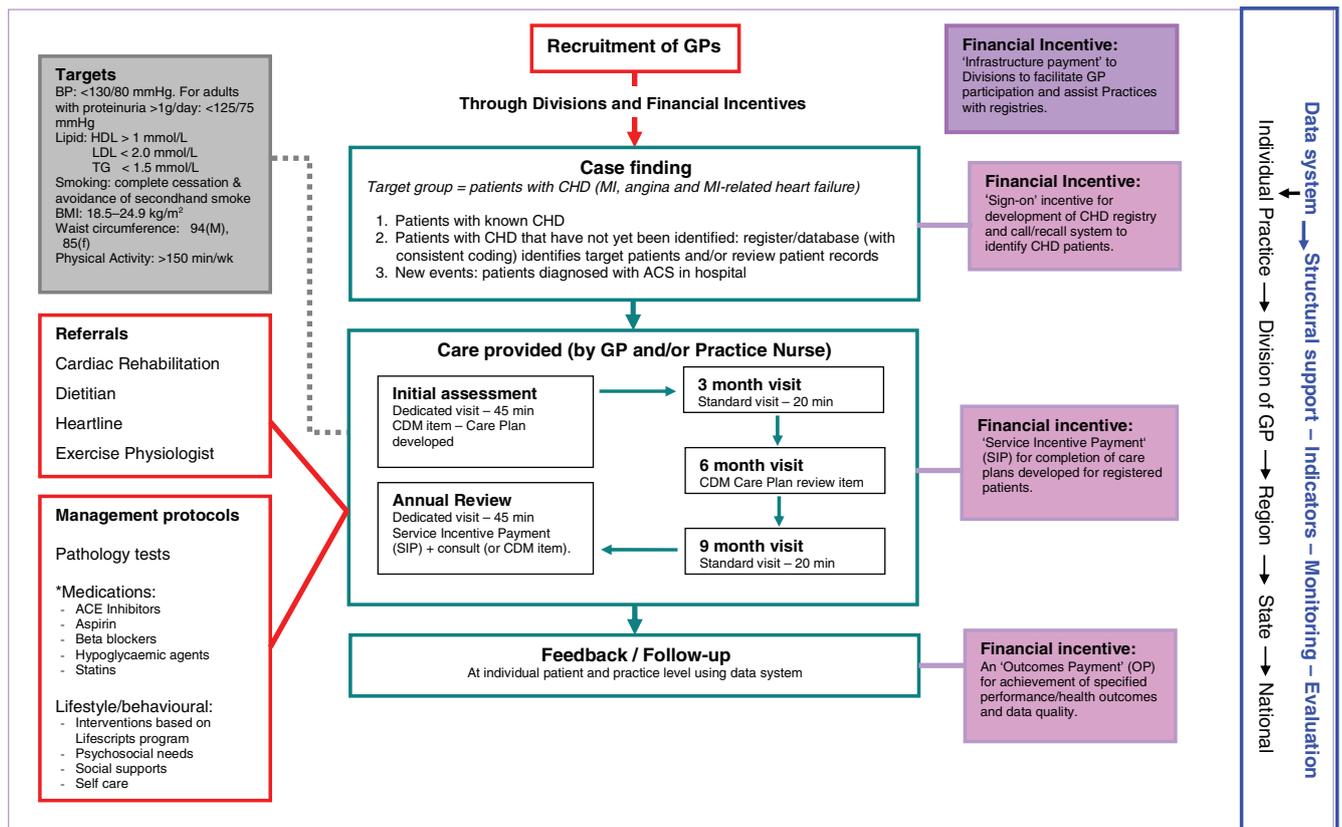
Important considerations in the development of any national program for CHD will be the potential impact on morbidity and mortality, combined with the likely cost-burden faced by the Australian taxpayer. To address these questions we sought to design and economically model a general practice-based chronic disease management program for patients with CHD.

Methods

An exploratory economic appraisal was undertaken, comparing the additional ‘net cost’ of the proposal (i.e. gross cost of the intervention minus anticipated cost offsets), with the attributable health benefits measured as quality adjusted life years. Costs and outcomes were assessed from a ‘health sector perspective’, but with a primary focus on ‘government as third party funder’. The analysis was undertaken using 2006 as the reference year, with a 3% discount rate applied to costs and health gains received in future years.

Proposed program

Key design features of the ‘General Practice-based CHD initiative’ include the establishment of practice-specific patient registers of CHD patients with recall mechanisms and provision of ‘cycles’ of assessment and care as outlined in Fig. 1. Specific interventions would focus on the initiation and maintenance of lifestyle changes, the quality use of guideline-advocated therapies, promotion of self-care and consideration of



*Tailored to concomitant disease, presence of myonecrosis with index event and tolerance with medications.

Fig. 1. Consultation and financial incentive elements of CHD initiative.

psychosocial needs. This multi-faceted approach is described in Table 1.

Following an initial assessment, review consultations occur every 3 months, with a reassessment at 12 months. This initiative would be supported by existing reimbursements for each of the consultations, as well as the introduction of financial incentives for maintenance of a data system addressing quality of care indicators and achievement of clinical outcomes.

Key contributors to the cost-effectiveness of such a program are: (i) the local burden of CHD morbidity and mortality; (ii) the health benefits achieved by the program; (iii) the uptake of the program; (iv) the costs of implementation; and (v) the likely cost offsets associated with the health benefits.

Burden of CHD in Australia

DALYs (disability adjusted life years) are a useful measure of health outcomes because they combine a measure for premature death (years of life lost, YLLs) and a measure of morbidity (years lived with disability, YLDs). Although DALYs originated as a descriptive measure (a summary measure of population health), they are now commonly used as an outcome measure in economic evaluations, because they are available based on consistent methods across a comprehensive range of diseases, illnesses and risk factors.¹⁰ Table 2 describes the CHD burden on which this analysis is based.

Program benefits

The estimated benefits of the initiative described have been derived from several sources, and include an assessment of the burden of CHD, the likely 'effectiveness' of the intervention and the anticipated uptake or reach of the program. In combination, these estimates enable a calculation of the 'impact' or total absolute benefit of the program. The estimation of 'effectiveness' was based on a systematic review that reported a 16% reduction in admissions to hospital, a 6% reduction in recurrent Myocardial Infarction (MI) and a 9% reduction in all cause mortality associated with multidisciplinary CHD management programs,¹¹ whereas the National Health Priority

Areas Report indicated a 15% reduction in coronary events and a 17% reduction in coronary deaths was possible with improved interventions for patients with CHD.¹² Therefore, a 15% reduction in DALYs, premature deaths and rehospitalisation was used in this analysis, with more pessimistic variations of 10, 7.5 and 5% run as a sensitivity analysis. The lower effectiveness assumptions were chosen to give an illustrative range of more pessimistic values, rather than to reflect specific trial evidence.

Estimates of uptake

Estimation of the program's reach was based on assumptions made regarding the proportions of patients with CHD visiting a general practitioner (GP), GPs willing to undertake the program, patients participating in the program and those patients completing the program (as detailed in Table 2). Estimates of uptake were derived from similar 'Practice Incentive Programs' for diabetes, asthma, and cervical cancer screening.¹³ For these parameters, 'low', 'medium' and 'high' rates were estimated, with the medium values used in the base-case analysis. It was also assumed that only full completion of the program would be associated with incremental benefits of reduction in premature CHD deaths and DALYs.

Estimates of cost

Costs assessed in the program include: (i) the financial incentives to facilitate general practice participation and rewarding of quality care; (ii) payment for annual cycles of consultations; and (iii) the effects on the health care system of improved quality of care (reduced hospital admissions and increased pharmaceutical, pathology, imaging and medical service costs). These costs are presented in Table 2.

Potential cost offsets resulting from a reduction in clinical events were discounted and lagged to account for the natural delay in program benefits. Additional costs such as time and costs of patient and carer travel, increased utilisation of allied health professionals, and the opportunity cost of less time in general practice for the treatment of other conditions were not assessed in this model. Furthermore, no attempt has been made to assess the impact of the proposal on the broader economy as a result of improved productivity.

Analysis and sensitivity analysis

The cost-effectiveness of the program was calculated as the projected net cost of the program divided by the projected DALYs prevented (see equation). All projected costs and benefits were discounted by 3% per annum to adjust for time preference (when costs are paid and benefits are received) and are expressed in real Australian dollars (to account for the impact of inflation), with 2006 as the reference year. An incremental cost-effectiveness ratio of <\$50 000 per DALY prevented was considered as the 'acceptable' threshold within the Australian health care perspective.

'Cost effectiveness' (incremental cost effectiveness ratio [ICER])
= net cost (\$)/net benefits (DALYs prevented)

The intervention was modelled using 'steady-state' analysis, whereby the intervention was assumed to be fully implemented

Table 1. Proposed general practice-based CHD initiative

Key components	
Initial and ongoing assessment	Disease risk: diabetes, hypertension and dyslipidaemia, and obesity Lifestyle and behavioural risks (smoking, alcohol, nutrition and physical activity) Psychosocial risk: depression and social isolation
Develop care and self-management plan	Medical plan (aspirin, statin, β -blockers, clopidogrel, \pm ACE-inhibition) with assessment of dosing, monitoring and compliance Lifestyle and behavioural interventions Depression management Social supports
Referral to other health-care settings	Nurse-led secondary prevention clinics Cardiac Rehabilitation Programs Specialist Cardiologist consultation
Data collection	Quality of care indicators Achievement of therapeutic goals Clinical outcomes

Table 2. Key assumptions

DALY, disability adjusted life year; YLD, year lived with disability (calculated for incident cases and for prevalent cases)

	Value	Range
CHD burden¹⁴		
Total DALYs due to CHD in Australia 2006 ^A	263 487	
Total YLDs due to CHD in Australia 2006 ^A	45 344	
Total deaths due to CHD in Australia 2006 ^A	28 207	
Program uptake		
Patients who visit a GP each year ^B	90%	85–100%
GPs likely to participate in scheme ^C	75%	60–80%
Patients who accept GP invitation to participate ^D	80%	70–90%
Patients attending full cycle of care ^E	70%	50–90%
Cumulative patient ‘reach’ for estimation of outcomes	40%	21–65%
Effectiveness^{11,12}		
Reduction in CHD premature deaths	15%	5–15%
Reduction in CHD DALYs	15%	5–15%
Costs		
Initial Assessment (CDM item 721)	\$122.40	
3 and 9 month review consultation (level B consultation)	\$31.45	
6 and 12 month review of care plan (CDM item 725)	\$61.20	
Sign-on payment for practice CHD register/recall system	\$1000 per GP	
Service incentive payment for completing cycle of care	\$40.00	
Quality outcome payment for achieving specified targets of coverage or quality outcomes ^F	\$7.44 million	
Infra-structural payments to Divisions to facilitate GP participation in CHD initiative ^F	\$4.08 million	
Increase in pharmaceutical costs	50%	
Increase in pathology and imaging costs	15%	5–15%
Decrease in hospitalisation costs	15%	5–15%

^AEstimates for 2003 taken as the estimate for our reference year of 2006.

^B‘High’ estimate assumes all CHD patients will see a GP at least once a year, as they have an important life threatening disease. ‘Low’ estimate assumes CHD patients will see a GP at the same rate as the general population (i.e. 85%) based on the BEACH²⁸ database. ‘Medium’ or most likely estimate is set between these two logical endpoints.

^CBased on Practice Incentive Program (PIP) data for diabetes, asthma and cervical screening published by the Medicare Australia website.¹³

^DResearcher estimate, confirmed by study Advisory Group.

^EA patient drop-out rate is assumed for the ‘high’ (10%), ‘medium’ (30%) and ‘low’ (50%) scenarios. The yearly drop-out estimate is pro-rated equally over the 3 month, 6 month, 9 month and 12 month follow-up visits. Only patients who complete the 12 month care program are assigned a health outcome benefit.

^FBased on number of practices receiving diabetes outcome payment 2005–2006.¹³

nation-wide, and operating in accordance with its efficacy/effectiveness potential. The gross costs of one representative year of ‘steady-state’ operation (2006) were compared with the anticipated health gains for CHD patients and associated cost offsets (lagged to reflect the anticipated year of receipt). This assumption was made to simplify the analysis and in recognition of the fact that the achievement of ongoing benefits for our 2006 cohort of CHD patients would be matched by ongoing expenditures (i.e. ongoing consultations and financial incentives to GPs).

In order to test the impact of several key assumptions, variances in several estimates were also tested in the model (refer Table 2). These included:

1. Higher and lower rates of ‘reach’ of the program (and associated costs), resulting from variations in the rates of:

- patients seen by GPs;
- GPs involved in the scheme;
- patient participation and completion of the program.

2. Lower estimated rates of program effectiveness representing more conservative estimates of program benefits and cost offsets.

Results

Estimated burden of disease

Using 2003 estimates of incident cases and prevalence of CHD, the estimated YLDs resulting from CHD were 45 344, YLLs were 218 143 and DALYs were 263 487. This last figure represents 10% of the total DALYs identified in the Australian burden of disease study.¹⁴

Estimates of program benefits

The base-case estimate of program uptake or ‘reach’ was 40% of patients with stable CHD (Table 2). Therefore, the estimates of DALYs attributable to CHD and the base-case estimate of a 15% reduction in DALYs indicate that a total of 15 625 DALYs would be prevented (14 311 DALYs after discounting by 3%). The higher rate of uptake (65%) would result in 25 716 undiscounted DALYs prevented (discounted by 3%: 23 554), whereas the lower rate of uptake (21%) would prevent 8271 undiscounted DALYs (discounted by 3%: 7576). ICERs for lower effectiveness assumptions of 10, 7.5 and 5% are presented in Fig. 2.

Program costs

The projected net cost of the program was AUS\$115.66 million. This comprised: \$116.23 million in patient consultations; \$34.34 million in increased pharmaceutical costs; \$5.75 million resulting from greater use of imaging and pathology services; and \$19.33 million for incentive payments facilitating program initiation and management. These total costs of \$175.65 million are off-set by a potential reduction in costs of hospital admissions of \$59.99 million. With the ‘high’ uptake estimate, total net costs were \$160.35 million, resulting from \$259.10 million in gross costs and \$98.74 million in savings from reduced clinical events; whereas the ‘low’ uptake would lead to a net cost of \$75.59 million, as a result of \$107.35 million in gross costs and a potential saving of \$31.7 million by reduced hospitalisations.

Cost effectiveness and sensitivity analysis

Using these base-case estimates of costs, program uptake and effectiveness results in an incremental cost effectiveness ratio (ICER) of \$8081 per DALY prevented, which is well below the \$50 000 per DALY benchmark currently deemed acceptable within the Australian health care environment. Exploring the impact of higher uptake, but lower efficacy

suggests that even with the most conservative estimates of benefit, such an intervention would provide benefits that remain well within an acceptable range for health care funding (Fig. 2). Furthermore, these results represent conservative estimates as benefits of the program have only been attributed to patients who have completed *all* consultations in *all* the sensitivity permutations.

Discussion

As a leading source of death and disability, CHD remains an important target for improving the health of Australians.⁸ To date, enormous human and financial resources have been devoted to research and development of effective therapies to reduce CHD death and disability. Yet, the magnitude of benefit promised by clinical trial data has not been realised in many sections of the community, despite the availability of these proven therapies in current clinical practice.¹⁵ The application of the clinical evidence remains an important limiting step in translating therapeutic innovation into improvements in patient outcomes.^{7,16} Bridging this barrier with a dedicated general practice-based, goal-oriented program appears very cost-effective with ICER estimates that are far superior to more novel therapeutic approaches currently undergoing intense research.

Acute mortality from CHD continues to decline with the development and widespread application of acute pharmacologic and procedural therapies. In contrast, the chronic burden from this disease is likely to increase. This is, in part, the result of the emerging epidemic of obesity and diabetes now faced in Australia, mirroring demographic patterns seen in many parts of the Western world, combined with the extended average life expectancy observed among Australians today.¹⁷ Effective management strategies to tackle the chronic burden of CHD are urgently needed to attenuate the impact of these demographic trends. Recognition of these needs has led to substantial research efforts seeking novel therapeutic agents and strategies targeting newly elucidated disease

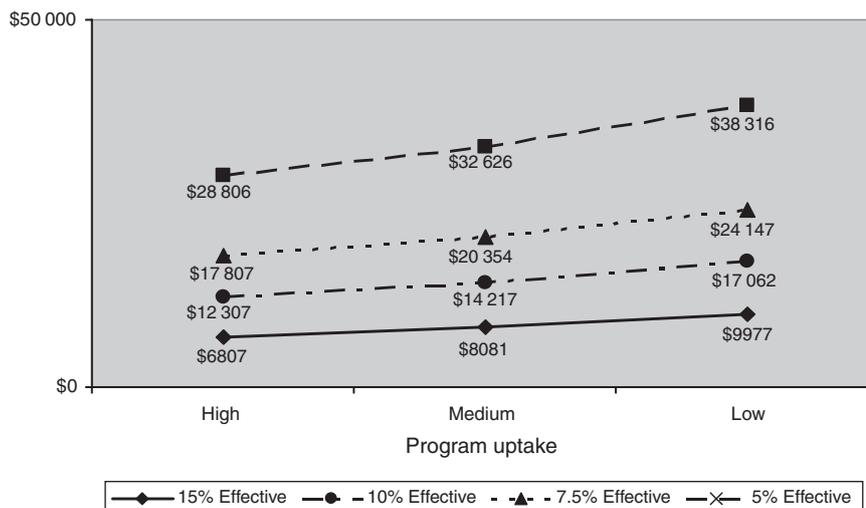


Fig. 2. Incremental cost-effectiveness ratios for base case estimates and sensitivity analysis based on variations in effectiveness and program uptake.

pathways, in the hope of capitalising on such technological and scientific advances as the decoding of the human genome and advances in stem cell technology.^{18,19} Yet, the past 3 decades of clinical research in cardiology have defined an ample array of therapeutic options for the treatment of easily identifiable clinical risk factors and behaviours that account for most of clinical risk. Recent studies suggest that up to 90% of all first MIs are accounted for by well established and modifiable risk factors,²⁰ and that very few (<3%) of all cardiovascular events occur in patients without any of the traditional risk factors (smoking, hypertension, diabetes, obesity and hypercholesterolaemia).²¹

Therefore, although the promise of novel scientific discoveries is attractive, substantial gains in health can be achieved with optimal application of the therapeutic strategies available to us today. However, the practical issues of compliance, optimising therapeutic choices in the face of intolerance to medications, achieving the required lifestyle modifications and the difficulty of attaining treatment goals for the management of hypertension, dyslipidaemia and diabetes potentially explain a large component of the residual risk and morbidity experienced by people with CHD.^{6,16,22,23} These issues represent obvious missed opportunities for providing clinical benefits in the ongoing struggle to contain the burden of CHD in the Australian community.

Although the evidence supporting current recommendations are robust, it is also recognised that effective implementation of optimal pharmacologic therapy and lifestyle modification for secondary prevention is time and resource intensive, and is therefore often challenging in general practice, where these activities compete with other priorities. Furthermore, efficacy often depends on the patient's initiative and self-motivation in achieving treatment goals. To date, evidence demonstrating the effectiveness of integrated programs for the management of CHD risk have been limited. However, investigators have been able to demonstrate both effectiveness and cost-effectiveness of such programs within our local context.^{22,24,25} Examples in other areas of chronic management have suggested that registries enabling the identification of 'at risk' individuals, a comprehensive treatment plan addressing several facets of management to reduce overall risk and clear treatment goals to facilitate compliance and long-term lifestyle modification are key aspects of successful disease management programs as seen in diabetes. Effective implementation of such a program for CHD will require dedicated infrastructure and reimbursements to overcome barriers specific to each practice, with incentive payments to reward the delivery of quality care. Although specifically addressing CHD, it would be logical and more efficient for such a program to build on and integrate with existing chronic disease payment and incentive initiatives in general practice such as the Diabetes Practice Incentive Program, Practice Nurse initiatives, Australian Primary Care Collaboratives and relevant Chronic Disease Management (CDM) items. As an initial step, 'pilot' programs and possibly even clinical studies incorporating randomisation clustered by general practitioner aimed at further defining the uptake and effectiveness, as well as the costs of such approaches are urgently required. Furthermore, specific programs evaluating this strategy among rural and indigenous patients are also

required. Such information would be of vital importance for refining the assumptions upon which this model is based, and provide a better assessment of the potential value of this approach.

Nevertheless, drawing from local data sources, this analysis suggests that a dedicated general practice-based program for the management of CHD is potentially very cost-effective, with an incremental cost-effectiveness ratio that is far superior to many of the emerging cardiovascular technologies, such as drug-eluting stents and implantable defibrillators.^{26,27} Such observations argue strongly for efforts to build capacity in the Australian general practice environment to enable chronic disease management programs. Even when the lowest relative effectiveness is modelled with the highest program uptake, these estimates of cost-effectiveness remain below the level commonly applied to novel pharmacotherapies. However, even given the extensive burden of CHD currently faced, net costs of approximately \$116 million are not inconsequential. Such estimates only serve to highlight the magnitude of the problem now faced, and the social and economic imperatives to address the problem of CHD in Australia.

Limitations

As with the majority of health economic analyses, these estimates are based on assumptions. Although some data regarding the uptake of similar programs indicate rates entirely consistent with those modelled here robust prospective data demonstrating the benefits and uptake of such a program would be valuable in refining the cost-effectiveness models (see <http://www.apcc.org.au>). However, it should be acknowledged that this equally applies to all new therapies and technologies, particularly when these factors are generalised beyond the clinical trial context, where the relative efficacy of these novel approaches cannot be assumed.

In addition, care should be taken in the interpretation of direct cost offsets from the potential reduction in hospitalisations. In reality, these are not true financial savings, but should be considered as 'opportunity costs'.

Finally, whereas 'myocardial infarction related heart failure' has been included in the baseline estimates of disease burden, the efficacy of this program in reducing DALYs and death in this group of patients is less certain. Nevertheless, among this high-risk group, efforts to improve compliance and lifestyle goal attainment are likely to have at least comparable benefits.

Conclusions

Although innovation in CHD management promises improved patient outcomes in the future, effective therapies and strategies for reducing morbidity and mortality are available today. A general practice-based program for the optimal application of these strategies and therapies is likely to be very cost-effective and provide substantial and sustainable benefits to the Australian community. Further, it is important to note that these promising cost-effectiveness credentials have been based on a stand-alone proposal of GPs preparing a CHD care plan as a dedicated activity. In reality, of course, CHD patients have comorbidities (e.g. diabetes) and GPs would be encouraged to

prepare one comprehensive care plan covering all conditions. The integration of a new dedicated CHD initiative with the existing diabetes initiative is a matter requiring careful consideration with stakeholders. If done correctly, such integration offers the potential for significant improvements for CHD patients, while at the same time achieving economies of scale.

Acknowledgements

This work was overseen by the National Heart Foundation of Australia CHD-GP Working Group. Members of the Working Group are as follows: Andrew Boyden (National Heart Foundation of Australia); Robert Carter (University of Melbourne); Derek Chew (Flinders University); Andrew Dalton (University of Melbourne, Adhealth); Helen Egan (National Heart Foundation of Australia); Lisa Gold (La Trobe University); Nancy Huang (National Heart Foundation of Australia); Jeanie McKenzie (National Heart Foundation of Australia); Bree Rankin (University of Melbourne); Anthony Scott (University of Melbourne); and Shiong Tan (General Practice and WA Health). We also acknowledge Peter Sexton and Eleanor Clune who reviewed and provided comments on this paper.

References

- 1 Australian Bureau of Statistics. Causes of death, Australia, 2007. Cat. no. 3303.0. Canberra: Australian Bureau of Statistics; 2009.
- 2 Antithrombotic Trialists Collaboration. Collaborative meta-analysis of randomised trials of antiplatelet therapy for prevention of death, myocardial infarction, and stroke in high risk patients. *BMJ* 2002; 324: 71–86. doi:10.1136/bmj.324.7329.71
- 3 LaRosa JC, Grundy SM, Waters DD, Shear C, Barter P, Fruchart J-C, Gotto AM, Greten H, Kastelein JJP, Shepherd J, Wenger NK. Intensive lipid lowering with atorvastatin in patients with stable coronary disease. *N Engl J Med* 2005; 352: 1425–35. doi:10.1056/NEJMoa050461
- 4 Cannon CP, Braunwald E, McCabe CH, Rader DJ, Rouleau JL, Belder R, Joyal SV, Hill KA, Pfeffer MA, Skene AM. Intensive versus moderate lipid lowering with statins after acute coronary syndromes. *N Engl J Med* 2004; 350: 1495–504. doi:10.1056/NEJMoa040583
- 5 Blood Pressure Lowering Treatment Trialists' Collaboration. Effects of ACE inhibitors, calcium antagonists, and other blood-pressure-lowering drugs: results of prospectively designed overviews of randomised trials. *Lancet* 2000; 356: 1955–64. doi:10.1016/S0140-6736(00)03307-9
- 6 Bhatt DL, Steg PG, Ohman EM, Hirsch AT, Ikeda Y, Mas J-L, Goto S, Liao C-S, Richard AJ, Röther J, Wilson PWF. International prevalence, recognition, and treatment of cardiovascular risk factors in outpatients with atherothrombosis. *JAMA* 2006; 295(2): 180–9. doi:10.1001/jama.295.2.180
- 7 Senes S, Penm E. Medicines for cardiovascular health: are they used appropriately? Cardiovascular disease series no. 27. Cat. no. 36. Canberra: Australian Institute of Health and Welfare; 2007.
- 8 Australian Institute of Health and Welfare. Heart, stroke and vascular diseases – Australian facts 2004. Cardiovascular Disease Series no. 22. AIHW cat. no. CVD 27. Canberra: Australian Institute of Health and Welfare and National Heart Foundation of Australia; 2004.
- 9 Sexton PT, Sexton TL. Excess coronary mortality among Australian men and women living outside capital city statistical divisions. *Med J Aust* 2000; 172: 370–4.
- 10 Mathers C, Vos T, Stevenson C. The burden of disease and injury in Australia. AIHW cat. no. PHE 17. Canberra: Australian Institute of Health and Welfare; 1999.
- 11 McAlister FA, Lawson FM, Teo KK, Armstrong PW. Randomised trials of secondary prevention programmes in coronary heart disease: systematic review. *BMJ* 2001; 323: 957–62. doi:10.1136/bmj.323.7319.957
- 12 Commonwealth Department of Health and Aged Care and Australian Institute of Health and Welfare. National health priority areas report: cardiovascular health 1998. AIHW cat. no. PHE 9. Canberra: Commonwealth Department of Health and Aged Care and Australian Institute of Health and Welfare; 1999.
- 13 Medicare Australia. Divisions of General Practice statistics reports; Practice Incentive Program (PIP) data tables. Available at: https://www.medicareaustralia.gov.au/statistics/div_gen_prac.shtml [verified 21 September 2006].
- 14 Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez AD. The burden of disease and injury in Australia 2003. PHE 82. Canberra: Australian Institute of Health and Welfare; 2007.
- 15 Steg PG, López-Sendón J, Lopez de Sa E, Goodman SG, Gore JM, Anderson FA Jr, Himbert D, Allegrone J, Van de Werf F. External validity of clinical trials in acute myocardial infarction. *Arch Intern Med* 2007; 167: 68–73. doi:10.1001/archinte.167.1.68
- 16 Vale MJ, Jelinek MV, Best JD. How many patients with coronary heart disease are not achieving their risk-factor targets? Experience in Victoria 1996–1998 versus 1999–2000. *Med J Aust* 2002; 176: 211–5.
- 17 Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases: part I: general considerations, the epidemiologic transition, risk factors, and impact of urbanization. *Circulation* 2001; 104: 2746–53. doi:10.1161/hc4601.099487
- 18 Miller DT, Ridker PM, Libby P, Kwiatkowski DJ. Atherosclerosis: the path from genomics to therapeutics. *J Am Coll Cardiol* 2007; 49: 1589–99. doi:10.1016/j.jacc.2006.12.045
- 19 Barile L, Chimenti I, Gaetani R, Forte E, Miraldi F, Frati G, Messina E, Giacomello A. Cardiac stem cells: isolation, expansion and experimental use for myocardial regeneration. *Nat Clin Pract Cardiovasc Med* 2007; 4(Suppl. 1): S9–14. doi:10.1038/necpcardio0738
- 20 Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanus F, McQueen M, Budaj A, Pais P, Varigos J, Lisheng L. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet* 2004; 364: 937–52. doi:10.1016/S0140-6736(04)17018-9
- 21 Vasan RS, Sullivan LM, Wilson PWF, Sempos CT, Sundström J, Kannel WB, Levy D, D'Agostino RB. Relative importance of borderline and elevated levels of coronary heart disease risk factors. *Ann Intern Med* 2005; 142: 393–402.
- 22 Vale MJ, Jelinek MV, Best JD, Dart AM, Grigg LE, Hare DL, Ho BP, Newman RW, McNeil JJ. Coaching patients On Achieving Cardiovascular Health (COACH): a multicenter randomized trial in patients with coronary heart disease. *Arch Intern Med* 2003; 163: 2775–83. doi:10.1001/archinte.163.22.2775
- 23 Simons LA, Ortiz M, Calcino G. Persistence with antihypertensive medication: Australia-wide experience, 2004–2006. *Med J Aust* 2008; 188(4): 224–7.
- 24 Redfern J, Ellis E, Briffa T, Freedman SB. Modular prevention of heart disease following Acute Coronary Syndrome (ACS). *BMC Cardiovasc Disord* 2006; 6: 26. doi:10.1186/1471-2261-6-26
- 25 Briffa TG, Eckermann SD, Griffiths AD, Harris PJ, Heath MR, Freedman SB, Donaldson LT, Briffa NK, Keech AC. Cost-effectiveness of rehabilitation after an acute coronary event: a randomised controlled trial. *Med J Aust* 2005; 183(9): 450–5.

- 26 Buxton M, Caine N, Chase D, Connelly D, Grace A, Jackson C, Parkes J, Sharples L. A review of the evidence on the effects and costs of implantable cardioverter defibrillator therapy in different patient groups, and modelling of cost-effectiveness and cost-utility for these groups in a UK context. *Health Technol Assess* 2006; 10(27): 1–164.
- 27 Lord SJ, Howard K, Allen F, Marinovich L, Burgess DC, King R, Atherton JL. A systematic review and economic analysis of drug-eluting coronary stents available in Australia. *Med J Aust* 2005; 183: 464–71.
- 28 Britt H, Miller GC, Knox S, Charles J, Pan Y, Henderson J, Bayram C, Valenti L, Ng A, O'Halloran J. General practice activity in Australia 2004–05. General Practice Series no. 18. AIHW cat no. GEP18. Canberra: Australian Institute of Health and Welfare; 2005.

Manuscript received 2 February 2009, accepted 3 July 2009