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DISEASE MANAGEMENT PROGRAMMES FOR MAJOR DEPRESSION: MAKING THE FINANCIAL CASE

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ABSTRACT

Depression is a significant burden for the United Kingdom economy and despite conclusive evidence on the clinical efficacy of treatments and acknowledgements of the impact on quality of life, a high proportion still goes undiagnosed and untreated. The purpose of this paper is to present the economic case for a more structured approach to depression management, using techniques from the disciplines of health economics and actuarial science to demonstrate cost-effectiveness and return on investment. The results are presented first as an economic cost-effectiveness analysis, comparing the benefits of additional quality-adjusted life years (QALYs) with the costs, and secondly as a financial projection model of costs and savings, familiar to actuaries.

The results of the model show that from a societal perspective, disease management programmes for depression are likely to both reduce costs and increase quality of life for patients in the overall adult population. This is also true from the perspective of an employer who has the cost burden of direct medical costs and sickness absence. For a healthcare payer who is not bearing the cost of sickness absence, such as a primary care trust (PCT) or private insurer, disease management programmes are likely to improve quality of life, but increase direct healthcare costs. However, the additional cost per QALY is well below the commonly used threshold in the U.K. of £30,000; therefore, most health economists would deem disease management programmes for severe and moderate depression to be a good use of public healthcare funds. The actuarial calculations, which show an internal rate of return for 45% to 50%, validate this conclusion.

KEYWORDS

Depression; Disease Management; Cost-Effectiveness; Analysis; Actuarial Modelling; Healthcare

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1. Background and Context

1.1 *Introduction*

1.1.1 This paper examines the financial and economic case for a more

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structured approach to the management of moderate to severe depression in United Kingdom (U.K.) primary care. The paper presents the results of a model that examines the incremental costs and benefits associated with the introduction of a United States (U.S.A.)-style depression-specific disease management programme (DMP) in a U.K. population.

1.1.2 Actuaries in the U.K. have not traditionally been involved in calculations to test the financial benefits of specific treatment protocols, instead leaving such estimates to health economists. However, in the U.S.A., many health actuaries are intimately acquainted with the claimed and actual cost savings from DMPs and are used to statistically validate the Return on Investment from both internal health insurer and external vendor programmes. One of the background purposes of this paper is to educate actuaries in two areas a) around the statistical issues encountered when attempted to test whether or not a DMP is financially viable and b) understanding the key differences between the approach an actuary might take to such calculations and the differing approach taken by health economists. I firmly believe these two approaches are complementary and that actuaries and health economists have much to learn from each other and hope the two groups of professionals can find more opportunities to work together.

1.2 *The Depression Burden*

1.2.1 Depression is a significant burden on the worldwide economy. Studies have suggested that the direct and indirect costs of depression in Europe amount to 1% of European Union (E.U.) GDP (Sobocki *et al.*, 2006). A U.S.-based study put the annual costs of depression in 1990 at $43.7bn, of which $23.8bn were indirect costs arising from workplace absenteeism and low productivity (Greenberg *et al.*, 1993). Over the last few years, there has been increased worldwide recognition of these economic costs and efforts have been made to increase awareness, remove some of the social stigma associated with mental health, and improve detection and treatment.

1.2.2 There is still plenty of evidence of considerable under-diagnosis and under-treatment (Sturm *et al.*, 1998). Some U.S. studies suggest that only 25% to 30% of people with depressive disorders receive effective levels of treatment (Young *et al.*, 2001; Wang *et al.*, 2000). In 2004 the U.K. National Institute for Clinical Excellence (NICE) estimated that only 37.5% of patients presenting with depression in primary care are diagnosed accurately (NICE Guideline on Depression, 2004). Diagnosis is often difficult because many patients present with primary physical symptoms, such as insomnia (Kirmayer *et al.*, 1993), and may be reluctant to believe they have depression. Unless general practitioners (GPs) are alert to the likelihood of depression, patients tend to receive treatment for physical symptoms rather than any underlying mental conditions.

1.2.3 Anti-depressants require time to work, can have unpleasant side

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effects, and need to be continued for a period after the patient recovers to minimise the probability of relapse. These factors can dissuade patients from completing the prescribed course, resulting in low treatment compliance rates and high relapse rates. Patients may prefer to undergo psychotherapies rather than take medication, but an under-supply of trained psychologists and therapists means that talking therapies have traditionally had long waiting lists in many parts of the U.K. (Wooster, 2008).

1.2.4 In 2004 NICE recognised the importance of better quality of care for depression and recommended case management and other intensive interventions. In recent years, the Quality and Outcomes Framework (QOF) gives GPs economic incentives to diagnose and provide enhanced care for some specific populations with depression.

1.2.5 Diagnosed depression prevalence is thought to be increasing in most developed countries. This is possibly due to greater awareness of the disease and hence greater willingness on behalf of patients to seek help, along with a more sympathetic reception from GPs. Evidence also suggests that depression prevalence is higher among populations with chronic physical diseases such as diabetes (Anderson *et al.*, 2001). With the prevalence of diabetes and other chronic physical diseases increasing, the population prevalence of depression is also likely to increase without better treatment. Reducing the initial incidence of depression is not straightforward and therefore it is important to find ways to reduce the length of initial acute episodes, and prevent relapse and recurrences, to help manage population prevalence (Katon, 1997).

1.3 *Disease Management Programmes*

The use of DMPs is widespread in the U.S., and the concept is becoming increasingly popular in the U.K. DMPs are used to manage patients with chronic and long-term conditions who tend to be high users of both emergency care and health services in general. A large proportion of their use of health services is attributed to poor self-management of the primary disease, lack of knowledge by the patient, and lack of co-ordination of care by health delivery systems. It is hypothesised that a co-ordinated programme will improve the standard of life of the patient, improve the quality of medical care delivered, and reduce overall long-term costs to the economy.

1.4 *Depression-Specific DMPs*

There are numerous examples of depression-specific DMPs in the U.S.A. These range from programmes targeted at all patients presenting in primary care with major or minor depression to programmes aimed at specific depressed population, such as patients with co-morbid diabetes or coronary heart disease (National Pharmaceutical Council, 2003). Some DMPs have been developed by large healthcare payers such as Kaiser Permanente and others by niche DMP vendors. Most large U.S. healthcare insurers now have

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a depression-specific DMP, although some are presentational for the purposes of marketing to new customers and make little real clinical or financial impact on their populations.

2. Defining A Disease Management Programme (DMP)

2.1 *Terminology*

2.1.1 The terms 'disease management', 'chronic disease management', and 'long-term condition management' are generally assumed to be equivalent. This paper uses the terminology 'Disease Management' (DM) to refer to all these types of programmes.

2.1.2 Many people use the terms 'disease management' and 'case management' interchangeably without a clear definition of each term. However, in their pure forms, each type of programme has distinct characteristics and the terms are not completely equivalent, although both represent approaches to co-ordinating care delivery (Crippen, 2002). DMPs focus on populations with a specific chronic diagnosis and aim to follow evidence-based clinical practices to give the best outcomes for that diagnosis and reduce the risk of future complications. Case management programmes are usually focused on high-cost complex patients with many emergency admissions and a range of co-morbidities. The focus of case management is on co-ordinating the many different services that patients require and improving their overall health and reducing cost by pro-actively managing their journeys through the system. While each type of programme may contain elements of the other, they are not the same.

2.2 *A Definition of Disease Management*

2.2.1 The Disease Management Association of America (DMAA) defines disease management at a conceptual level:

> "Disease management is a system of co-ordinated health care interventions and communications for populations with conditions in which patient self-care efforts are significant. Disease management supports the physician or practitioner/patient relationship and plan of care, emphasizes prevention of exacerbations and complications utilizing evidence-based practice guidelines and patient empowerment strategies, and evaluates clinical, humanistic, and economic outcomes on an ongoing basis with the goal of improving overall health. Disease management components include:
>
> - population identification processes;
> - evidence-based practice guidelines;
> - collaborative practice models to include physician and support-service providers;
> - patient self-management education (may include primary prevention, behaviour modification programmes, and compliance/surveillance);
> - process and outcomes measurement, evaluation and management; and
> - routine reporting/feedback loop (may include communication with patient, physician, health plan and ancillary providers, and practice profiling)."

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2.2.2 In practice, most DMPs consist of the following (Johnson, 2003):

- Identifying and enrolling people suffering from a chronic disease via analysis of historic claims data, health-risk assessment forms, referrals from GPs, or some kind of predictive model or screening process.
- Stratifying patients to determine appropriate levels of intervention and guidelines for enrolling/discharging patients from the programme.
- Outbound telephone calls by nurses/case managers to assess patient's state of health and willingness to participate and to determine their level of knowledge and awareness of disease.
- Development of a care plan for each patient, based on evidence-based clinical guidelines.
- Tools to measure functional quality of life and report on compliance of patients.
- Ongoing mail, e-mail, and telephone calls to the patient to provide education, support, and encouragement and to adjust the care plan as necessary.
- GP education to raise awareness and tools to determine physician compliance with evidence-based care protocols.

2.2.3 In the U.S.A., many DMPs are delivered by specialist companies who contract with health insurers and the government to provide specific services to their disease populations. However, some insurers have developed their own in-house DMPs, or have purchased an existing DM company to bring the expertise in-house.

2.2.4 In the U.K., some DM companies work in niche areas and some insurers and primary care trusts (PCTs) develop their own version of a DMP, but the programmes tend to be much less ubiquitous and comprehensive than in the U.S.A.

2.3 *Typical Diseases in a DMP*

2.3.1 Most DMPs have traditionally covered the most common chronic physical conditions with potential high-cost complications, such as diabetes, congestive heart failure, asthma, coronary heart disease, chronic obstructive pulmonary disease and stroke. However, in the last few years, other conditions (including mental health, HIV-AIDS, and End Stage Renal Disease) have started to be offered by DM companies in the U.S.A.

2.3.2 The main requirements for developing a DMP tend to be that:

- The disease is highly prevalent.
- Successful management of the disease is likely to involve behavioural and lifestyle change by the patient, requiring education and support.
- There is a high cost of mismanagement in terms of future complications, emergency hospital admissions, and overall future health.

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- The management of the disease would benefit from more integrated care delivery by the most appropriate clinicians.
- Successful management has a large impact on overall health and quality of life.
- Ongoing monitoring of the disease is important to pick up potential complications.

2.4 *Why Include Depression in a DMP?*

2.4.1 While it is accepted that the most common physical chronic diseases such as diabetes and coronary artery disease fulfil the criteria listed above, it is less obvious that mental health can be classified this way. However, depression is increasingly recognised as a chronic disease characterised by multiple acute episodes/relapses (Hirschfeld, 2001). Early recognition of the signs of relapse can lead to appropriate interventions, which help to avoid or minimise the impact of the acute episodes.

2.4.2 Studies have shown that GP education to raise awareness of depression and hence increase the accuracy of diagnosis and effectiveness of treatment has little long-term improvement in clinical outcomes (Thompson *et al.* (2000), Worrall *et al.* (1999)). GP and patient educational strategies, along with GP access to psychiatrists and other specialists, improve outcomes, but still have limited clinical effectiveness (Bosmans *et al.* (2007), Worrall *et al.* (1999)). However, two 2003 meta-analyses examined the evidence for educational and organisational interventions to improve the primary care treatment of depression and concluded that complex strategies that incorporated a range of interventions and greater co-ordination by healthcare professionals were effective in improving patient outcomes (Badamgarav *et al.*, 2003; Gilbody *et al.*, 2003).

2.4.3 Patient self-management is more important for good clinical outcomes in depression than simply providing physicians with education. However, the ability of patients to self-manage is dependent on the quality of collaboration between medical providers and the patient. Depression care could be improved by a combination of better co-ordination of care services, better GP and specialist education, more patient support and a greater supply of appropriate services and trained therapists. A DMP can deliver most of the elements required to help patients manage their depression successfully and therefore improve outcomes (Von Korff *et al.*, 1997).

3. Measuring the Cost-effectiveness of DMPs

3.1 The U.S.A. and the U.K. tend to have different approaches to measuring the cost-effectiveness of health interventions. These alternative measures of the cost-effectiveness of healthcare have evolved as a response to market imperfections (see Box 1) and resulting incentives in each type of

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Box 1: Why are healthcare markets economically imperfect?

Economists have a range of simplifying assumptions used to underpin market analyses. Unfortunately almost all the assumptions fail in the healthcare market, for various reasons. Two of the key reasons are:

- ***Perfect information:*** *Health markets do not have perfect information and information is asymmetric, i.e., it is not equally available to all parties. Quality of healthcare and health gain is difficult to judge, especially for individual consumers without specialist knowledge, but also for private health insurance companies that are usually footing the bill. Private insurance companies find it hard to improve the quality of care because of the resistance of the providers of healthcare to "interference" by commercial entities.*
- ***Third-party payers:*** *In most healthcare markets, the patient is not directly responsible for paying the healthcare costs at the point of service in full. In a mainly privatised system like the United States, the payer is likely to be a commercial insurance company. Many government programmes such as Medicare (for seniors) are also run by commercial insurance companies, although the bill is ultimately paid by the government and hence taxpayers. In most European systems, the payer is likely to be the government in some form and therefore taxpayers.*

In addition, the consumer may not even pay the premium directly, let alone the cost of the health service. In many partially or fully privatised health systems, the employer rather than the consumer pays the health insurance premium and therefore decides on the health insurer.

health system. This section discusses the two main methodologies used, the theoretical background underlying each approach, and their advantages and disadvantages.

3.2 Firstly we discuss a return on investment (ROI) methodology and why it is predominant in the U.S.A. Secondly, we discuss standard economic cost-effectiveness analysis (CEA) and how and why this has developed in countries with socialised health systems.

3.3 *The Financial ROI Measurement*

3.3.1 In health systems where private payers are more dominant, the cost-effectiveness of a DMP is measured primarily using financial ROI

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models. These models ignore health gains, but include the medical service utilisation and costs of the managed population with and without a DMP in place and therefore measure cost-savings as:

Cost Savings = A − B − C where:

A = Expected cost of the medical services supplied to a population in Year X without a DMP
B = Actual cost of the medical services supplied to a population in Year X with a DMP
C = Cost of the DMP.

3.3.2 To estimate the *expected* cost of the medical services supplied, the costs of the population in the period before the implementation of the DMP are trended forward to the period after the implementation of the DMP (also referred to as the 'pre-/post-method of measurement').

3.3.3 Early measurements of the effectiveness of disease management in the U.S.A. centred on ROI metrics devised by DM companies, with cost-savings methodology built into contracts between payers and the DM companies. These methodologies were based on observational studies of claims data, with limited or no control groups. Although some consensus has been reached on the methodologies used by actuaries to calculate cost-savings and hence ROI, DMP savings are still the topic of heated discussion as awareness of the underlying analytical problems inherent in the ROI measures has grown (Mirkin *et al.*, 2004; Disease Management Work Group of the American Academy of Actuaries, 2007).

3.3.4 In addition, DM companies in the U.S.A. often attempt to measure health outcomes and quality as part of the reporting process. However, these are rarely linked explicitly to cost in a way that enables comparison of the effectiveness of a DMP with alternative investments in healthcare and therefore the main measure of a DMP is the ROI. Possible reasons for the use of this methodology are discussed below.

3.4 *The Profit Motive and Market Failure*

3.4.1 A profit-maximising private company wants to attract customers, maximise the perceived value of insurance bought and therefore the price that can be charged, and minimise the costs of providing the service (such as claims cost and commissions). For a private company, the fundamental question is: "How can a DMP help me maximise profits in a competitive market?"

3.4.2 If markets were fully transparent with perfect information and consumers bore the full cost of health insurance, then consumers would presumably buy their insurance on the basis of the company that would provide the maximum expected health gain for their premium. Consumers would be free to determine where to spend their health insurance premium on

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the basis of their income level and optimising their health gain for the cost they are willing to pay. Private insurance companies would also try to maximise profits by achieving the maximum health outcome for their members for the money spent. This would lead payers to seek ways to measure health outcomes per unit cost.

3.4.3 However, because healthcare markets are imperfect and consumers do not have direct information on health outcomes, they are more likely to make purchases of health insurance on the basis of proxies for health gain such as access, waiting times, preferred doctor, or quality of customer service in paying claims rather than health gain and quality of medical services paid for and supplied. They even make their choices based on the premium levels, in the belief that higher premiums imply more services of higher quality. In addition, health gains can be realised over long time frames. In a competitive market model where patients move between employers and/or health insurers every few years, the health-maximising incentive is diluted considerably for a commercial insurer.

3.4.4 These issues lead to a dependence on ROI models in isolation, without robust consideration of health benefits and gains.

3.4.5 Although private health insurance companies are profit-maximising in their pure form, many countries try to meet their health policy objectives by imposing government targets on health gains and outcomes that private payers must meet. However, these are generally very crude and likely to be process- rather than outcome-driven.

3.5 *The Health-Economic CEA*

3.5.1 Within socialised health systems where the government is the primary or only payer, the most common tool for measuring cost-effectiveness is the CEA. This health-economic analysis attempts to estimate a cost per unit of 'health gain', where health gain can be measured in a number of different ways, such as QALY, disability adjusted life year (DALY), or numbers of pain-free days. By converting health outcomes to one standard measure, such as a QALY, cost and outcomes can be linked and health interventions compared explicitly.

3.5.2 The theory underlying CEAs is that scarce resources should be distributed where the most health gain can be achieved for a given amount of money. At a government level, the CEA tries to ensure a rational framework for allocating resources, across all types of public spending. For a government, the key question is: "What is the opportunity cost to society of producing additional health gain and how can this be balanced with other spending priorities, both within health and against other government programmes, e.g., social services, defence, or transport?"

3.5.3 Therefore, a cost per QALY measure from a CEA gives some ranking of this programme compared with others and some way of prioritising for governments looking to allocate overall budgets efficiently.

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This is why CEA is more popular in countries with socialised health systems where the government is the primary payer.

3.5.4 However, a standard CEA does not tell a payer the financial effect of implementing a DMP in a way that is helpful for budgeting. It is therefore of limited value by itself for a payer who must develop forecasts of health revenue and expenditure in order to present a business case for investment in a DMP. While a CEA can theoretically be extended to assist the budgeting process, this rarely happens. CEAs are often presented as academic pieces of theoretical work, and are rarely understood or used by private payers and decision-makers.

3.5.5 It is also worth commenting here that the use of QALYs is not without contention. QALYs are measured on a scale of 0 to 1, with a QALY of 1 denoting a year in perfect health, a QALY of 0 denoting death and states of imperfect health assumed to be between 0 and 1.* An intervention that gives 5 more years of life, but with the patient in imperfect health (say a state of health which is associated with a QALY of 0.5), would be assumed to produce 2.5 QALYs. However, deriving and attributing the value of QALYs associated with a particular disease state requires indirect methods of measurement, which are necessarily somewhat subjective. In addition, there are arguments to say that the methodology is implicitly ageist, because an intervention performed on a younger patient is more likely to produce a high number of QALYs than the same intervention performed on an older person, simply because the younger person is likely to have a higher life expectancy. Williams (1985) describes the rationale behind the development of QALYs.

3.6 *Equating the Two Perspectives*

3.6.1 From a theoretical perspective, the ROI and CEA models can be equated, given some simplifying assumptions and taking the financial ROI model one step further to attribute an explicit cost to a health gain. Box 2 illustrates this using a basic example. Note that this simplified example only considers a single year viewpoint, whereas in practice, it is the results over many years that are important.

3.6.2 However, as we have already discussed, healthcare markets are imperfect and complex. In particular, when a patient is not paying for his or her own healthcare, the decision on whether to fund treatment is taken by a third-party payer, rather than the patient; the perspective and incentives facing the third-party payer drive the decision on whether or not to fund a DMP. Because of the unique characteristics of a healthcare market, the

* It is theoretically possible to have a QALY < 0 if the state of health is assumed to be worse than death.

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Box 2: A simplified example

1. *A patient with diabetes costs £1,000 on average in terms of medical services used in Year X and has a QALY of 0.8.*
2. *In Year X+1, the patient has use of a DMP, which costs £200 per patient to provide. However, the DMP decreases the medical expenditure by £150 to £850 and increases the patient's QALY score to 0.9.*
3. *CEA would say that an additional QALY of 0.1 has been provided at an incremental cost of £200 − £150 = £50. This gives a cost per QALY of £500.*
4. *Financial ROI would say that the cost per patient has increased from £1,000 to £1,050, once the cost of the programme has been taken into account, giving £50 incremental cost, or net saving of −£50. Clearly this is a negative ROI.*

incentives and drivers experienced by government and private payers tend to differ and therefore their decision-making process leads to reliance on one of the two models described above, without consideration of the other perspective.

3.6.3 In a perfectly functioning market, standard economics will dictate that the DMP is worth investing in from the patient's point of view as long as the patient is willing to pay *at least* £500 per additional QALY. The amount the patient is prepared to pay will depend on his or her state of health in the first place,* along with income level and the opportunity cost of the other goods forgone to buy the additional QALYs. However, assuming the patient is prepared to pay more than £50 for his additional 0.1 QALY, both the CEA and the financial ROI model will give the same answer: the CEA says that the willingness to pay (WTP) is above the threshold of £500 per QALY and the financial ROI model shows a positive ROI for the patient, as the value of what he has gained is greater than the value of the money forgone.

3.7 *Decision-Making under Uncertainty*

Unfortunately, real healthcare markets are nowhere near this efficient. The first problem we must deal with is that the cost in Year X + 1 (E) is not known with certainty by the patient. Our theoretical model must take into account that the patient is working on *expected costs* when the decision

* According to the law of diminishing returns, the patient is likely to have a greater willingness to pay for additional health gains if his or her state of health is low in the first place — the higher the initial state of health, the less the patient is willing to pay for incremental health gains.

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is made to purchase, rather than actual costs. However, to deal with this additional complication, we can assume that the patient's E is £1,000 and proceed as before. However, if the DMP can reduce *variation* in costs and outcomes as well as expected costs, and the patient is risk-averse, he or she may have a higher willingness to pay to reflect the reduction in risk.

4. Practical Issues in Measurement

4.1 Cost-effectiveness for DMPs is hard to measure under *all* theoretical measurement models. DMPs are not single clinical interventions that can be compared easily with the next-best alternative, such as the dispensing of one drug compared with another in a randomised controlled trial (RCT). Instead, DMPs are a bundle of often nebulous actions taken by different stakeholders and they place a heavy reliance on the buy-in of patients and changes in patient and physician behaviour.

4.2 There are two primary methods of obtaining data on the effectiveness of DMPs. The first is to look at costs alongside clinical outcomes in RCTs. The second involves observational studies where the costs for a group of patients are considered before and after the DMP is implemented.

4.3 Historically, RCTs have been used for CEA by health economists, while observational 'pre-and-post' studies have been used by actuaries to measure cost savings. There are advantages and disadvantages with both methods, discussed below.

4.4 *RCTs*

4.4.1 In a traditional RCT, patients are randomly assigned into an intervention or control group and then studies look at the outcomes and costs of the two groups over a specified period of time. Ideally, to avoid the study measurement itself affecting outcomes, neither the patient nor the GP would know into which group each patient falls. However, when the intervention is a DMP where the patient must actively participate, it is almost impossible to design a study with blinding. To circumvent this issue, 'cluster RCTs' with GP practices randomised are sometimes used rather than individual patients.

4.4.2 Under a cluster RCT design, GPs may still act differently when they know that a DMP is available, which could contaminate the results of the trial. Arguably, again, this is a desirable part of the DMP and therefore valid. However, it is difficult to 'match' GP practices with similar enough patient profiles in terms of demographics and morbidity — if the patient profiles are not similar, or the methodology cannot easily adjust for the differences, the outcome of the trial could be affected significantly.

4.4.3 The advantage of RCT methodology is that the outcomes of two

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patient groups over the same period of time can be compared side by side. The effects of any confounding factors that may have been introduced over time (for example, a new payment method for physicians or hospitals) can be eliminated, as they should affect both groups equally. However, RCTs are expensive to carry out and therefore tend to be used on a small scale. This gives rise to problems with sample size and statistical significance and means it is difficult to ensure both intervention and control populations have similar demographic and health status profiles. RCTs often have low external validity and therefore extrapolation of the results of one RCT to another environment may result in invalid conclusions and flawed decision-making.

4.4.4 RCTs also have to contend with ethical issues because, by design, they have to exclude sick patients from the benefits of the intervention being tested. However, several larger RCTs for DMPs have been initiated by the U.S. Medicare programme in the last few years.

4.5 *Observational Studies*

4.5.1 The ethical and practical difficulties and costs in designing large-scale RCTs is one of the reasons that financial ROI models have tended to use other types of data, such as observational studies.

4.5.2 This method involves following the costs and outcomes of a specified population pre- and post-implementation of a DMP, using historical data rather than alongside a clinical trial. The main advantage of an observational study is that it may be easier and cheaper than an RCT. The sample sizes also tend to be relatively large, which lead to fewer problems with statistical significance of results. However, observational studies have many drawbacks, including the difficulties of comparing pre- and post-programme costs on the same basis. Trends in healthcare costs and medical practices must be taken into account, which is often problematic.

4.6 *Regression to the Mean*

4.6.1 Regression to the mean is a key reason why measurement of clinical effect can be so difficult in 'before and after' studies. It occurs because patients are generally identified and invited to join a trial following an expensive acute event or an abnormal clinical result, such as a high score on a depression scale. However, the event or reading may be atypical due to random variation and not reflective of the true average cost or true average clinical reading. When costs or clinical outcomes are measured during a follow-up period, they are naturally lower and closer to the true long-term average. By recruiting patients into a DMP at this point in time and comparing their costs or outcomes pre- and post-DMP, you would naturally expect to see a reduction in costs and better clinical readings once the DMP is in place, but some of the beneficial effects would have happened naturally.

4.6.2 Both observational and RCT studies suffer from this phenomenon,

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but in an RCT it will be controlled to some extent, provided the patients are recruited at a similar point in their disease progression. Both the intervention and the control group will experience regression to the mean, but the differences in the post-DMP costs in the two groups can be compared on the same basis. With observational studies, it is extremely difficult to control for regression to the mean. This has been a major issue with most DMP ROI and cost-effectiveness measurement in the U.S.A. (Mirkin *et al.*, 2004), Academy Health Issue Brief (2003)), almost all of which has been based on observational studies comparing pre- and post-enrolment costs over a period of time.

4.7 *Selection Bias*

Selection bias is the second key reason why measurement of the effectiveness of DMPs is difficult and applies mainly to pre- and post-observational studies. In trials or studies where patients have the choice of whether or not to participate in a DMP, the patients who are more motivated or aware of their own health are more likely to agree to participate. This 'self-selection' means that patients in the DMP are naturally more likely to be compliant with treatment and engage with the programme and therefore have better outcomes, regardless of the actual DMP. It could be argued that, as patient-engagement is a key predictor of the success of any DMP, this effect is valid, but it does mean that caution should be used when assuming the treatment effects of the DMP can be replicated among whole populations.

4.8 *Specific Issues for Measuring Depression DMPs*

In addition to the issues discussed above, which are common to the measurement of most clinical interventions, measuring the cost-effectiveness of DMPs for depression has some additional challenges.

4.8.1 *Productivity costs*

A large part of the economic and societal burden of depression relates to lost or reduced workplace productivity (Sobocki *et al.* (2006), Greenberg *et al.* (1993), Kessler *et al.* (2006), Stewart *et al.* (2003), Simon *et al.* (2000a)). To be a true measure of cost-effectiveness from a societal perspective, the measurement of DMPs should take account of indirect costs and benefits rather than just medical treatment costs borne by health insurance or government payers. However, productivity costs and benefits are difficult to measure accurately at a population level.

4.8.2 *Extrapolation of costs and benefits*

Depression is a long-term chronic disease. However, most existing studies look at short to medium-term outcomes to judge cost-effectiveness. It is therefore necessary to extrapolate the costs and effects to estimate the likely

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outcome on quality of life and costs over the period of the patient's lifetime in order to measure cost-effectiveness. Whether or not this is possible will depend on the appropriateness of the benefit measure. If a clinical trial measures a specific outcome, such as the probability of a relapsing major depressive episode within a certain time frame, this is more difficult to extrapolate to a measure of quality of life over an extended number of years than if the clinical trial attempts to measure QALYs in the original trial. Any measurement of healthcare service use and costs should also take place over an appropriate time frame.

4.8.3 *External validity*

Depression also affects specific populations differently. It is a likely co-morbidity of many physical diseases, especially for elderly populations, and there is considerable debate about whether depression can *cause* physical co-morbidities, as well as be present as the *effect* of physically debilitating illness. This causes two issues in the measurement of cost-effectiveness:

- Whether measurement should include the costs and benefits of physical co-morbidities.
- Whether a study in one specific population can be generalised to provide assumptions for a model centred on a different population.

4.8.4 *Comparison of DMP to an alternative*

To judge the incremental cost-effectiveness of a depression DMP, the costs and benefits of the programme must be compared to a credible alternative. In clinical trials for a new drug used to treat a disease, the credible alternative is usually either the existing drug, or 'no drug'. For a DMP, the obvious alternative would be 'current treatment', but this will vary significantly by doctor, area of the country, supply of medical services, and patient.

4.8.5 *Discount factors*

If costs and benefits accrue over a long period of time, the choice of discount factors may be critical to the results. The U.K. NHS specifies that a risk-free rate of return should be used to discount costs and benefits and compare the results with other types of interventions, currently 3.5% per year. A private payer would typically have a risk-adjusted 'hurdle' rate of return to judge different interventions.

5. Existing Cost-effectiveness Analyses of DMPs for Depression

5.1 A large body of literature exists on the clinical outcomes of different treatments for depression. A considerably smaller amount of literature has been published on the cost-effectiveness of specific treatments for depression,

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and a smaller still amount addressing the cost-effectiveness and clinical outcomes of collaborative care programmes and other methods of co-ordinating care that mimic some of the aspects of DMPs. Because it is difficult to find non-academic ROI studies on DMPs for depression, this section reviews the academic literature, which mainly concerns CEA studies.

5.2 Most of the existing DM studies focus on the treatment of patients with diagnosed depression. Very few studies examine the effect of the programme on the initial diagnosis rates and detection of depression. A 2003 meta-analysis (Badamgarev *et al.*, 2003) cited three such studies, of which only one showed statistically significant increases in detection and diagnosis (Callahan *et al.*, 1994). Studies show that systematic screening can increase detection rates by between 10% and 47% (Pignone *et al.*, 2002).

5.3 A meta-analysis (Gilbody *et al.*, 2006) reviewed 11 CEAs for 'enhanced primary care for depression' conducted over a 10-year period. The meta-analysis identified nine U.S.A. studies (Katon *et al.*, 2002; Simon *et al.*, 2000a; Simon *et al.*, 2000b; Simon *et al.*, 2001; Simon *et al.*, 2002; Pyne *et al.*, 2003; Schœnbaum *et al.*, 2001; Lui *et al.*, 2003; Von-Korff *et al.*, 1998), but just two U.K.-based studies (Thompson *et al.*, 2000), Gask *et al.* (2004), both of which reviewed physician-education interventions, rather than full DM-type models of care. There is a severe scarcity of primary evidence on the cost-effectiveness of a full-scale DM model in a U.K. setting. Gilbody's study concludes that interventions based on a DM-type model result in better outcomes, but increased costs of between £7 and £13 per additional depression-free day. This study does not attempt to convert depression-free days into QALYs and therefore it is difficult for U.K. policymakers to compare these findings directly with the cost-effectiveness of other medical interventions.

5.4 In addition, the majority of the U.S. clinical and CEA papers on depression derive from a series of studies in one particular academic healthcare system in the North West region of the U.S.A. This affects the transferability of these findings to other populations and geographical regions; demographic and socio-economic characteristics may differ elsewhere, as well as the prevalence of physical co-morbidities.

5.5 The organisation structure of healthcare systems and the way physicians are reimbursed may have significant effects on clinical and cost outcomes. The results of U.S. studies are affected by insurance bias. For example, control and intervention treatments in RCTs will have different numbers of visits to GPs, psychiatrists, hospitals, mental health professionals, and psychotherapists, as well as differences in drug prescriptions. Within the U.S. system, each of these usually means a different cost incurred by the patient. Therefore, the extent to which a patient is compliant with a treatment protocol is influenced by their financial circumstances, as well as clinical outcomes.

5.6 Generally speaking, these issues are not as important in the U.K.,

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where few services incur patient copays. Therefore translating the results of U.S. studies to a socialised system such as the NHS is particularly problematic.

5.7 Another issue concerns the definition of depression. The U.K. uses International Classification of Diseases 10 (ICD-10) coding, which allows for distinctions between mild, moderate, and severe depression. The U.S.A. uses ICD-9 and makes a distinction only between mild/minor and major depression. Most U.S. studies on the cost-effectiveness of DMPs for depression have focussed on major depression. Those that have considered mild or minor depression have concluded that the evidence for cost-effectiveness is considerably weaker than for more seriously depressed patients (Von Korff *et al.*, 1998).

5.8 *Interventions*

5.8.1 Ignoring the interventions that focus just on improving clinical education and have proven ineffective (Thompson *et al.*, 2000), the DMP interventions used in the CEA literature have some common elements:

- Promoting adherence by GPs to evidence-based guidelines by educational seminars, leaflets, and/or videos.
- Distribution of educational material for patients and caregivers.
- Nurse-based (either specialist or non-specialist) follow-up care to improve patient adherence to prescribed anti-depressants and/or psychotherapy programmes; this may be either telephone or face-to-face patient visits with nurses or other case managers.
- Co-ordination of care between GPs, specialists, and nurses/case managers, with GPs having access to specialist advice on treatment and drug therapies for specific depressed patients.

5.8.2 In addition, interventions in some studies provided easier access to talking therapies and psychiatrists than generally available under the usual care.

5.8.3 The studies examined did not look specifically at cost-effectiveness between different types of treatment, i.e., psychotherapy or drug treatment. Instead, the studies assumed that the GP and patient in collaboration would choose the most clinically appropriate treatment initially and the DMP would facilitate adherence to the chosen treatment protocol and therefore reduce the probability of relapse.

5.9 *Direct and Indirect Costs and Perspective*

5.9.1 Several of the CEA studies include 'indirect' costs in their analysis. However, all of them defined indirect costs as the wages foregone because of time taken to attend psychotherapy sessions or follow-up visits with clinicians. Only one CEA study attempted to measure the reduced productivity or lost workdays of patients with major depression (Schœnbaum *et al.*,

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2001). Almost all studies took the viewpoint of a medical-expense insurer rather than a true societal perspective or even the viewpoint of an employer, who is concerned with productivity and absence costs as well as medical costs.

5.9.2 Direct costs were generally measured as primary care and outpatient costs, such as the costs of GP visits, anti-depressants, access to specialists, and costs of psychotherapy. No studies found compelling evidence of an offset in other costs such as inpatient admissions or emergency visits, or a reduction in the number of deaths, as all these events are relatively rare and large study populations would be needed to examine these costs with any precision.

5.10 *Study Populations*

5.10.1 Most studies have examined newly diagnosed depression populations, with a few specialised studies examining the cost-effectiveness of DMPs for treatment-resistant depression. One study examined the use of DMPs to prevent relapse in populations with recurrent depression (Simon *et al.*, 2002).

5.10.2 All the studies reviewed excluded mothers with post-natal depression, patients with psychotic disorders or bipolar disorder, and patients with alcohol or drug dependence. Some studies also excluded patients who were illiterate (usually where English was not the first language), recently bereaved patients, and those exhibiting signs of mania. These exclusions can make up a significant proportion of the population of depressed people and therefore caution should be used in extrapolation of the results to population level.

5.10.3 Only one CEA accounted specifically for the costs of physical co-morbidities by looking at a specific diabetic population to determine how that population might by affected by depression management programmes (Simon *et al.* 2007).

5.11 *Modelling Issues*

Study design

The majority of existing CEAs are based on RCTs, and all were limited by small sample sizes. While the RCT design increases the internal validity of the study and controls for population differences, the relatively small numbers of patients included means that cost and benefit data are subject to large confidence intervals. A consequence of the small sample sizes is that relatively rare but expensive additional medical services for depressed populations (such as emergency inpatient costs), are difficult to include in models in a robust way, as are the relative risks of death among control and intervention sample populations.

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5.12 *Parameter and Model Uncertainty*

All the studies reviewed used a decision-analytic approach, with sensitivity analyses to demonstrate parameter uncertainty. Some studies gave confidence intervals around their results, but this was not done by all studies. A few analyses made use of bootstrapping techniques to derive confidence intervals or demonstrated cost-effectiveness acceptability curves.

5.13 *Regression to the Mean*

The vast majority of clinical studies recruit patients via a screening process after diagnosis from a GP. This limits the potential for regression to the mean effects, as patients are not generally being enrolled after a high-cost episode such as a hospitalisation.

5.14 *Time Horizon*

The follow-up period for most economic evaluations has tended to be limited between 6 and 12 months, with only a couple of studies looking at time periods longer than one year. This limited time period means that differences in outcomes and costs over longer periods of time are ignored in the models.

5.15 *Outcomes*

5.15.1 Older clinical studies concentrated on measuring the improvements in depression severity score or the probability of relapse within the time horizon of the study. However, more recent studies have used a method developed by Lave *et al.* (1998) that uses depression severity scores to determine whether or not patients experience depression-free or depression-burden days throughout the time period measured. The CEA studies cited by Gilbody (2006) uniformly used either cost per depression-free day, or cost per QALY, as an outcome measure.

5.15.2 QALYs can be estimated by assigning utility scores to depression-free and depression-burden days. The literature suggests that a year of major depression results in an associated loss of 0.2 to 0.4 QALYs (Schœnbaum *et al.*, 2001).

5.16 *Cost-Effectiveness Results*

For newly diagnosed depression, Gilbody (2006) found that costs per QALY for DMPs compared with usual care ranged from £8,300 per QALY for a nurse/case management programme to £19,500 per QALY for a more complex DM model approach. These QALY estimates are well below the reference point of £30,000 per QALY which is the most commonly used benchmark in the NHS for determining economic cost-effectiveness.

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6. A Model for Measuring Depression DMPs

6.1 This section describes a decision-analytic model for measuring the impact of implementing a U.S.-style DMP in a U.K. adult population with moderate or severe depression. The DMP is compared with usual treatment in primary care.

6.2 The model is presented first as an economic CEA, familiar to health economists. It is then expanded to look at service use and costs associated with a DMP to present results from the perspective of a financial ROI model, familiar to actuaries.

6.3 *The Role of the DMP*

6.3.1 The DMP is assumed to play three major roles. The first is enhancing correct diagnosis and recruiting people with depression into the programme. The second is facilitating appropriate treatment in line with the patient's preferences and best-practice protocols to increase the probability of compliance and therefore of curing the acute phase of moderate or severe depression. The third is preventing the risk of a relapse during the continuation phase and/or recurrence (defined as a new episode of depression after a full recovery from a prior episode) of acute episodes during maintenance/recovery phases by increasing compliance with prescribed treatment.

6.3.2 The presence of the DMP does not change the treatment options available by providing extra resources, for example cognitive behavioural therapy (CBT), which currently has long waiting lists in most parts of the U.K. Under both the usual care and the DMP scenario, the patient is assumed to have access to the most clinically appropriate medications and/or psychological therapies as he or she desires.

6.4 *Perspective*

6.4.1 The perspective taken initially is of a healthcare payer by considering the direct costs of healthcare delivery. The model is then expanded to include indirect costs, such as wages forgone in attending treatment, the costs of sickness absence, and the costs of low productivity in the workplace. In this form, the model reflects the true societal costs of depression. The model uses QALYs as a benefit measure and costs from the U.K. The price year was 2007.

6.4.2 Because of the lack of U.K.-specific studies of the treatment effect of a DMP, most treatment effects are taken from U.S. studies and applied to base parameters from the U.K. Therefore, the treatment effect is assumed to be transferable across health systems, even when the prognosis with usual care differs between health systems.

6.5 *Epidemiology of Moderate and Severe Depression*

The disease progression of moderate or severe depression is well

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documented in the literature. Patients usually experience an acute phase, which lasts on average 8-12 weeks (Hirschfeld, 2001). After this acute phase, most will recover, although around 5-10% of patients will experience a chronic course of depression, i.e., they will not recover after their first depressive episode (Keller *et al.*, 1992; Angst, 1997). However, among those patients who recover after the first acute episode of major depression, the risk of relapse or recurrence without continuing treatment is in excess of 50% and the risk of relapse or recurrence after two episodes is approximately 80% (Angst, 1998; Piccinelli & Wilkinson, 1994).

6.6 *Treatment Protocols and NICE Guidance*

6.6.1 NICE guidance recommends that treatment for acute-phase moderate or severe depression takes place in primary care with selective serotonin reuptake inhibitors (SSRIs) as the first-line treatment, and extended psychotherapy for patients not willing to take anti-depressants or patients who have not previously responded well to pharmacotherapy (NICE 2004). NICE also recommends combination therapy (anti-depressant drugs plus psychological interventions) for patients with chronic (continuous for two years or more) or recurrent depression. NICE protocol also recommends telephone support of patients every two months, which is considerably less frequent than the interventions recommended by the U.S. DMP studies.

6.6.2 Various studies have demonstrated the importance of continuing treatment after the acute phase to minimise the risk of relapse or recurrence (Katon *et al.* (2001), Hirschfeld (2001)). Hirschfeld (2001) describes a model where patients recovering from an acute episode move into a 'continuation phase', where active treatment is administered for a period of 6 to 12 months. Patients at high risk of recurrence should be considered for a further period of treatment in a 'maintenance' phase, which could continue for several years, possibly even for the remaining lifetime. 'High-risk' patients are defined as those with a history of three or more prior episodes of major depression, pre-existing dysthymia, severe depressive episodes, seasonal patterns, a familial history of depression or other affective disorder, poor response to continuation therapy, co-morbid anxiety, or substance abuse problems (Hirschfeld & Shatzberg, 1994).

6.6.3 NICE recommends that the 20-40% of moderately or severely depressed patients with recurrent depression be given anti-depressants for a minimum of two years following recovery from the acute phase.

6.7 *Purpose of the Model*

6.7.1 The purpose of the model is to estimate the additional benefits and costs of using a DMP in the capacities discussed above and to determine the cost-effectiveness of using a DMP to deliver best-practice care. Assuming accurate diagnosis, under both usual care and the DMP, it is assumed that the patient is offered the initial treatment that is most clinically appropriate

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after discussion between the treating physician and the patient. However, the DMP differs from usual care in the follow-up and rates of patient compliance.

6.7.2 The model is *not* intended to estimate the financial cost of providing treatment for all patients in line with NICE guidance. The cost to the NHS of providing care in accordance with NICE guidance has been amply demonstrated by Secta and NICE in their paper on costing clinical guidelines in 2004. Similarly to previous U.S. studies for collaborative care, the model does not compare the cost-effectiveness of alternative methods of treating moderate or severe depression, i.e., it does not determine whether therapy, drugs, or combination treatment is more cost-effective.

6.8 *Methodology and Data*

6.8.1 *Overview of models*

6.8.1.1 The first part of the model is a short-term decision tree, shown in Figure 1, which is designed to represent the probabilities of accurate diagnosis during an initial consultation with a GP. The decision tree also sets out the probabilities and costs of different treatment paths to calculate the aggregate costs of patients in each phase under both no-DMP and DMP scenarios, taking into account the probabilities of compliance at each phase.

6.8.1.2 The second part of the model is a semi-Markov model, which allows for the possibility of movement between the disease states. Patients move into the Markov model when they are newly diagnosed with moderate or severe depression. The Markov model then uses three-month cycles and transition probabilities derived from the existing literature to determine the

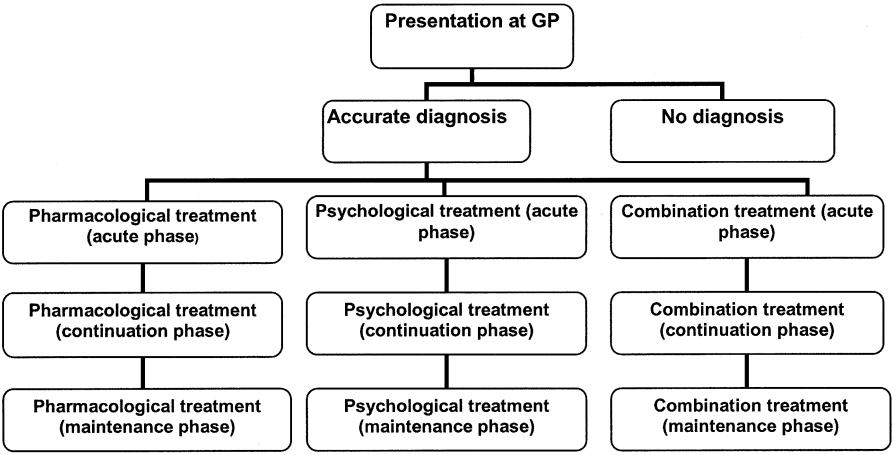

Figure 1. Decision tree for treatment and costs

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number of patients from the initial 1,000-patient cohort in each Markov state at the end of each cycle. The Markov model is time-dependent, as transition probabilities depend on the amount of time a patient has already spent in a specified Markov state. The transition probabilities are based on rates from the existing literature, expressed as base-transition probabilities with treatment effects expressed as odds ratios. The exact derivation of the probabilities and literature used is set out later in this section.

6.8.1.3 The four Markov states modelled are:

- 'Acute': the patient is experiencing an acute episode of depression, associated with significant loss of quality of life.
- 'Continuation': the patient has recovered from the acute episode, but must continue with treatment to prevent acute relapse; all patients who recover from an acute episode should undergo continuation treatment for nine months (three cycles).
- 'Maintenance': for-high risk patients who have completed the continuation phase without relapse, but have significant risk of a recurrence. High-risk patients should spend at least one year in this phase and some may continue for the rest of their lives. For simplicity, the model assumes that patients who reach the maintenance phase

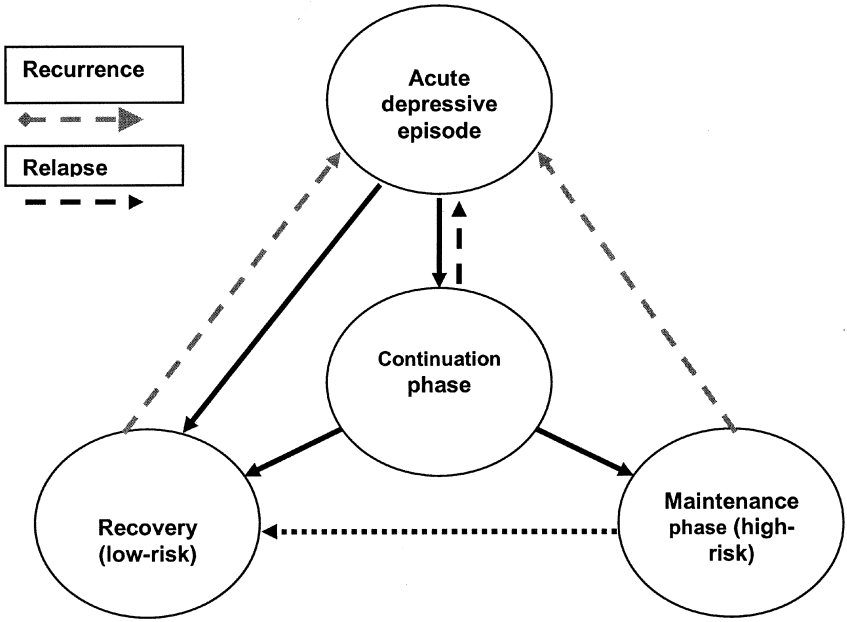

Figure 2. Markov model representation of disease states post-diagnosis

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remain there throughout the lifetime of the model (five years); in practice some patients will move into the recovery state, while other will remain in the maintenance state indefinitely.
- 'Recovery': for low-risk patients who have not relapsed in the continuation phase.

6.8.1.4 Death is not considered in the model, because of the lack of conclusive evidence from the literature on the relative risk of death among patients with moderate to severe depression compared with the general population.

6.8.1.5 The Markov model is represented in Figure 2.

6.8.1.6 The Markov model also estimates the costs and benefits for undiagnosed patients to compare these with diagnosed patients under the DMP/no-DMP outputs.

6.8.2 *The DMP*

The DMP is assumed to have the following elements:
- Initial GP, nurse, and other primary-care worker education to assist accurate diagnosis and treatment.
- Screening to assist diagnosis.
- Ongoing access to evidence-based guidelines and protocols.
- Patient education at point of diagnosis about treatment options and their advantages and disadvantages.
- GP access to psychiatrists to discuss non-responders to initial treatment, appropriate drug dosages, or changes in treatment regimes.
- Co-ordination of case between GPs, psychiatrists, nurse/case managers, and graduate mental health workers.
- Telephone contact between graduate mental health workers and patients, with face-to-face follow-up between patients and nurses at set intervals.
- Unlimited access to the patient's preferred treatment plan, whether this is drugs, psychotherapy, or a combination of both.
- Patient development of self-care plan at point of diagnosis, with assistance by a nurse or case manager.
- Patient development of relapse/recurrence plan, with assistance by a nurse or case manager.

6.8.3 *Diagnosis rate assumptions*

6.8.3.1 The base assumption of correct diagnosis of moderate or severe depression without a DMP is assumed to be 50%. This is consistent with the NICE study (2004) which shows 37.5% for all depression (including mild) and other studies cited elsewhere that estimate that 40% to 60% of depression remains undiagnosed.

6.8.3.2 The DMP is assumed to increase diagnosis rates by 25% in the

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base-case scenario, consistent with treatment effects from the literature which show increases in detection of 10% to 47%.

6.8.4 *Treatment assumptions*

Treatment for a newly diagnosed moderate or severe acute episode is assumed to adhere to current NICE guidelines. Therefore, SSRI drugs at generic cost are the first-line treatment, with psychological interventions for patients who do not wish to take drugs. Combination therapy is available for patients with a history of chronic or recurrent depression.

6.8.5 *Compliance rates and transition probabilities assumptions*

6.8.5.1 The compliance rates and transition probabilities are based on an analysis of the existing literature. Tables 1 to 6 set out findings from the various literature studies and the assumptions chosen for the model. The assumptions were generally chosen to be close to averages of the different literature studies.

6.8.5.2 The treatment effect in Table 1 is calculated as:

$$\text{Treatment effect} = \frac{\text{Compliance rate with a DMP}}{\text{Compliance rate with no DMP}}.$$

6.8.5.3 Based on Table 1, the model uses base-case compliance rates of:

- Acute state: 55% no DMP, with a treatment effect of 150% for the DMP (i.e. 82.5% compliance). This is based on the results for 3-4 months since diagnosis in Table 1.
- Continuation or maintenance state: 50% no DMP, with a treatment effect of 125% for the DMP. This is based on the results for 12 months since diagnosis in Table 1.

6.8.5.4 Note that the compliance rates in Table 1 are slightly higher for 12 months compared with 6-7 months since diagnosis and this appears anomalous because different studies are included in each average and also because Wells (2000) gives a higher compliance rate for overall appropriate care at 12 months compared with 6 months. In practice, we would expect compliance rates to reduce over time and the majority of studies which review compliance rates by time since diagnosis bear this out (Katon, 1995, 1996, 1999, 2001).

6.8.5.5 The existing literature generally focuses on compliance rates for pharmacological therapy. The model assumes the same compliance rates for both drug and psychological counselling. In practice, greater availability of psychological counselling, with none of the pharmacological unpleasant side-effects, may lead to overall higher compliance rates with or without a DMP.

6.8.5.6 The recovery rates from the acute phase to the continuation

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Table 1. Compliance rates in published literature

Time since diagnosis		Katon 1999	Katon 2001	Simon 2001	Katon 1996	Katon 1995	Rost 2002	Hedrick 2003	Wells 2000	Simon 2004	Average
1 month	No DMP	69%			63%						66%
	DMP	77%			85%						81%
	Treatment effect	112%			135%						123%
3-4 months	No DMP	62%	66%	32%	62%	50%		62%		40%	53%
	DMP	79%	81%	82%	89%	76%		80%		50%	77%
	Treatment effect	127%	123%	256%	144%	152%		129%		125%	151%
6-7 months	No DMP	51%	58%		54%				40%		51%
	DMP	73%	72%		79%				51%		69%
	Treatment effect	145%	124%		146%				128%		136%
9 months	No DMP		56%				36%				46%
	DMP		68%				10%				39%
	Treatment effect		123%				27%				75%
12 months	No DMP		50%						50%		50%
	DMP		63%						59%		61%
	Treatment effect		127%						118%		123%

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Table 2. Recovery rates at different points since diagnosis in published literature

Time since diagnosis		Katon 1999	Dietrich 2004	Wells 2000	Katon 1995-96	Average
3 months	No DMP	23%	17%			20%
	DMP	40%	26%			33%
	Treatment effect	174%	159%			166%
6 months	No DMP	31%	27%	50%		36%
	DMP	44%	37%	60%	73%	53%
	Treatment effect	142%	137%	120%		133%
12 months	No DMP			49%		49%
	DMP			59%		59%
	Treatment effect			120%		120%

Table 3. Transition probabilities from acute to continuation state

	No treatment / undiagnosed	No DMP (diagnosed)	DMP (diagnosed)
Probability of recovery from acute between 0-3 months	10%	20%	35%
Probability of recovery from acute between 3-6 months	25%	75%	94%
Probability of recovery from acute in each cycle after six months	5%	10%	5%

phase used in the model are based on rates of cumulative probabilities of recovery after a period spent in an acute phase. These are transformed into transition probabilities from the acute state to the continuation state to give the following independent probabilities used in the Markov model. These are broadly consistent with the average treatment effects estimated from the literature (see Table 2).

6.8.5.7 It is worth noting that the pattern of recovery probabilities from the acute state for diagnosed patients between the DMP and No DMP columns change with the length of time in the acute state. For periods up to 6 months in the acute state, the DMP gives a higher probability of recovery. However, the probabilities for people in the acute state more than 6 months are actually lower in the DMP scenario. This is because the majority of patients have already recovered under the DMP scenario and only the very difficult cases remain. This suggests that the DMP not only increases the number of people overall who are likely to recover from the acute state, but accelerates recovery for many people, giving them a shorter period in the acute state (see Table 3).

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Table 4. Proportion of people relapsing in continuation phase

Time since recovery from acute		Katon 2001	Hirschfeld 2001
3 months	No treatment		30
	No DMP	10	
	DMP	13	3
6 months	No treatment		10
	No DMP	9	
	DMP	12	3
9 months	No treatment		6
	No DMP	17	
	DMP	11	7

Table 5. Proportion of people with recurrence in maintenance phase

Time since recovery from acute		Katon 2001	Rost 2002	Hirschfeld 2001
12 months	No treatment			60
	No DMP	35	70	
	DMP	35	50	10-30
24 months	No treatment			23-57
	No DMP		59	
	DMP		26	6-26

6.8.5.8 The recovery rates from an acute phase for undiagnosed patients with no treatment are derived from Hirschfeld (2001).

6.8.5.9 Relapse and recurrence transition probabilities from the continuation or maintenance states back into the acute state are derived from the literature as referenced in tables. The literature expresses the relapses in terms of the numbers of people still in remission after a period of time. Table 4 sets out the proportion of people from a starting cohort of 100 in the continuation phase assumed to relapse in each period based on the studies examined.

6.8.5.10 Table 5 sets out the proportion of people in the maintenance phase who experience recurrence in each period, based on a starting cohort of 100 starting maintenance phase therapy.

6.8.5.11 The data are used to derive base transition probabilities and treatment effects for the Markov model to give the parameters set out in Table 6. For the probability of relapse after 6+ months in continuation phase, the probability with No DMP is assumed to be equal to the probability with No Treatment/Undiagnosed.

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Table 6. Transition probabilities from continuation or maintenance state to acute

	No treatment/ undiagnosed	No DMP	DMP
Probability of relapse after 0-3 months in continuation phase	30%	10%	7%
Probability of relapse after 3-6 months in continuation phase	14%	9%	8%
Probability of relapse 6+ months in continuation phase or any period in maintenance phase	15%	15%	5%

6.8.5.12 Table 6 shows the probability of relapse after 6+ months in the continuation phase or any period in the maintenance phase as *higher* than the probability of relapse after 3-6 months in the continuation phase. This is because of the differing severity levels of patients. Only high risk patients who have very severe depression and are likely to have experienced several episodes of depression already will be in the maintenance phase and these patients are likely to experience much higher probabilities of relapse.

6.8.6 *QALY assumptions*

6.8.6.1 Each Markov state has the following associated QALYs (utility for a year spent in the state — see Table 7).

6.8.6.2 The QALY associated with an acute episode of depression is assumed to be 0.46, in line with a recent study on patients with moderate depression (Sobocki *et al.*, 2007). Based on the consensus in the literature, an increase of 0.3 QALYs is associated with recovery from an acute episode. There is no robust literature on the loss in QALYs associated with the side effects of treatment in continuation and maintenance states, but the model assumes an increase of an additional 0.05 QALYs between the continuation or maintenance states and recovered/well, to allow for the side effects of medication.

6.8.6.3 At the start of the modelled time period, 30% of people are assumed to have chronic or recurrent depression and receive combination

Table 7. QALY assumptions

	QALYs
Recovered/well	0.81
Acute state	0.46
Continuation state	0.76
Maintenance state (high risk patients only)	0.76

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treatment. These are also the patients who will receive maintenance treatment after the continuation phase. Of patients starting treatment, 10% are assumed to choose psychological treatment alone (Schœnbaum *et al.*, 2001).

6.8.7 *Cost assumptions*

6.8.7.1 Direct costs include:

- Costs of anti-depressant drugs. Assumed to be £12 per month for an SSRI prescription, based on costs from the NICE guideline (2004), inflated to 2007 figures at 2.5% per year. These costs per month are independent of the phase of treatment. In reality, costs may decrease a little in the continuation or maintenance phase as the drugs should be lower dosage. Any increase in the brand or generic unit costs of SSRIs over time is assumed to be offset by the increasing proportion of generics used over time; costs per month are assumed to be constant in the future for modelling purposes.
- Costs of caregivers' time, based on the following salary costs, loaded by 50% for overheads. From these costs, hourly consulting rates were estimated, assuming clinical patient hours of 800 to 1,000 per year. These salary and hourly costs are consistent with those from the Personal Social Services Research Unit (PSSRU) database for 2005-06 (see Table 8).

6.8.7.2 All patients on medication are assumed to have one GP visit per month for repeat prescriptions during the acute phase, one per three months during the continuation phase, and one per six months during the maintenance phase. Patients receiving CBT are assumed to have one session per week during the acute phase, one per fortnight during the continuation phase, and one per month during the maintenance phase.

6.8.7.3 In addition, the following care is provided for DMP patients (see Table 9).

6.8.7.4 Indirect costs consist of the time that patients spend receiving therapy, visiting the doctor or nurse, and taking phone calls with the mental

Table 8. Salary and hourly consulting costs

Caregiver	2007 salary (including employee benefits)	Per hour consult
Graduate mental health worker	£20,000	£30
Nurse/Case manager	£33,000	£50
CBT therapist	£37,500	£70
GP	£110,000	£165
Psychiatrist	£115,000	£173

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Table 9. DMP care (per 3 months)

Caregiver	Acute	Continuation	Maintenance
Nurse consults with patient (30 minutes)	1.0	1.0	1.0
Case manager telephone calls with patient (15 minutes)	5.0	2.0	1.0
Clinical team meetings (10 minutes discussion per patient)	3.0	1.0	0.5

health worker. Indirect costs also arise from lost days of employment because of sickness absence and lower productivity due to depression.

6.8.7.5 Patients' time for treatment is assumed to be the time spent in consultations or phone calls, plus 30 minutes travelling time each way for face-to-face consults. Additional time for collecting prescriptions is excluded. Patients' time is valued at the average U.K. weekly wage of £447* and assumes a 35-hour working week.

6.8.7.6 Sickness-absence costs are also valued using the national average wage of £447. The effect of depression on absenteeism and low productivity is assumed to be the equivalent of 2.25 days per month off work during an acute phase (Kessler *et al.*, 2006), with no effects on absenteeism and productivity during the continuation or maintenance phases. This accounts for the costs for sickness absence that are directly related to the depressive illness, rather than the total costs of sickness absence for patients with depression.

6.8.8 *Discount rate*

A discount rate of 3.5% per year is used for both costs and QALYs, in line with current NICE guidance.

6.8.9 *Other key assumptions*

Other assumptions and limitations implicit in the model are:

- Compliance rates and transition probabilities do not vary significantly by age, sex, socio-economic status, or type of treatment
- No significant false-positive diagnoses: no patients diagnosed with moderate or severe depression who are only mildly depressed or who do not have depression
- Patients must visit the GP for prescriptions and therefore a DMP does not free up any GP time if the patient is receiving drugs (In practice, Nurse Practitioners can prescribe in some areas of the U.K.)
- Patients must have psychological therapies face-to-face. (Computerised CBT has been recommended as a solution by the National Institute for

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Mental Health in England and may significantly reduce direct and indirect costs.)

- Average wages are a more appropriate measure of sickness-absence cost than government sick pay or long-term disability insurance costs
- Mortality rates, and secondary care utilisation and costs, have an insignificant effect
- The model does not account for additional visits by undiagnosed patients or diagnosed patients under usual care due to:
  (1) GP visits under the guise of other presenting symptoms
  (2) Less effective treatment.

6.9 *Results*

6.9.1 The incremental cost-effectiveness ratios (ICERs) from the model under the baseline assumptions are presented below (see Table 10). Firstly, the outputs from the Markov model are used to calculate ICERs for each newly diagnosed person entering the model. Secondly, the diagnosis rates are used to calculate ICERs for a cohort of 1,000 depressed people to estimate the effect on the ICER when increased diagnosis rates are included.

6.9.2 The results show that the DMP both reduces costs and increases benefits compared to the alternative, i.e., it is a dominant treatment. While direct costs are increased, indirect costs reduce significantly, because of the costs of sickness absence. Even if just direct costs are included, the cost per QALY is considerably below that of other treatments in the U.K. This conclusion is consistent with findings from the literature, although the cost per QALY is generally higher in the literature (see ¶5.16).

6.9.3 Table 11 shows the effect of including both diagnosed and undiagnosed patients in the calculation.

6.9.4 Increasing the proportion of people diagnosed by the DMP increases direct and some indirect costs because of the additional treatment required. However, there is an offset in indirect costs due to reductions in sickness absence.

Table 10. Costs, benefits, and ICERs per diagnosed patient over five years

	No DMP	DMP	Incremental
Direct cost	£2,400	£3,146	£746
Indirect cost	£5,680	£3,495	−£2,184
Total cost	£8,079	£6,641	−£1,438
QALYs	3.2	3.5	0.30
ICER — direct cost/QALY			£2,456
ICER — total cost/QALY			−£4,733

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Table 11. Costs, benefits, and ICER per 1,000 depressed people

	No DMP	DMP	Incremental
Direct cost (£ 000s)	£1,200	£1,966	£766
Indirect cost (£ 000s)	£7,537	£5,707	–£1,830
Total cost (£ 000s)	£8,737	£7,674	–£1,063
QALYs	2,893	3,156	263
ICER — Direct cost/QALY			£2,914
ICER — Total cost/QALY			–£4,043

6.10 *Sensitivities and Uncertainties*

6.10.1 A one-way sensitivity analysis was used to test the effect of parameter uncertainty. The scenarios tested were:

- No. 2: Increase in the diagnosis treatment effect of a DMP to 50%.
- No. 3: Decrease in the diagnosis treatment effect of a DMP to 10%.
- No. 4: Increase in DMP treatment effect on compliance rates and transition probabilities by 25%.
- No. 5: Decrease in DMP treatment effect on compliance rates and transition probabilities by 25%.
- No. 6: Drug costs increase 25%.
- No. 7: Average clinical salaries increase 25%.
- No. 8: Average patient wages increase 25%.
- No. 9: Exclude sickness-absence costs.
- No. 10: Increase QALYs in the acute state from 0.65 to 0.75, so that the increase in QALYs from acute to continuation or maintenance is 0.2 QALYs.

6.10.2 The results of the sensitivity analysis are shown in Table 12 and represented graphically in Figure 3.

6.10.3 Under almost all scenarios, a DMP has a dominant effect when the costs of sickness absence are included: the only exception to this is Scenario 5 where the total cost per QALY is positive, but still small compared to other treatments used in the U.K. The other case in which the total cost per QALY is positive is Scenario 9, where sickness-absence costs are excluded. Again, the total cost per QALY is relatively insignificant compared with the perceived NICE threshold.

6.10.4 The key sensitivities in the model are:

- The treatment effect of a DMP on compliance rates and transition probabilities. Assuming the treatment effect is 25% higher leads to a significant decrease in the direct costs per QALY.
- Increases in the average wage lead to much higher offsetting costs of sickness absence, which increase the dominant effect of the DMP. This

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Table 12. Key sensitivities

	Scenario									
	Base 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Direct cost/QALY per diagnosed patient	£2,456	£2,456	£2,456	£606	£9,825	£2,460	£3,039	£2,456	£2,456	£3,575
Indirect cost/QALY per diagnosed patient	–£7,189	–£7,189	–£7,189	–£7,682	–£5,377	–£7,189	–£7,189	–£8,987	£904	–£10,464
Total cost/QALY per diagnosed patient	–£4,733	–£4,733	–£4,733	–£7,075	£4,448	–£4,730	–£4,150	–£6,531	£3,360	–£6,889
Direct cost/QALY per depressed person	£2,914	£3,100	£2,701	£1,401	£7,106	£2,936	£3,601	£2,914	£2,914	£4,228
Total cost/QALY per depressed person	–£4,043	–£3,763	–£4,363	–£5,978	£1,265	–£4,021	–£3,356	–£5,782	£3,993	–£5,866

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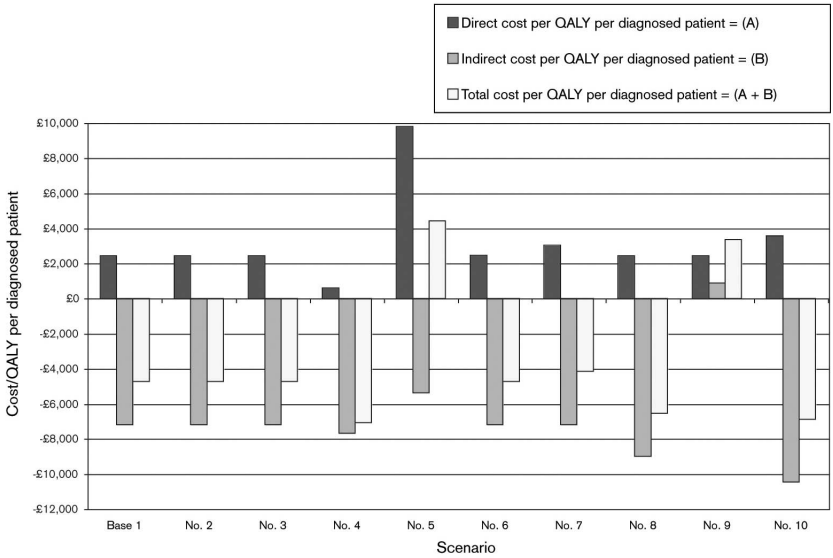

Figure 3. Cost per QALY per diagnosed patient

implies that the DMP becomes more cost-effective for patients on higher average wages, even though they must give up time to attend therapy and participate in the DMP. If patients use time after work for therapy (as is more likely for high-income jobs), this will decrease indirect costs still further and the DMP becomes even more cost-effective.

- Reducing the QALY gain for recovery from an acute episode from 0.3 to 0.2 also has a significant effect on costs per QALY.

6.10.5 Drug costs are not an important driver for the model, as they are relatively insignificant compared with the direct and indirect costs associated with psychological therapies. In addition, the treatment effect of the DMP on diagnosis rates is not an important driver of costs relative to other factors.

6.11 *Model Limitations*

6.11.1 The greatest weakness of the model is that many of the assumptions derive from small, U.S.-based RCTs. The treatment effect assumed may not be replicated in a U.K. setting with a different starting healthcare system infrastructure and demographic profile. In addition, the existing RCTs often exclude large sections of the depressed populations from

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the studies and so caution is recommended in extrapolating the DMP treatment effects to a population. Compliance rates and transition probabilities may vary significantly by age, sex, socio-economic status, and initial health status.

6.11.2 The model only included costs, healthcare-service use, and sickness absence directly related to depression. A more sophisticated model would include costs and benefits of the DMP on physical co-morbidities linked to depression and show the effect on other types of healthcare-service utilisation, such as hospital inpatient care and emergency care. The model could also incorporate long term disability costs, employee turnover costs, and productivity measures besides sickness absence. Ideally the model would be stochastic to demonstrate the distribution of possible outcomes.

6.11.3 Sickness-absence costs are estimated using the national average wage. This could be amended to reflect a direct governmental viewpoint by including average long-term sickness or disability payments rather than average wages and excluding short-term sickness costs.

6.11.4 The model assumes unlimited capacity of the best and most appropriate treatment for each patient. In practice, severe capacity constraints mean this is unlikely to be available in the U.K. in the short term. The initial investment required to set up a DMP *and* ensure sufficient capacity to give all patients the best treatment is likely to be significant.

6.12 *Financial ROI*

6.12.1 The section above presents an economic CEA, which demonstrates that, in health economics terms, the DMP is a *dominant* procedure; it provides health benefit and costs less than the current usual care. This should translate into a positive financial ROI from an actuarial perspective. To demonstrate this, a model was built to look at service use and costs over five years for a depressed population with and without a DMP.

6.12.2 Two populations were considered:

(a) an employer population of 10,000 employees, with a standard age/sex demographic mix and national average wages. (*See ¶6.21*); and
(b) the U.K. total population. (*See ¶6.22*).

6.12.3 Current and relevant incidence rates for major depression are difficult to extract from the available data. However, we use prevalence rates from the 1994-1998 General Practice Sample Survey for Treated Depression as a starting point. We then adjust these rates to allow for:

- Calendar-year trends.
- Incidence versus prevalence, using the assumption that each depressive episode lasts for three to six months on average.
- Major depression rates versus all depression. We assume that major depression is 20% of all depression diagnosis, based on evidence cited by NICE that the prevalence of major depression is around 20% to

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25% of the prevalence of the broader category of 'mixed depression and anxiety disorders'.

6.12.4 In practice, research shows that incidence and prevalence are higher among certain groups that we would expect to be more represented in the general population than in the employed population. These groups include those who are homeless, those with lower socio-economic status, and those with lower educational achievement. Offsetting these trends somewhat are higher rates among urban rather than rural populations. It is clear that for an accurate picture of the financial impact of depression, a detailed study would have to be carried out on the sub-population in question.

6.12.5 The two populations modelled differ only in their demographic mix, which in turn affects the incidence of major depression in the overall population as incidence is driven by gender and age mix. However, because the demographic mix is a lesser driver of financial outcomes than other parameters, such as the cost of sickness absence (which depends on the average wage), the financial ROI for the two populations is similar.

6.13 *Employer Population*

6.13.1 For an employed population of 10,000 (including dependents of employees), our estimated annual incidence rate of major depression is approximately 3%. This population is assumed to have 'standard' employer demographics with an average age of 40 to 45 and an approximately even split of males to females.

6.13.2 Average direct and indirect costs attributable to depression with and without the DMP and estimated cost savings are set out in Table 13.

6.13.3 The results show that there are considerable direct costs associated with a DMP for an employer assuming the employer is responsible for *all* the medical costs. In practice, because the NHS is likely to pay for at least some of the direct medical costs for some patients, the direct costs are likely to be reduced. In addition, the employer is likely to see considerable reductions in sickness absence and therefore a reduction in indirect costs (see Figure 4).

6.13.4 The results for an individual employer can be modelled by using specific inputs on the average wage level, the demographic mix, employee turnover, and more detailed input on the costs of sickness absence due to depression. However, based on the results presented here, any employer considering implementing its own depression-specific DMP should expect to receive a considerable ROI over a five-year period and would see savings as early as the second year. Note that these savings and the ROI would be reduced significantly if the employer experiences high staff turnover.

6.14 *U.K. National Population*

6.14.1 For the U.K. population as a whole, our estimated annual

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Table 13. Estimated costs with and without DMP for depression (£ 000s)

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
No DMP	Total direct costs	£214.8	£127.3	£135.1	£141.4	£147.5	£766.3
	Total indirect costs — patient time	£79.7	£45.4	£46.6	£47.0	£47.2	£265.8
	Total indirect costs — sickness absence	£1,225.3	£922.6	£926.6	£928.0	£928.7	£4,931.1
	TOTAL	£1,519.9	£1,095.3	£1,108.3	£1,116.4	£1,123.3	£5,963.2
DMP	Total direct costs	£635.9	£213.6	£177.5	£181.9	£187.1	£1,395.9
	Total indirect costs — patient time	£238.5	£78.1	£63.0	£62.8	£62.7	£505.2
	Total indirect costs — sickness absence	£1,043.1	£611.1	£600.8	£599.6	£598.9	£3,453.6
	TOTAL	£1,917.5	£902.8	£841.3	£844.2	£848.7	£5,354.6
ADDITIONAL COSTS/ SAVINGS OF DMP	Direct additional costs	£421.0	£86.3	£42.3	£40.4	£39.6	£629.6
	Indirect additional costs (patient time)	£158.8	£32.7	£16.5	£15.8	£15.5	£239.4
	Indirect savings (sickness absence)	−£182.2	−£311.5	−£325.8	−£328.4	−£329.7	−£1,477.6
	TOTAL Savings	−£397.6	£192.5	£267.0	£272.1	£274.6	£608.6
	Internal rate of return						47.2%
	Net present value of savings @ 3.5% discount rate						£504.7

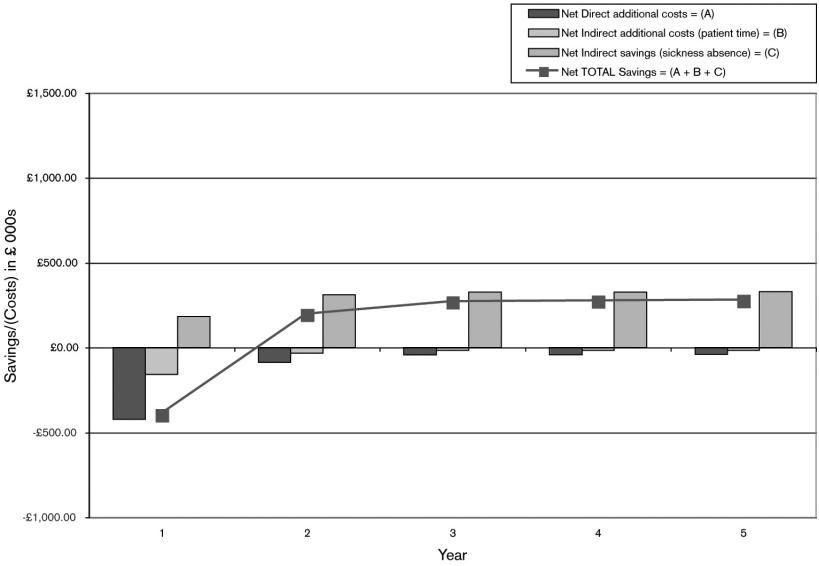

Figure 4. Employer population estimated incremental costs/savings

incidence rate of major depression is approximately 4%. Average direct and indirect costs attributable to depression with and without the DMP and estimated cost savings are set out in Table 14.

6.14.2 For the U.K. population as a whole, the estimate of the cost burden of depression is £8bn in 2006, the majority of which is indirect costs. A depression DMP has a high ROI for society, by reducing the cost of sickness absence (although not all this population will be employed and therefore the cost savings from sickness absence may be overstated). However, the way this cost splits between those items of expenditure that are borne by the government through direct costs to the NHS budget, costs to social security and social services, and unemployment costs, and those items that are borne by the private sector, e.g., employers and insurers, is critical to understand, as it will affect policy-making in this arena. While a depression DMP yields considerable ROI overall, it is likely to have a significant impact on the NHS budget in the short term as it requires a large amount of initial investment (see Figure 5).

6.14.3 Again, the results for a particular PCT or sub-population may yield very different results, and the specifics of each population should be taken into account before the results are used for local policy-making.

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Table 14. Estimated costs with and without DMP for depression (£m)

		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
NO DMP	Total direct costs	£1,130	£670	£711	£744	£776	£4,031
	Total indirect costs — patient time	£419	£239	£244.9	£247.0	£248.1	£1,398
	Total indirect costs — sickness absence	£6,445	£4,853	£4,874	£4,881	£4,885	£25,937
	TOTAL	£7,995	£5,761	£5,830	£5,872	£5,909	£31,366
DMP	Total direct costs	£3,345	£1,131	£942	£965	£993	£7,375
	Total indirect costs — patient time	£1,255	£411	£332	£330	£330	£2,657
	Total indirect costs — sickness absence	£5,487	£3,214	£3,160	£3,154	£3,150	£18,165
	TOTAL	£10,086	£4,756	£4,434	£4,449	£4,473	£28,197
ADDITIONAL COSTS/ SAVINGS OF DMP	Direct additional costs	£2,215	£461	£231	£221	£217	£3,344
	Indirect additional costs (patient time)	£835	£172	£87	£83	£82	£1,259
	Indirect savings (sickness absence)	−£958	−£1,638	−£1,714	−£1,727	−£1,734	−£7,772
	TOTAL Savings	−£2,092	£1,005	£1,396	£1,423	£1,436	£3,169
	Internal rate of return						46.8%
	Net present value of savings @ 3.5% discount rate						£2,626

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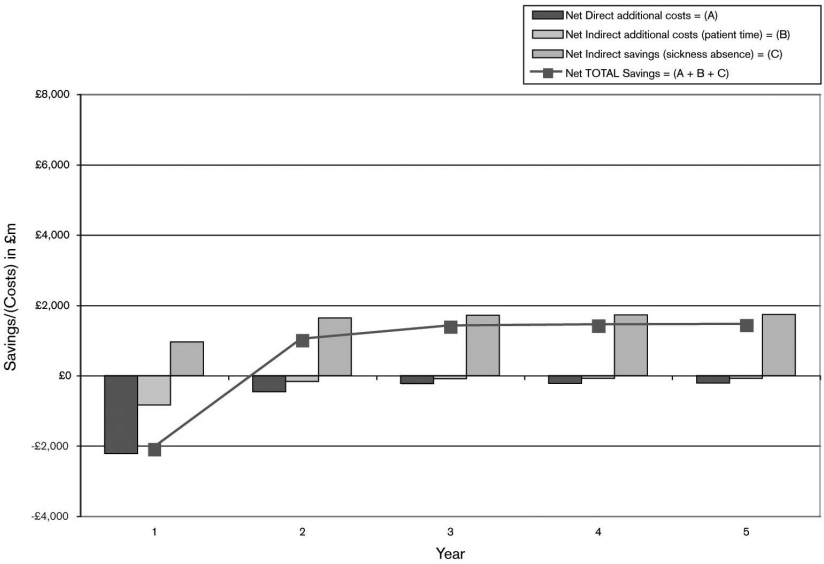

Figure 5. U.K. national population incremental costs/savings

7. Discussion of Wider Societal Issues and Implementation

7.1 This paper demonstrates that for best-estimate assumptions, a DMP is extremely cost-effective at the quoted NICE cut-off level of £30,000 per QALY, even when taking direct and indirect costs into account. When the high costs of sickness absence that are directly attributable to depression are included, DMPs are likely to *save* money overall and show a positive ROI.

7.2 Whether or not a DMP is cost-effective for depression will depend on the treatment effect seen in practice. The DMP modelled in this study assumes an 'optimal' DMP, with *all* the elements required for effective clinical outcomes. The model also considers costs and benefits over a five-year time frame. Payers trying to minimise initial investment costs by implementing only some elements of the DMP or by measuring return on investment over a shorter time period may not see the expected cost savings.

7.3 *Economic Incentives*

7.3.1 This study highlights the issue of who pays for the burden of depression on society and how this should be measured. Sickness-absence costs due to depression are a major drain on the economy. However, as long as direct healthcare costs of treatment and the indirect costs of sickness

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absence are treated separately by government budgets it will be difficult to drive action.

7.3.2 While U.K. employers have incentives to minimise sickness absence, they rarely bear the full burden of treatment for depression and therefore their incentives to implement DMPs are weak. However, for employers who pay for some direct medical costs through private insurance for their employees, the economic incentive to develop an in-house DMP is considerably stronger. This is especially true as employees with private medical insurance are likely to be those earning relatively high wages and therefore possibly commensurately greater sickness-absence costs.

7.3.3 For DMPs to be effective, financial flows in the NHS must create the correct economic incentives. PCTs or Practice-Based Commissioning (PBC) clusters must be able to create DMPs, without financial penalties for the parties involved. For example, GPs may be reluctant to call psychiatric professionals in the local hospital for advice as they may incur a consultation charge for the patient. This creates disincentives for them to improve treatment regimes for patients by greater co-operation with specialists. However, larger PBC clusters may find it financially viable to employ their own psychiatrist and counsellors for a DMP.

7.4 *Practical Issues*

There are several practical hurdles to overcome in the U.K. before an effective DMP could be implemented. DMPs call for education of patients and clinical teams. Considerable re-engineering of the patient pathway and the organisation of clinical personnel would be required, along with an increase in the supply of trained psychological therapists and case managers. There is unlikely to be sufficient capacity in the NHS in the near future for optimal treatments for patients. If a large-scale increase in capacity did occur, the greater supply of treatments may affect the costs of the DMP and therefore the cost-effectiveness determination.

7.5 *Social Issues*

7.5.1 It can be argued that depression risk is related to a wide variety of demographic and socio-economic determinants, including age, education, income, and unemployment history as well as physical health and co-morbidities. Therefore, it may not be an issue that can be tackled through health interventions alone, no matter how holistic the DMP.

7.5.2 In common with most public health interventions, DMPs have the potential to widen health inequalities by providing enhanced care to certain sections of the population, either through post-code prescribing or by appealing to sections of the population that are relatively better educated, more engaged with their health, and have higher overall health status. By giving some patients access to higher quality healthcare, these patients will have improved health outcomes, widening the gap between those who do and

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do not have access to a DMP. Over time, this may create a two-tier service, with the patients who require most help the least likely to receive the additional services and achieve the best outcomes. This is true both for depression-specific DMPs and for DMPs focussed on other diseases and interventions.

8. Further Work and the Role of the Actuarial Profession

8.1 A U.K.-based RCT with a robust economic evaluation is urgently needed to estimate the costs and benefits of a U.S.-style DM approach in the U.K. and validate the assumptions used in this model. A large-scale study would enable mortality and secondary-care costs to be considered. In addition, a feasibility study to explore organisational barriers and implementation issues within the NHS would be extremely beneficial. A future model should attempt to estimate the effect of increases in therapist capacity and alternative ways of delivering psychological therapies that may be less resource-intensive.

8.2 With the appropriate assumptions, the model presented here could be used to determine which patient groups are likely to benefit most from DMPs and therefore where initial programmes should be targeted. The model could also be extended to examine the effects on mild depression.

8.3 Most of the existing clinical studies focus on specific populations and exclude a wide cross-section of people with depression. There would be benefit in estimating the effect of a DMP on several of these specific groups, including mothers with post-natal depression, people with alcohol or substance abuse problems, and those with bipolar disorder, or manic depression.

8.4 Depression also has a significant cost impact for other specific populations, such as those with a chronic physical condition and co-morbid depression. A body of work to determine the financial impact of co-morbid depression and DMPs for these populations would be invaluable. Similarly a study which includes the additional cost of treatment for physical co-morbidities for populations with a primary diagnosis of depression would be useful, as these costs can be significant.

8.5 Finally, alternative ways of diagnosing patients or finding patients with depression should be explored. Reliance on busy GPs to detect depression via screening should not be the only source of referral into a DMP. Using a predictive model to identify patient groups at high risk of depression and reduce initial incidence, in combination with better diagnosis tools once an acute phase has started, would significantly increase the benefit of a DMP. If more acute phases can be averted and the risk of relapse reduced, overall prevalence would be decreased significantly, with the commensurate decrease in the economic and quality of life burden for U.K. society.

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8.6 *The Actuarial Profession's Role*

8.6.1 Actuaries are highly skilled modellers and their core competencies are easily transferred to healthcare issues. However, because of the dominance of economists and academics in socialised health systems and the lack of incentives in these systems to focus on financial viability and sustainability, actuaries have not traditionally found their skills much in demand by health care managers. Unlike in the U.S.A., most U.K. healthcare payers are motivated by government targets which emphasise health inequalities and allocation of resources to the most needy, rather than profit maximisation. However, actuarial skills are increasingly being demanded by PCTs in the U.K., who are slowly recognising that long-term forecasting, predictive modelling, risk analysis of populations and financial sustainability are key tools for success in meeting their populations' needs.

8.6.2 In rising to this challenge, the Actuarial Profession should emphasise that actuarial skills are complementary to other professionals and actuaries should seek to be part of multi-disciplinary teams to tackle healthcare problems. Most healthcare modelling requires a good knowledge of the underlying clinical processes, whether this is through thorough review of the literature, or the inclusion of medical knowledge in the project team. In addition, actuaries must recognise and understand the role played by health economists so they can articulate clearly where their knowledge and skills are complementary and the additional value which actuaries bring to these issues.

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