

# The current cost of angina pectoris to the National Health Service in the UK

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**Objective:** To calculate the cost of angina pectoris to the UK National Health Service (NHS) in the year 2000.

**Methods:** Calculation of the cost of hospital admissions, revascularisation procedures, hospital outpatient consultations, general practice (GP) consultations, and prescribed drug treatment.

**Results:** 634 000 individuals (1.1% of the UK population) consulted GPs 2.35 million times, costing £60.5 million. They required 16.0 million prescriptions (cost £80.7 million) and 254 000 hospital outpatient referrals (cost £30.4 million). There were 149 000 hospital admissions, 117 000 coronary angiograms, 21 400 coronary artery bypass operations, 17 700 percutaneous coronary interventions, and 516 000 outpatient visits, at a cost of £208.4 million, £69.9 million, £106.2 million, £60.7 million, and £52.2 million, respectively. The direct cost of angina was therefore £669 million (1.3% of total NHS expenditure), with hospital bed occupancy and procedures accounting for 32% and 35% of this total, respectively.

**Conclusions:** Angina is a common and costly public health problem. It consumed over 1% of all NHS expenditure in the year 2000, mainly because of hospital bed occupancy and revascularisation procedures. This is likely to be a conservative estimate of its true cost.

Angina pectoris affects 2–3% of the population, or up to two million men and women in the UK.<sup>1–5</sup> As well as having reduced quality of life and functional capacity, affected individuals usually need long term drug treatment and to have regular contact with a general practitioner (GP).<sup>2–5</sup> Because patients have a threefold increased risk of developing unstable angina (UAP) and myocardial infarction, they also often require emergency hospital admission.<sup>1–5</sup> Coronary artery bypass grafting (CABG) and percutaneous coronary interventions (PCIs) are also increasingly employed in patients with angina. Both procedures are expensive, and the cost of PCI has risen with the wider use of intracoronary stents to prevent restenosis at the site of the target lesion.<sup>6</sup> Consequently, it is likely that angina imposes a large economic burden on the health care systems of developed countries. However, there are few data that quantify this burden—particularly within a whole population.

Our aim was therefore to examine the cost of angina in the UK, as a proportion of total health care expenditure, using contemporary and detailed information not previously available.<sup>2–4 7–10</sup>

## METHODS

A prevalence based approach was used to estimate the economic burden of angina.<sup>11 12</sup> Estimates of prevalence, healthcare utilisation, and costs were obtained from a systematic review of published reports and contemporary official web sites. These were applied on an age and sex specific basis to official mid year population estimates for the UK (population 59 million).<sup>13</sup> In all cases, where a range of estimates was available we used the most conservative alternative.

## Community based health care

### General practitioner consultations

Age and sex specific rates of GP consultations were obtained from the information and statistics division of the National Health Service (NHS) in Scotland (ISD). As we have reported previously,<sup>11 12</sup> this division routinely collates data from a

number of general practices serving a representative sample of the Scottish population (51 at the time of our data extraction). These data are used to compile the Scottish continuous morbidity record (CMR).<sup>7</sup> All GPs involved in this scheme routinely collect information on each patient consultation, providing a list of diagnoses (including angina pectoris) for that particular consultation. This information is regularly audited and validated before official entry into the dataset. As the current dataset only provides the major cause of consultation—based on the same type of adjustment used in our previous economic analyses<sup>11 12</sup>—we applied age and sex specific ratios to calculate the additional number of GP consultations where angina pectoris was likely to be a major contributory factor. These ratios, based on the ratio of hospital admissions where angina is either recorded as a principal diagnosis or as the second diagnosis (data obtained from ISD), range from 1.6 in those aged less than 45 years to 3.2 in those aged 85 years or more. The overall estimated rates of consultation were then cross checked with alternate data from other parts of the UK.<sup>5 14</sup> We adopted a conservative assumption that one in 10 consultations occurred in the patient's home, consistent with other estimates.<sup>14</sup>

### General practice referrals to outpatient clinic

Previous UK data suggest that about 20% of patients with angina will be referred to a specialist outpatient clinic by their GP.<sup>15 16</sup>

### Drug prescriptions

We used a contemporary UK study of the pattern of medical treatment in patients with angina,<sup>3</sup> in addition to data

**Abbreviations:** CABG, coronary artery bypass grafting; CMR, continuous morbidity record; GP, general practitioner; ISD, information and statistics division of the NHS in Scotland; NHS, National Health Service; PCI, percutaneous coronary intervention; SMR, Scottish morbidity record scheme; UAP, unstable angina pectoris

generated by IMS Health Ltd, which monitors the prescribing patterns of 500 GPs from around the UK according to the World Health Organization *International classification of diseases*, to estimate the proportion of patients prescribed the major classes of drugs used to treat angina (aspirin,  $\beta$  blockers, calcium antagonists, and nitrates).<sup>17</sup> Based on these two sources, and in keeping with our previous studies,<sup>11, 12</sup> we assumed an average of eight (individual) prescriptions per patient per annum. These data were compared and validated using official statistics on prescribing.<sup>8, 9</sup>

### Hospital based health care

#### Hospital admissions

As reported previously, hospital admission rates and length of stay for the year 1995 were obtained from the Scottish morbidity record scheme (SMR) database maintained by ISD.<sup>18, 19</sup> Only admissions with a principal discharge diagnosis of UAP, angina pectoris, or "chest pain" leading to coronary angiography were considered. These data were then applied on a sex and age specific basis and to the overall UK population. They were also cross checked with British Heart Foundation statistics.<sup>10</sup>

#### Coronary angiography and revascularisation procedures

Information on coronary procedures was obtained from ISD and a recent report from the Scottish coronary revascularisation register (for the period 1997 to 1999).<sup>18-20</sup> These sources allow exclusion of all procedures associated with acute myocardial infarction. They also provide data on the rate of intracoronary stent placement<sup>21</sup> during PCI, and the number of patients undergoing a repeat bypass procedure—both of which influence the cost. We applied these data to the whole of the UK on an age and sex specific basis. We cross checked our data on PCI and CABG with the British Heart Foundation statistics.<sup>10</sup>

#### Postdischarge outpatient clinic visits

As before,<sup>11, 12</sup> we assumed that each "live" discharge associated with one of the aforementioned diagnoses, not leading to long term care, would be followed by an average of three postdischarge visits to an outpatient clinic, and that these would be specific to the unit from which the patient was discharged. We also assumed that each CABG and PCI would require two additional specialist outpatient appointments per patient.

### Cost of angina related health care

Each of these components of health care expenditure was summed to estimate the overall cost of the management of angina pectoris in the UK during the calendar year 2000. This cost was then compared with total NHS related health care expenditure for that year.<sup>22</sup>

### Community based health care

We used available average costs of a GP consultation (according to whether this took place as a "surgery" appointment or a home visit) and of a GP referral to a hospital outpatient clinic.<sup>23, 24</sup> For both types of consultation it was assumed that the cost of investigations (for example, ECG and exercise testing) are incorporated into the cost of the visit. The average cost of a prescription for each of the major classes of drug used to treat angina in the UK was obtained from IMS Health Ltd, which records the number and cost of sales of pharmacological agents to retail pharmacies from wholesalers.<sup>17</sup> A 10% dispensing cost was added.

### Hospital based health care

The costs associated with hospital admissions and postdischarge outpatient clinic visits were obtained from an audit of Scottish health care provision costs for the 1999/2000 financial

year beginning in March 1999 and published by ISD.<sup>24</sup> This report provides health care expenditure data for the whole of the NHS in Scotland and on a hospital specific basis. Hospital expenditure associated with length of stay was stratified on an age and sex specific basis and according to the type of unit in which the hospital stay occurred. These cost estimates are inclusive of all health care expenditure associated with a hospital admission. We have not therefore calculated inpatient pharmacotherapy and routine procedural costs as separate components of expenditure.

### Procedures

The average cost of coronary angiography and revascularisation procedures were derived from official estimates from the NHS in the UK for the year 2000.<sup>22</sup> Separate costs were applied to PCI with and without stent placement and for CABG being undertaken for the first or second time. We also calculated the additional cost of antiplatelet treatment following these procedures.<sup>19</sup>

### Sensitivity analyses

Because of uncertainties surrounding some of the resource utilisation estimates (for example, the number of hospital admissions), likely changes in treatment practice in the near future, and other measures (such as prevalence rate), various sensitivity analyses were undertaken. Those having a significant effect on the overall cost of angina are described further. These included costing for:

- a higher prevalence of angina (20% greater)
- a larger number of hospital of admissions (10% more)
- a 1.6-fold increase in the population rate of revascularisation (CABG and PCI) in line with the average equivalent rate of revascularisation in western continental European countries when adjusting for the age of the population and gross domestic product of the UK<sup>25</sup>
- a higher rate of statin prescribing (particularly in the light of recently published data suggesting the benefits of a greater uptake of this treatment).<sup>26</sup>

## RESULTS

### Cost of community based health care

#### General practitioner consultations

The number of men and women consulting a GP for angina in 2000 was estimated at 327 000 and 307 000, respectively, accounting for approximately 1.17 million male and 1.18 million female consultations.<sup>7</sup> This ratio of 3.6 and 3.8 GP consultations per male and female patient, respectively, is consistent with previous reports.<sup>7</sup> At an average cost of £22 per consultation (and £59 per domiciliary visit),<sup>22, 23</sup> total expenditure for GP consultations in the year 2000 was £60.5 million.

#### General practitioner referrals to outpatient clinic

Assuming that 20% of the 634 000 patients with angina attended an average of two hospital outpatient visits (at a cost of £120 per visit)<sup>23</sup>—that is, leading to a total of 254 000 consultations—this component of health care expenditure cost £30.4 million.

#### Drug prescriptions

Table 1 summarises the cost volume and cost of prescribing for angina. These 16 million prescriptions cost the NHS £80.7 million (including 10% pharmacy dispensing costs). This represents an average prescription cost of £30.91 per GP consultation for these patients (approximately one third greater than the national average for the entire patient population).<sup>27</sup>

### Cost of hospital based care

#### Hospital admissions

In the year 2000 there were approximately 80 100 male and 60 500 female admissions with a discharge diagnosis of

**Table 1** Number and cost of prescriptions for angina pectoris in the UK during 2000

Class of drug (% prescribed)	Number of prescriptions	Total cost
Aspirin (90%)	4.6 million	£3.0 million
β Blockers (60%)	3.1 million	£8.7 million
Calcium antagonists (50%)	2.5 million	£21.5 million
Nitrates, oral and patch (50%)	2.6 million	£10.7 million
Nitrates, sublingual (90%)	1.3 million	£2.0 million
Statins (25%)	1.2 million	£17.4 million
Potassium channel activators (18%)	0.9 million	£10.2 million
Total	16.0 million	£73.4 million

angina pectoris or unstable angina. There were a further 4400 male and 4200 female admissions with a principal diagnosis of “chest pain” leading to coronary angiography—representing approximately 9% of discharge diagnoses for chest pain.

Overall, these admissions accounted for a total of 264 400 and 267 700 days of hospital admission in men and women, respectively. The specific daily costs we applied to geriatric, general medical, coronary care, and intensive care units for the year 2000 were £127, £220, £521, and £1385, respectively.<sup>24</sup> The overall bed-day costs of male and female hospital admissions were therefore £108.6 million and £99.8 million, respectively—a total of £208.4 million.

#### Procedures

We estimated that 117 400 coronary angiograms were undertaken in the year 2000. At an average cost of £595 per procedure,<sup>19–22</sup> the total was £69.9 million.

Approximately 21 400 CABGs and 17 700 PCIs were undertaken. The average cost of a PCI without stenting was £2500, while the use of stenting increased the cost to £3900 (the incremental expense of each intracoronary stent being £400–600).<sup>6–21</sup> Short term antiplatelet treatment was estimated to cost an additional £88 per procedure.

The average cost of a “first time” CABG was estimated to be about £4900, and the cost of a repeat procedure approximately £1000 more.<sup>19–22</sup>

The cost of PCI without stenting was estimated to be £17.7 million, and PCI involving stent placement cost an additional £41.4 million. The estimated cost of antiplatelet treatment after PCIs was £1.6 million.

The cost of CABG was estimated at £106.2 million (this includes £6.4 million for repeat procedures).

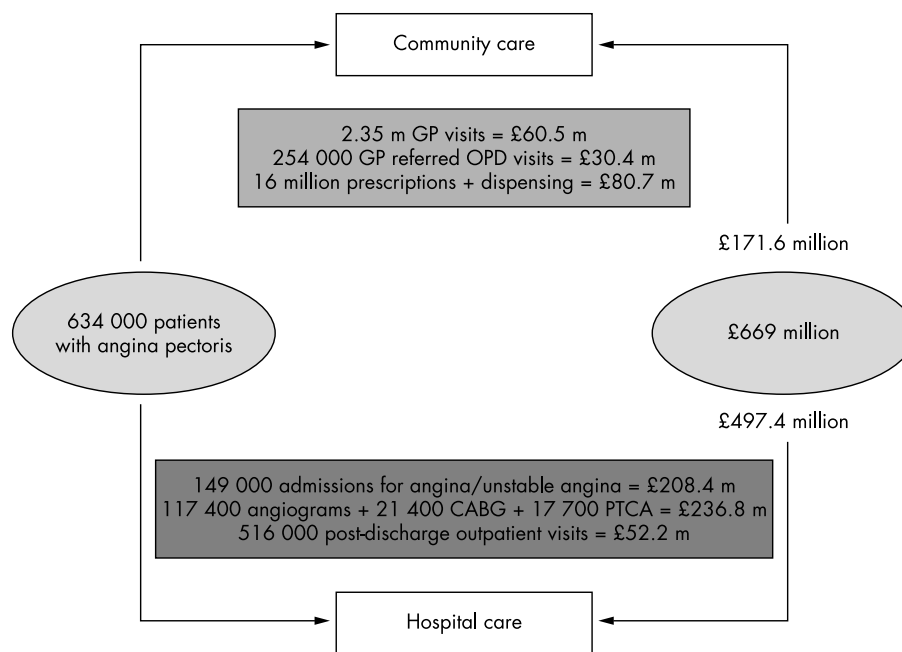
The total cost of revascularisation (over and above the cost of hospital bed utilisation and routine coronary angiography) was therefore estimated to be £166.9 million.

#### Postdischarge outpatient visits

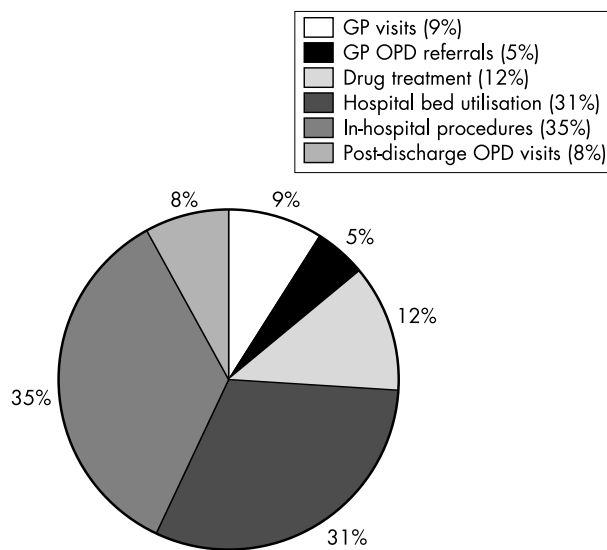
Based on the estimated number of “live” male (78 300) and female (59 200) hospital discharges associated with a principal diagnosis of angina pectoris or unstable angina, and the assumption of an average of three outpatient visits per patient for those not discharged to long term community care (with an average cost per visit ranging from £85 for a general medical assessment to £120 for a specialist cardiology assessment<sup>24</sup>), total expenditure for this component of health care was calculated to be £40.3 million (comprising 235 000 male and 177 500 female consultations, respectively). The additional cost of the 25 400 outpatient consultations for those patients who had a discharge diagnosis of chest pain and underwent a coronary angiogram was estimated to be £2.5 million. It was further estimated that an additional 42 800 and 35 400 specialist outpatient consultations after CABG and after PCI, respectively, would have occurred in the year 2000. At an average cost of £120 per visit, this component of expenditure was estimated to be £9.4 million. The overall cost of these outpatient consultations was therefore estimated to be £52.2 million.

#### Total health care expenditure relating to angina pectoris in 2000

Based on these conservative estimates, we have calculated that the total cost of health care activity directly attributable to angina pectoris was £669 million in the year 2000 (fig 1). In the same year, the cost of health care provided by the NHS for the whole of the UK was estimated to be £52 billion.<sup>22</sup> Angina therefore directly contributed to 1.3% of such expenditure. The major component of overall cost was hospital admission, particularly those involving a revascularisation procedure (a total of £445.9 million, representing 67% of angina related activity and 0.86% of NHS expenditure for that year) (fig 2).



**Figure 1** Components of the overall cost of angina pectoris to the UK National Health Service (year 2000). GP, general practitioner; m, millions; OPD, outpatient department.



**Figure 2** Proportion of overall cost of angina pectoris accounted for by individual components of health care activity. GP, general practitioner; OPD, outpatient department.

**Sensitivity analyses**

Figure 3 summarises the results of the series of one way sensitivity analyses. If the prevalence of angina were 20% higher than in our base estimate, the total cost would increase by £34.9 million. A 10% increase in angina related hospital activity would increase costs by £25.1 million. Similarly, a 1.6-fold increase in revascularisation rates (equivalent to the average rate of revascularisation in continental European countries) would raise costs by £106.6 million. Finally, an increase in statin use to the equivalent of treating 50% of men and women with angina would increase costs by £20.9 million.

**DISCUSSION**

As expected of a common condition that requires long term pharmacological treatment, that leads to frequent hospital admissions, and which often needs expensive interventions, angina is a very costly problem for the NHS in the UK. Our analysis shows that angina “directly” consumes about 1.3% of total health care expenditure. Hospital activity, and particularly revascularisation procedures, comprise the largest component of this expenditure (about two thirds). This economic burden is likely to remain high or even grow. As the population progressively ages and survival rates for patients with ischaemic heart disease steadily improve, the prevalence of angina may not decline.<sup>28</sup> However, expensive invasive procedures and costly new drugs are likely to be used more commonly, leading to a relative rise in health service expenditure.<sup>21–25</sup> In any such accounting exercise it is, however,

important to make a careful assessment of the assumptions used in calculating the component costs of the total estimate.

**Analyses of component costs**

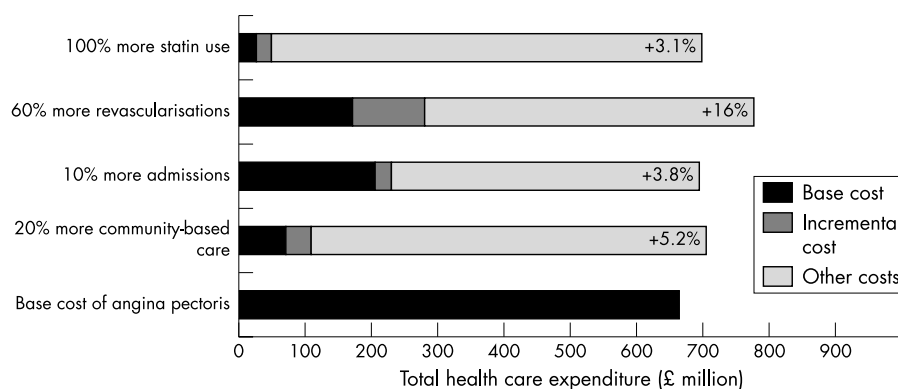
**GP consultations**

The first component was GP consultation rates. At first sight, the number of patients seems small in comparison with the reported prevalence of angina, which is much higher in many other studies. For example, when we applied data from recent British<sup>24</sup> and European<sup>29</sup> epidemiological studies to the UK population on an age and sex specific basis, we estimated that in the year 2000 there were about 2.21 million men and women with symptoms consistent with angina pectoris. This figure is just over three times greater than our estimate of the number of patients being actively treated for angina (634 000 individuals, representing 1.1% of the UK population in 2000). However, it is recognised that epidemiological studies using tools such as the Rose angina questionnaire<sup>30</sup> inflate the prevalence of angina. Our estimate of the number of consultations is very much in keeping with the finding of the Health Survey for England (1993)<sup>31</sup> that 1% of the population report grade 2 (more severe) angina, compared with 3–4% reporting any angina. Both this 1% figure and our consultation estimate from the CMR dataset (1.1%) are also consistent with a report from the Office of Population Censuses and Surveys (1995) and a recent study indicating that approximately half a million patients with angina in the UK consult their GP each year.<sup>14–32–33</sup> Furthermore, the proportion of men reporting Rose angina grade 1/2 symptoms has fallen from 3.2% in the 1994 Health Survey for England questionnaire to 2.6% in 1998, while the proportion of women has remained stable at 3.2%.<sup>4</sup> The sensitivity analysis suggested that a 20% increase in the population prevalence of angina would increase the total number of patients being treated in the community to about 761 000 and cost an additional £27.1 million in associated health care costs.

Our estimate of GP costs should also be considered conservative as we did not specifically include items such as ECG recordings or visits to practice nurses—both of which are estimated to cost around £7 per item.<sup>23</sup> Our estimated rate of GP to hospital outpatient referral (20%) is consistent with contemporary UK studies.<sup>5–16</sup>

**Hospital admissions**

As noted above, the largest component of the overall cost of angina to the NHS is related to hospital admissions. Here it is difficult to know precisely how many admissions to hospital are the result of angina. Many patients are admitted with “chest pain” that is not coronary in origin. Some patients, however, have angina but are not labelled as such. As a compromise we included admissions coded as angina or unstable angina and “chest pain” admissions associated with coronary angiography. The total number of such cases was 149 200.



**Figure 3** Summary of the sensitivity analyses.

Obviously, this figure is subject to imprecision but agrees with a British Heart Foundation estimate of 144 670<sup>10</sup>—the estimated ratio of patients being managed in the community to those treated in hospital being approximately one to six. This latter figure is consistent with previous epidemiological surveys in the UK suggesting that 9% of patients with angina will require hospital admission per year (allowing for the fact that not all the patients who are in hospital will have been attending their GP with angina beforehand).<sup>5</sup>

Again, our cost of hospital care should be considered a relatively conservative estimate of the true cost. A small proportion of patients admitted with angina will go on to have myocardial infarction in hospital and be coded as such at discharge. Bed day (and procedural) costs will not, consequently, be attributed to angina in these cases. It is important to note that we applied an average daily cost of around £250 to estimate the cost of hospital care, whereas other estimates suggest that the true cost for cardiac patients could be up to £450.<sup>22</sup> Therefore, even when considering the separation of revascularisation costs in this analysis, our estimate of this component of activity remains conservative. Another potential cost underestimate in relation to hospital admissions concerns cardiac rehabilitation. At least some patients admitted with angina (as well as patients undergoing PCI and CABG) participate in a postdischarge rehabilitation programme. Unfortunately, we can find no reliable estimate of the numbers of patients and costs involved, although we have most probably accounted for some of these costs in estimating hospital expenditure. A contemporary UK report suggests that approximately 15% of all cardiac patients receive this form of management,<sup>34</sup> and another estimated that the median cost of a rehabilitation programme per patient was £360.<sup>35</sup> On the basis of these and our own estimates of the patient population, this component of activity would have cost the NHS an additional £72 million in the year 2000 for those patients with a primary discharge diagnosis of angina pectoris.

#### Revascularisation procedures

The other major contributors to the overall cost of angina are PCI and CABG. We were able to get reliable numbers for both these procedures and to adjust for procedures carried out after myocardial infarction (a concomitant diagnostic coding was available). Our finding that about 6% of men and women with angina per annum undergo a revascularisation procedure is in keeping with other British studies.<sup>32, 33</sup> In particular, the British Heart Foundation estimated that in 1998 approximately 28 000 CABG procedures and 25 000 PCIs were undertaken, for all indications, in the UK.<sup>10</sup> Our estimates of 21 400 CABGs and 17 700 PCIs for angina in the year 2000 are consistent with these figures. A recent study has shown that population rates of revascularisation procedures in the UK fall well short of those in other countries in central Europe.<sup>25</sup> When applying average European population rates of revascularisation to the UK in the sensitivity analysis, we showed that any attempt to replicate such rates would have required approximately 23 000 more procedures at an additional cost of £106.6 million in the year 2000.

#### Drug treatment

Lastly, we obtained a contemporary record of GP prescribing for angina. The number of prescriptions supplied by IMS UK Ltd (about 13 million in the year 2000) equates closely with the number of patients consulting for angina (635 000) and the proportion of those prescribed the major classes of drug used to treat angina, assuming the issue of eight prescriptions per patient per annum. These data are also consistent with official reports of prescribing rates.<sup>8, 9, 11</sup>

As expected, the sensitivity analysis showed that pharmacological agents, particularly those that reduce subsequent

morbidity,<sup>26</sup> represent a cost effective means of reducing the overall burden of a disease state. For example, if the number of prescriptions for statins were doubled in the identified patient population (a realistic scenario given the proven benefits of applying statins in this context<sup>26</sup>), this would only increase the overall financial burden of angina by 3%.

#### Cost comparisons with other disorders

To provide a perspective, previous analyses of ours using identical methods have estimated the direct costs of heart failure<sup>11</sup> and atrial fibrillation<sup>12</sup> to the NHS in the year 2000 to be £905 million and £459 million, respectively. Other analyses using similar but less conservative approaches have calculated the cost of health care expenditure in the UK associated with disease states such as stroke, diabetes, and epilepsy. In 2000 cost equivalents, these have been estimated at £1100 million,<sup>36</sup> £900 million,<sup>37</sup> and £190 million a year,<sup>38</sup> respectively.

The proportion of the overall cost of angina (£669 million in the year 2000) contributed by each component examined in this analysis resembles that of other chronic diseases such as heart failure<sup>11</sup> and stroke,<sup>36</sup> where hospital admissions account for the lion's share of cost. Conversely, with other chronic illnesses such as asthma<sup>39</sup> and hypertension,<sup>40</sup> drug treatment accounts for the bulk of expenditure. The pattern of expenditure for a given disease often indicates targets for therapeutic intervention that can reduce costs, and identifies potentially cost effective treatments. Clearly, treatments either preventing the development of heart disease or altering its natural history of long term morbidity within a whole population are likely to be cost effective overall (by reducing hospital admission and revascularisation rates) and have a major impact on the burden imposed by angina in particular.

#### Limitations

This study, like any other of its kind, has certain limitations. Some of these have been described above. One not discussed is the extrapolation of Scottish rates of GP consultation, hospital admission, and revascularisation to the UK as a whole. The prevalence of heart disease is greater in Scotland than in some parts of England (a greater socioeconomic gradient in heart disease related events in Scotland being an important consideration<sup>28</sup>); hence our data may inflate the overall UK cost of angina marginally. Conversely, we could not calculate the cost of accident and emergency department visits not leading to hospital admission. We know of no source of accurate data on such visits. Moreover, because reliable information is unavailable, we were also unable to calculate the indirect costs of angina (for example, those related to loss of employment), which are also likely to be substantial.<sup>32</sup>

#### Conclusions

Angina pectoris exerts a huge economic burden on the NHS in the UK, and the majority of the direct health care costs of this condition relate to hospital admission and revascularisation procedures. This is likely to be true for other developed countries—particularly in those countries with relatively high population rates of revascularisation.<sup>25</sup> Clearly there is a need to develop and apply cost effective strategies that reduce the need for hospital treatment (and in particular, revascularisation procedures) in this patient population.

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