HEALTH ECONOMIC MODELLING OF THE SERVICE OF CARE IN SHEFFIELD FOR PATIENTS WITH LONG-TERM DEPRESSION

(WORK IN PROGRESS)

Tosh J, Brennan A, Parry G, Saxon D, Ricketts T, Foster A, Thake A, Chambers E, Hutten R

University of Sheffield, Sheffield, UK

INTRODUCTION

Depression refers to a range of mental health problems which are characterised by the absence of a positive affect, low mood and a range of associated emotional, cognitive, physical and behavioural symptoms(1). Depression with anxiety is experienced by 9.7% of people in England (11.8% females, 7.6% males)(2). Although depression has traditionally be viewed as a time-limited disorder, which would last for approximately 4-6 months and patients would make a complete recovery, it is now clear that a significant proportion of patients have an incomplete recovery, and a prior episode of depression is a significant risk factor for relapse(1). At least 50% of people following their first episode of major depression will go on to have at least one more episode, and this risk rises to 70% and 90% after the second and third episode respectively(3). This has seen the treatment and management of depression focus on prevention of a subsequent relapse, because while the outlook for a first episode is relatively good, the outlook for recurrent episodes over the long term can be poor(4).

The focus of this study is on the significant numbers of patients with depression for whom the outlook is poor. The term 'long-term depression' is used to capture both those patients whose symptoms have not responded to treatment (sometimes called 'treatment resistant depression'), and also those patients who have suffered more than two distinct episodes of major depression. For these patients, depression is considered a chronic condition, and the impact of services and effective treatments can have significant implications, in terms of health outcomes and NHS services over a persons' remaining lifetime. An Office of National Statistics study in 2000 estimated the total direct costs of depression for the NHS as £370m, along with significant indirect costs for the economy (£8bn total morbidity costs, £562m total mortality costs)(5). It is clear from this study,

and other similar cost-of-illness studies(6;7) that depression imposes a significant burden on individuals, carers, the NHS and the wider economy. Therefore it is of fundamental importance to ensure that health care resources are efficiently used to maximise health benefits for people with depression.

The constraints on health-care resources mandate that resource-allocation decisions be guided by considerations of the cost in relation to expected benefits(8). A cost-effectiveness analysis is a method of economic evaluation that considers both the additional health benefits and the additional costs of a new treatment to determine whether they represent value for money. Health benefits can be measured In terms of quality-adjusted life years (QALYs), a single measure that combines length of life with health-related quality of life (HRQoL)(9). This is achieved by assigning every health state a HRQoL value, where 1 is equal to full health and states as bad as dead are given 0. A depressive episode lasting 18 months with a HRQoL of 0.4 would equal 0.6 QALYs. It is common for analyses to categorise the individual's experience into different health states with HRQoL scores assigned, and lifetime QALYs are calculated by summing the QALYs for each health state. To compare alternative possibilities (different treatments, or different service configurations), incremental costs and incremental QALYs between comparators are calculated. The ratio of incremental costs and incremental QALYs is called the incremental cost effectiveness ratio (ICER), which is the key metric estimated in a cost-effectiveness analysis. The National Institute for Health and Clinical Excellence (NICE) is an independent organisation in the UK that provides guidance on the use of treatments in the NHS. Cost effectiveness analyses are a key component of the NICE appraisal process of new treatments, and NICE has a threshold range of £20,000 - £30,000 per additional QALY. If treatments have an ICER above this threshold, it is unlikely they will get a positive recommendation. Due to the chronic nature of long-term depression, a cost-effectiveness analysis requires an estimate of costs and benefits that accrue over a patient's remaining lifetime(10). Decision analytic modelling methods are routinely used to extrapolate short-term clinical trial evidence, as well as incorporating longer term observation data, to inform estimates of lifetime costs and QALYs(11).

The 'Improving Quality and Effectiveness of Services Therapies and Self-management on long-term depression' (IQuESTS) study is funded by the National Institute for Health Research Collaborations for Leadership in Applied Health Research and Care (NIHR CLAHRC). The CLAHRC for South Yorkshire is a joint collaboration between the Sheffield Teaching Hospitals NHS Foundation Trust,

the Sheffield Health and Social Care NHS Foundation Trust, the University of Sheffield and Sheffield Hallam University. A team of academics, service users, clinicians, providers and commissioners are committed to translating results of academic research to routine NHS care, by improving self-management, and demonstrating a step change in the quality and effectiveness of NHS psychological therapies and services. This health economic modelling exercise is the first work package of the IQuESTS project, and the system modelling of the care pathway allows a shortlisted set of system improvements identified from the other work packages to be tested in the model. The potential cost effectiveness of these service improvements will inform whether they should go forward for testing in a pilot study, and potentially onwards into routine NHS practice in South Yorkshire.

This paper presents the IQuESTS Work Package 1 in the order of research, which has followed the Tappenden (2011 Thesis) Whole Disease Modelling (WDM) framework. This framework is presented first, followed by a conceptual model of the current service of care. The methods and preliminary results of the economic model are described, followed by a discussion about the use of the WDM framework, the economic analysis and the IQuESTS project, before conclusions are drawn.

WHOLE DISEASE MODELLING FRAMEWORK

Recent work by Tappenden (2011; PhD thesis) has involved the development of a "Whole Disease Modelling" (WDM) framework, with his case study being services for the treatment of colorectal cancer. This modelling framework has been developed to allow for a consistent platform through which to evaluate the expected costs, health outcomes and cost-effectiveness of potential policy changes within UK colorectal cancer services. This form of modelling moves away from the notion of considering an optimal policy at an isolated point in the broader care pathway, to modelling the pathway itself and the range of decisions therein. In taking this broader perspective, WDM can be used to address a much wider range of local and national level questions regarding the configuration of health services, with the intention of improving overall health outcomes across the system.

Tappenden has developed a methodological framework for WDM, and this framework has been applied for the development of this mathematical model of psychological services for long-term depression. Not only does this provide a validated modelling methodological framework for this study, but it also informs the potential generalisability of the framework. The framework is described in Table 1, and the IQuESTS Work Package 1 study is concerned with all 6 stages of the framework. This paper looks to summarise the Work Package 1 study and the experience of following this process.

Table 1: Whole Disease Modelling framework (Tappenden 2011)

Defining the terms of reference – boundary, breadth and depth
1. The boundary and breadth of the model should capture all relevant aspects of the disease and its treatment
2. The model should be developed such that the decision node is conceptually transferable across the model
3. The costs and consequences of key service elements should be modelled dependently
4. All evaluations should be posited on the same understanding of a single conceptualisation of disease course and management (i.e. the same conceptual model)
The framework requires six stages to be followed when developing a Whole Disease Model:
Stage 1 – Understand the decision problem
Stage 2 – Develop a conceptual model

Stage 3 – Systems design and analysis
Stage 4 – Implement qualitative model
Stage 5 – Model checking
Stage 6 – Use of model

It is important to highlight that the framework makes the development of a conceptual model a clear and distinct stage in the process. Traditionally, defining the model structure and cohort/patient pathway has not been an explicit process, with models sometimes being developed which do not appropriately represent reality. Having a distinct stage for developing a conceptual model allows the research team to understand how long-term depression affects a person, and how the health system is organised to provide for patients. The conceptual model can be represented as a disease model, and a service model, with the mathematical model relating the service to the disease. The conceptual model provides an agreed basis for the development of the mathematical model, and deviations from the conceptual model are transparent, and require justification.

The model boundary is defined as people with long-term depression who are within the NHS system of psychological therapies. It is important to note that NHS patients with long-term depression are a subset of the total amount of people with long-term depression, due to people choosing to seek care in either the voluntary or private sectors. Alternatively, people may not present at any professional provider, and instead may rely on family, friends or on self-management. The model breadth is the extent to which the model considers a particular patient's care pathway. In this conceptual model, the model focusses on NHS uses of psychological therapies from entry into a service, until death. The model depth is the amount of specific detail that the model requires, so to capture all costs, benefits and treatment related events. In this particular study, the research team were aware that data and evidence were likely to be limited, and so a pragmatic approach has been taken to ensure that appropriate detail is captured, whilst being aware of the relatively tight resources for this particular study, and its overall objective which is to inform potential service improvements for further analysis in a pilot study.

CONCEPTUAL MODEL

The conceptual model was developed through interviews with local experts (managers, service users, clinicians and academics), through relevant literature and from NICE guidelines and guidance. In terms of the clinical disease, many characterised long-term depression as a relapsing/remitting condition. For long-term depression, the agreement was that a person should have experienced 3 depressive episodes, and the disease level model is shown in Figure 1.

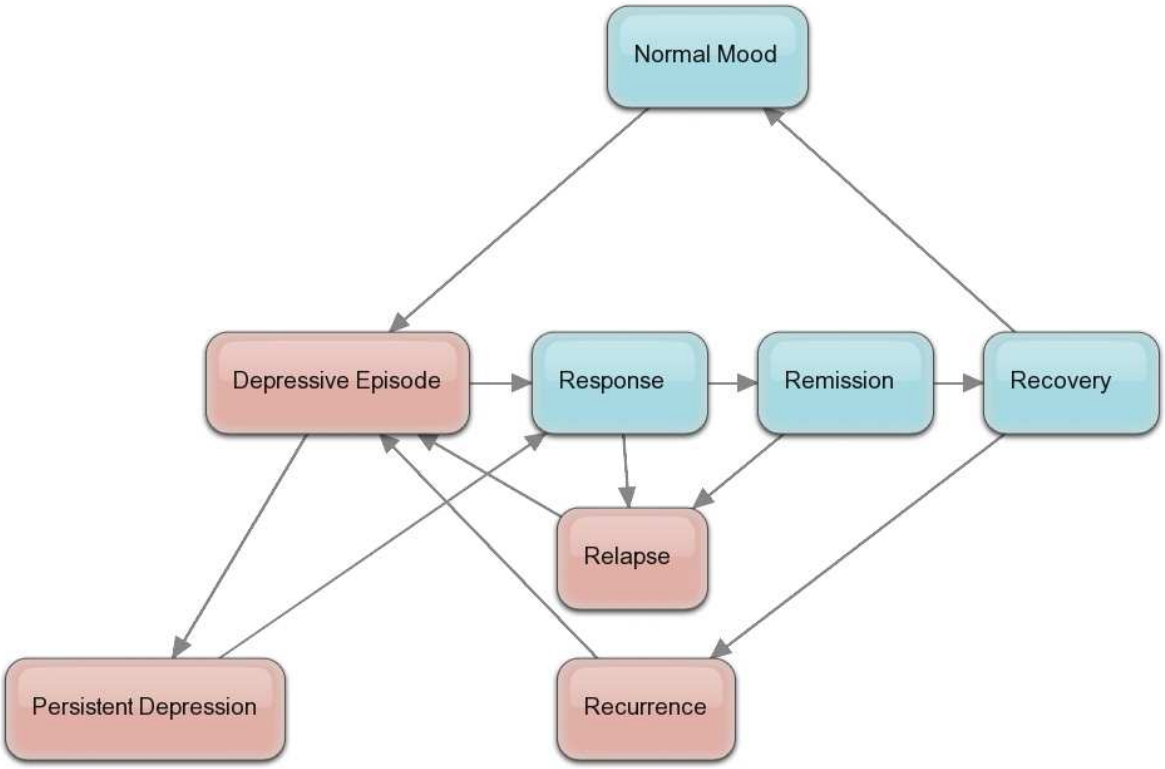

Figure 1: Conceptual Disease Level model

There was discussion about the distinction between relapse and recurrence, depressive episode and persistent depression, and between remission and recovery. It was suggested that these are dependent on the length of time experienced in the prior state(12;13).

The stepped care model (SCM) has been adopted in the recent NICE guidelines (1;14) as a structured way to identify the most appropriate and least costly interventions that are effective for an individual with depression. From the interviews, it was clear that the SCM has been embraced by local commissioners and NHS providers, and the new Improving Access to Psychological Therapies (IAPT) service is an integral component of the SCM(15). Although the SCM provides a clear structure for the system of care for people with long-term depression, it does not give clear criteria

for how people move in and out of the different health services (primary care, secondary care, tertiary care). The SCM has 5 components which are outline in Table 2, which through the interviews have been used as a broad structure for developing the conceptual model.

Table 2: Stepped Care Model

Step 1 – case finding and assessment in primary care Here, people with long-term depression may present with a relapse or recurrence. If they are identified has having long-term depression, the NICE guidelines recommend that they step up to Step 3 (primary care treatment for moderate to severe depression). However in practice it is likely that they move to Step 2.
Step 2 – primary care therapy (mild depression) Here, a range of treatments may be offered. These include low intensity IAPT psychological therapies, counselling, guide self-help as well as signposting and lifestyle advice. People who do not respond are stepped up to Step 3.
Step 3 – primary care therapy (moderate to severe depression) Here, treatments may include individual or group computerised behavioural therapies (CBT) provided by high intensity IAPT, along with concomitant antidepressants.
Step 4 – secondary and tertiary mental health services Here, Community Mental Health Teams (CMHTs) will undertake an assessment of the person, firstly to ensure they meet a screening criterion, and secondly to undertake an assessment of need. Potential treatments include combinations of antidepressants and individual CBT. Patients who do not respond may be referred to the tertiary service, which includes a Specialist Psychological Service (SPS) for helping those with severe depression.
Step 5 – Severe depression (and an immediate risk to life or severe self-neglect) People at stage will be seen by a Crisis Team, and may require inpatient care to achieve rapid short term improvements. Psychological therapies are not relevant for this step, however effective therapies may reduce the likelihood of patients requiring this step.

The conceptual model has been diagrammatically represented (Figure 2), and includes reference to the fact that people may enter both from medical referral as well as other specific public sector

routes. It also highlights how the third and private sector add an element of complexity, because they can be accessed at any point in the care pathway.

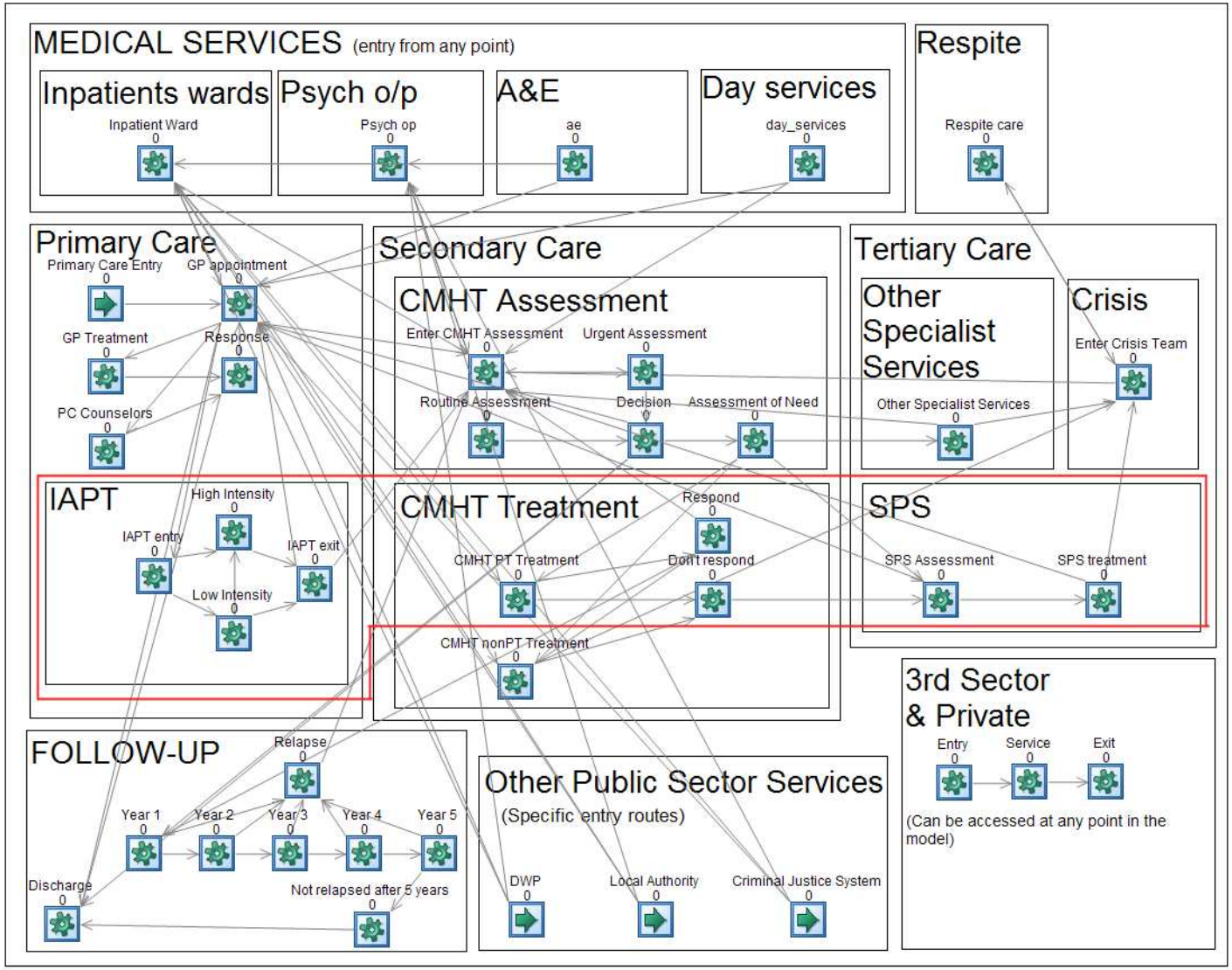

Figure 2: Conceptual Model (psychological therapies encircled)

QUANTIFIED MODEL

Methods

A discrete event simulation model has been developed in the Simul8© software package to assess the alternative options for service change. The benefits of each option are measured in terms of QALYs gained. Alternative service options can then be compared using the cost per QALY gained metric. Both costs and health outcomes are discounted at 3.5% each year to account for time preferences. The simulation of the patient pathway is shown in Figure 3, and this shows that simulated patients are either in a normal state, a depressive episode, or a dysthymic (chronic mild depression) episode. At any time point a patient may present to NHS services (Box 2 of the schematic) with either a current depressive or dysthymic episode. The simulated patient can then step through primary care treatment (GP counselling and anti-depressants), primary care IAPT psychological therapies (Box 3), secondary care CMHTs (Box 4) and tertiary SPS care (Box 5). The simulated patient is tracked for their remaining lifetime, until they die and proceed to Box 6.

The model simulates 1,000 patients and estimates the mean cost and mean QALY per patient. The model has been developed with a basecase set of assumptions and model inputs (known as parameters). This is to determine the current estimate of costs and health benefits, and the results of the alternative service options are compared to this basecase model. A set of options for evaluation in the model was compiled by organising a workshop. Local service providers, service users, academics, NHS managers and commissioners were invited to the workshop. The workshop was used as an opportunity to validate the conceptual model, and to identify potential service reconfigurations. Twelve options were developed and discussed at the workshop, and three of these options were determined as appropriate for mathematical modelling. The final shortlist of options will be prioritised through a Delphi exercise.

Table 3: Potential service changes for modelling

Service Change 1: Self-referral back to the therapist
Many therapists already offer a phone number to clients who are being discharged. This allows them to visit the therapist after discharge if they feel they require it, for a one off

session, and potentially fast-tracked straight back into therapy. **Model assumptions**: Can refer back if onset of next depressive episode happens within 6 months. Costs one therapist appointment, and then immediately begin a new course of therapy.
Service Change 2: Better management and prevention of drop out Almost 50% of people will drop out of psychological therapies, although management and interventions to address this has not been widely developed. Some evidence to support an additional session to develop preparation information and strategies, which may reduce drop out. **Model assumptions**: A reduction by 20% in the rate of drop-out in primary, secondary and tertiary services. Costs one extra therapist session (to develop management and coping strategies).
Service Change 3: Widening access to non-therapy services There are a range of services that fall outside of traditional psychological, psychosocial and medical therapies. These include social groups, physical and creative therapies. Widening availability through NHS funding may see more suitable and beneficial care being provided. **Model assumptions:** The increased availability of new non-therapy services sees a slight reduction in service drop-outs (10% reduction) and a 10% increase in the probability of response to treatment. Costs one extra therapist session.

Developing a model on the scale of an entire mental health service means that the relevant patient population is dependent on the boundary around the model; this is in turn determined by the scope and nature of the options to be considered. Given that the scope of options for assessment across the whole long-term depression psychological treatment pathway means that the population is defined as 'people using long-term depression services'. This has been more explicitly defined as people with a diagnosis of recurrent depression (ICD-10 of F33 or F38.1) or three separate depressive episodes (each episode being one of F41.2, F34 or F32). This captures recurrent/treatment-resistant depression as well as persistent sub or super-threshold depression/dysthymia.

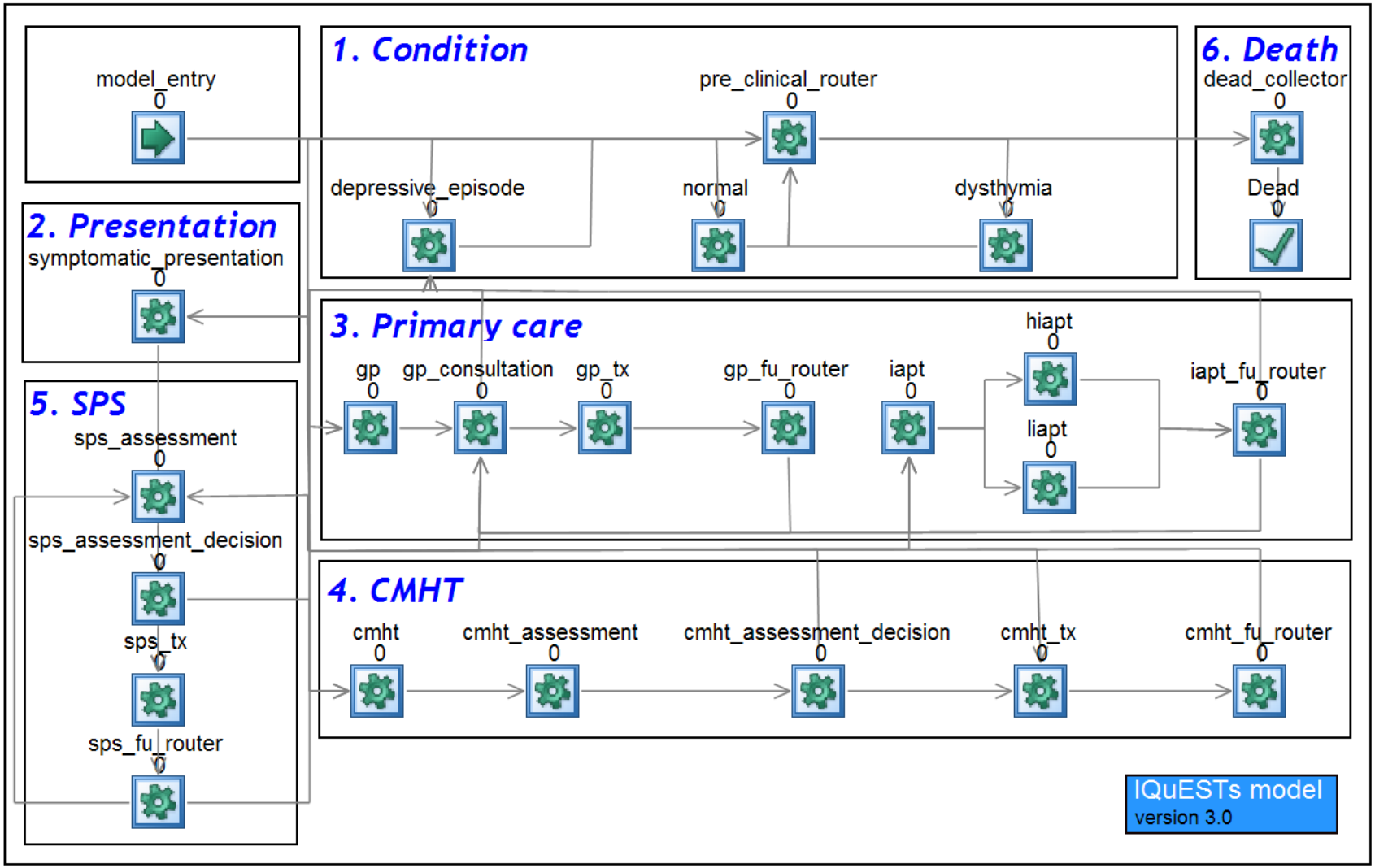

Figure 3: Model schematic

Each patient is assigned a number of characteristics which, based on event probabilities and Monte Carlo sampling, determine their rout though the model pathway. These characteristics are their current disease status (depressive episode, dysthymic episode, normal state), age, health utility, gender, previous history in the model (number of previous episodes, response to previous episode, presentation to service, response to treatments).

The model retains the function to include co-morbidities and socio-economic status; however evidence that means that these factors would have an impact on a patient in the model has not been forthcoming. The natural history of long-term depression is defined in terms of a relapsing/remitting condition. The time spent in each state is explicitly modelled with the impact of any health services or interventions. This represents the default profile for a person who does not present/engage with services, or who drops out from the system. The model allows effective treatments to impact on the natural history of the condition. Some treatments may reduce the severity of the episode, some may shorten the length of the episode, some may increase the time until a relapse occurs, and some may be a combination of all three possible benefit types. At present, a mortality impact of long-term depression has not been modelled. Life expectancies are modelled for men and women from the ONS Lifetables for England and Wales (2009).

Evidence used to inform parameter values in the simulation model were obtained from a range of sources, included a search of published literature surrounding the diagnosis, treatment and follow-up of long-term depression, and a search of published NICE Technology Appraisals and Clinical Guidelines. NHS Reference Costs were used to identify cost parameters. Routinely collected data from the Sheffield Health and Social Care NHS Trust have been analysed for this model. These data include IAPT primary care diagnoses and episodes of care, CMHT episodes and SPS episodes. The process of generating potential options for evaluation, model structuring and data collection were iterative and closely interrelated.

Table 4: Model Parameters

Parameter	Value/Distribution				Source
Epidemiological Parameters					
Length of untreated episode of recurrent depression	Episode	Mean time (years)	Weibull lambda	Weibull gamma	(16)
	Third	0.546	1.125	0.570	
	Fourth	0.596	1.025	0.602	
	Fifth +	0.433	1.134	0.453	
Probability of not having a recurrence of depression	After two previous episodes = 0.3 After three previous episodes = 0.1				(17)
Time between episodes of recurrent depression	LogNormal 0.934 years (sd 0.533)				(18)
Clinical Presentation					
Probability of presenting at service during a depressive episode	0.40 "40% of people with depressive disorder are under care of a professional" PSA varies estimate by +/- 10%				(19)
Probability of having no relapse after response to CBT	0.75 Beta distribution (5,15)				(20)
Primary Care					
Probability of person receiving primary care therapy (even if stepping up). Mirtazapine therapy	Assumed 100%				-
Probability of response after 8 weeks of mirtazapine	0.63 Uniform distribution between 0.58-0.67 (From NICE Clinical Guideline – Adapted from Cipriani *et al. (21)*				(1)
Probability of referral to IAPT	Assumed 100% of LTD patients are referred to IAPT				
IAPT					
Probability of low intensity IAPT for LTD	0.684				SHSC data
Probability of high intensity IAPT for LTD	0.316				SHSC data
Probability of effective low intensity IAPT for LTD (>10 point improvement in PHQ-9)	0.236 (This is estimated from patients with complete data only). IAPT completers only				SHSC data
Probability of effective high intensity IAPT for LTD (>10 point improvement in PHQ-9)	0.544 (This is estimated from patients with complete data only). IAPT completers only				SHSC data
Probability of completing low intensity IAPT for LTD	0.353				SHSC data
Probability of completing high intensity IAPT for LTD	0.353				SHSC data
Number of sessions for low intensity IAPT	3(+ 1 assessment session)				SHSC data
Number of sessions for high intensity IAPT	7 (+ 1 assessment session)				SHSC data
Length of therapy course for low intensity IAPT	0.419 years				SHSC data

Length of therapy course for high intensity IAPT	0.714 years	SHSC data
CMHT		
Time to assess patient for CMHT care	Assumed 0.08 years (4 weeks)	-
Probability of being accepted at assessment	Assumed 80%	-
Probability of effectiveness of psychological therapies in CMHT	Currently assumed to have same delivery and effectiveness as high intensity IAPT. No routine data for this	-
SPS		
Probability of being accepted at SPS assessment	0.706	SHSC data
Probability of effectiveness of psychological therapies in SPS	Currently assumed to have same delivery and effectiveness as high intensity IAPT. No routine data for this	-
Costs		
GP	£38	2009 NHS Unit Costs
IAPT Therapist (per session)	£88 (NonNHSCSCT (Community Therapy Services))	NHS Reference Costs (2010)
CMHT Assessment	£212 (177 – 213) (MHCSCFAA2). Uniform distribution	
CMHT Therapist (per session)	£135 (112 - 151) (MHCT2). Uniform distribution	
SPS Assessment	£139 (100 – 152) (MHST0). Uniform distribution	
SPS Therapist (per session)	£139 (100 – 152) (MHST0). Uniform distribution	
Antidepressant (mirtazapine) treatment. 30mg daily, 8 week course which if effective is maintained	£2.04 per 28 days = £4.08 per course	BNF 61
Health Utilities		
Untreated depression	0.38 Beta (0.49,0.81)	(22)
Pre-treatment depression	0.58 Beta (4.93,3.58)	
Minimal depression/normal	0.88 Beta (1.4432,0.1968)	

The Sheffield Health and Social Care (SHSC) NHS Trust datasets were combined to provide data on 1,807 people in Sheffield who meet the IQuESTS criteria for long-term depression. This combines patients identified from IAPT or CMHT services, as well as people identified through an SPS dataset and linking back to them through the INSIGHT NHS system. The SHSC dataset can be summarised as shown in Table 5. The table highlights significant gaps in the routine data evidence base, and explains why many parameters for the model have been populated with either literature evidence or with assumptions.

Table 5: SHSC Dataset

Data fields	**GP care**	**IAPT**	**CMHT**	**SPS**
Demographics (age, gender)	x	✓	✓	✓
IMS/Employment/Class/Ethnicity	x	✓	✓	✓
Assessment	x	✓	✓	✓
Treatment	x	✓	x	x
Episodes of care	x	✓	✓	✓
Outcome measure	x	PHQ-9	Some HONOS	CORE-OM

The model simulates 1,000 people. Probabilistic Sensitivity Analysis (PSA) is undertaken by running 500 Monte Carlo simulations drawing from assigned distributions for each parameter input. The PSA results were checked for convergence. See Table 4 for distributions for each model parameter. The results of the uncertainty analysis are presented as cost-effectiveness acceptability curves (CEACs).

Pidd describes two types of model validation; black box validation (checking the inputs provide expected outputs) and white box validation (the internal coding and programming of the model)(23). Black box validation has been applied by making comparisons with data in the literature. In addition, three specific applications will be carried out; validation of input parameters (eg goodness of fit of distribution inputs, appropriateness of literature sources), static logic validation (programming language is appropriately debugged) and dynamic logic validation (graphic outputs from the model to ensure the model functions correctly).

Also, face validity of the model and its results has been applied continually by presenting the model to the IQuESTS project team, the steering group and the advisory forum. Expert opinion and knowledge is crucial to ensure the model is appropriate, and it is important that a wide range of experts believe the developed model is an appropriate method for suggesting policy changes.

Preliminary results

It should be noted at this stage that these results are preliminary, and have not yet been fully validated. The static logic validation will be undertaken by a second modeller, and the final results and specified sensitivity analyses will require approval by the IQuESTS project team.

A full set of probabilistic results are presented in Table 6. The Reducing Drop Out and Self-Referral interventions both have a slight cost increase for the service (£202 and £539, respectively) compared to the basecase model, however these are offset by significant QALY gains (2.22 QALYs and 2.87 QALYs) and a reduction in the average number of episodes for people with long-term depression. The Widening Access intervention is likely to be cost saving (-£52), and alongside a significant increase in QALYs (2.27) is therefore a dominant strategy (more effective and less costly) than the basecase model. Incremental analyses (comparing each intervention against each other) are not presented, because the interventions could in fact be applied in combination. A factorial design analysis will be considered in the final analysis because it is likely that there are interactions across all the interventions.

Scenario sensitivity analyses have not yet been conducted; however there are assumptions that require testing to ensure that the results are robust and appropriate. Probabilistic Sensitivity Analysis has been conducted, to quantify the uncertainty in parameter inputs. Figure 4 suggests that all three interventions have a positive health impact, with Reducing Drop Out and Self-Referral both certain to have an increase in cost. There is uncertainty as to whether Widening Non-therapies is dominant, or if the health benefits require trading-off against an increase in NHS costs. The Widening Non-therapies intervention currently costs 1

additional therapist attendance, because the specific nature of which non-therapies are likely to be offered has not yet been fully developed. The cost-effectiveness results therefore suggest that these would need to be relatively low cost, to ensure the service remains cost-neutral.

The results are important for local decision-makers, who are unlikely to have a budget to allocate to service improvements, and instead may be looking to dominant/cost-neutral changes to the system.

The results show a significant change in the QALYs when discounting is applied. This is likely to be because the intervention is applied at the beginning of a patient's lifetime, and it can have a time dependent impact on the likelihood of future relapse. However without static validation having been conducted it could be a model error.

Table 6: Results

Option	Episodes	System results				Costs (£)				QALYs	Discounted		Cost effectiveness (compared to baseline)		
		1^0 visits	2^0 visits	3^0 visits	Number of PTs	1^0	2^0	3^0	Total	Total	Cost (£)	QALYs	Incremental cost (£)	Incremental QALYs	ICER (Cost per QALY)
Basecase	21.01 (1.28)	8.58 (1.19)	0.31 (0.05)	0.17 (0.03)	8.58 (1.19)	2,625 (386)	371 (63)	211 (36)	3,208 (478)	26.36 (7.48)	2,052 (322)	16.45 (5.84)	-	-	-
Reducing drop out	18.70 (1.50)	7.28 (0.94)	**0.36 (0.05)**	**0.20 (0.03)**	7.28 (0.94)	**2,636 (357)**	**476 (72)**	**270 (38)**	**3,381 (458)**	**26.71 (7.45)**	**2,255 (331)**	**18.67 (6.00)**	202	2.22	£91
Self-referral	18.30 (1.08)	6.28 (0.93)	**0.39 (0.04)**	**0.26 (0.03)**	6.28 (0.93)	**3,109 (294)**	**507 (60)**	**373 (40)**	**3,990 (368)**	**26.86 (7.42)**	**2,592 (255)**	**19.32 (5.82)**	539	2.87	£188
Widening access	18.63 (1.46)	7.25 (0.97	0.24 (0.03)	0.13 (0.02)	7.25 (0.97)	2,523 (354)	308 (49)	171 (31)	3,002 (428)	**26.72 (7.44)**	2,001 (303)	**18.72 (6.00)**	-52	2.27	Dominates Basecase

Values in **bold** represent an increase compared to basecase
PT = Psychological Therapies

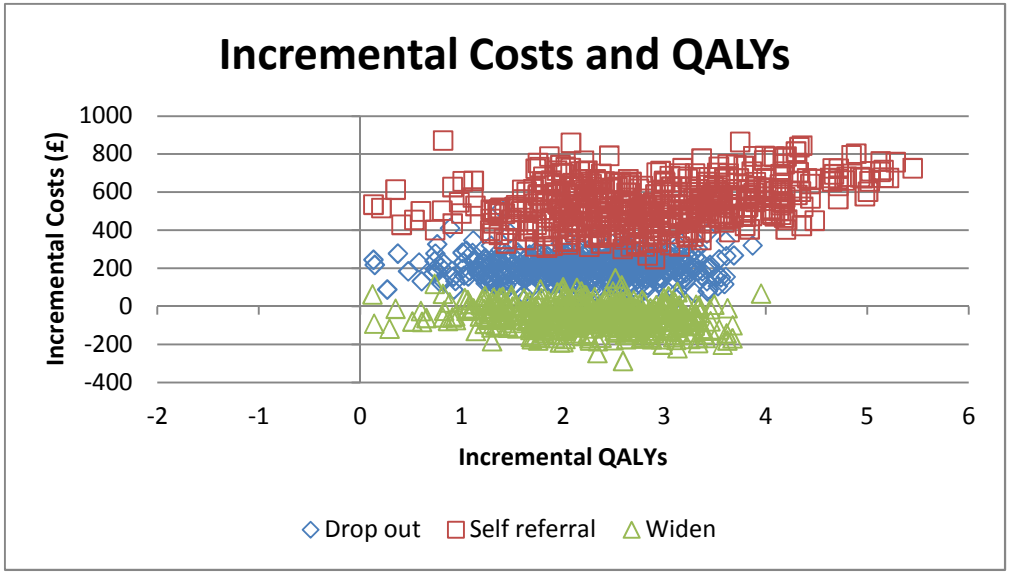

Figure 4: Scatterplot

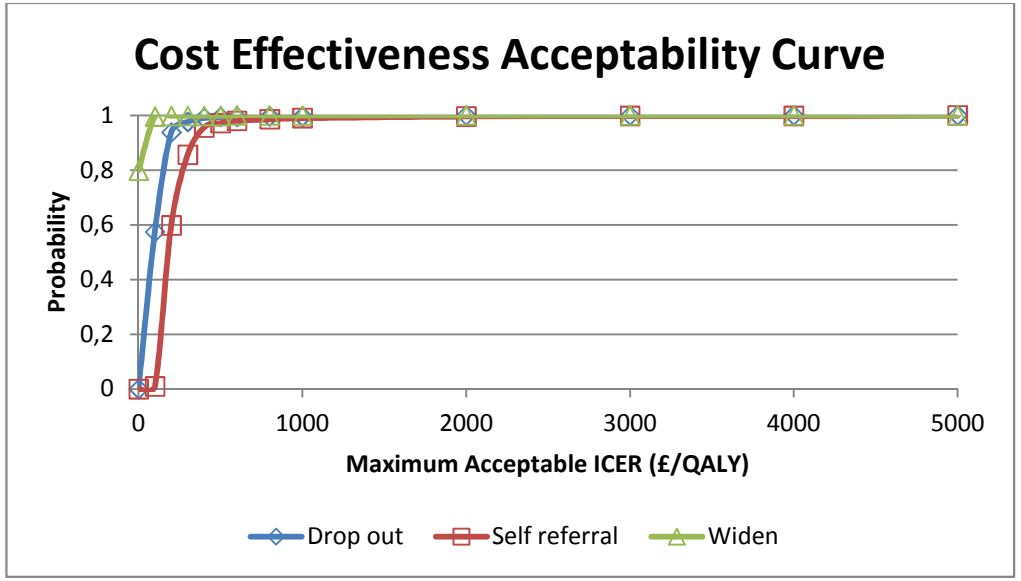

Figure 5: Cost effectiveness acceptability curve

DISCUSSION

The results of the analysis highlight the flexibility and appropriateness of the WDM framework when looking to evaluate service changes which will have a wide and long-term impact. Each of the three service changes evaluated show significant QALY benefits, through an increase in engagement with the services, and through a reduction in future depressive episodes. The cost-effectiveness of each change is dependent on the cost-effectiveness threshold used by local NHS commissioners; however it is likely that some improvements can be made in terms of health improvement which have a cost-saving or cost-neutral impact on the NHS services for people with long term depression

The quantified model also provides useful service performance metrics, such as flows of people through different parts of the service, and changes can be evaluated in terms of their impact on specific resources. This is important because the local NHS is currently going through a period of change, and budgets for specific providers and sectors are being restricted.

A particularly important result is that only low numbers of people with long term depression 'step up' to secondary (CMHT) and tertiary (SPS) services. Firstly because only a small proportion will present, but also because by the time they reach these higher steps, the depressive episode may have passed. In particular, the self-referral service change highlights that if people can quickly receive appropriate therapy then there are significant health benefits both immediately, and in the longer term.

As with any health economic modelling, there are limitations of the analysis which should be noted. Firstly, the analysis of the SHSC dataset has only been to identify broad flows of patients in the service, and covariates at this stage have not been incorporated into the analysis. One service improvement of interest to the IQuESTS group is to improve access and services for Black and Minority Ethnic (BME) communities, due to the high rates of mental health hospitalisations and challenges of meeting the needs of BME communities(24). Incorporating a multivariate analysis of the routine SHSC data will allow more accurate results to be estimated, especially for services which aim to target particular patients, although significant gaps in the dataset will still remain.

Secondly, health economic modelling allows evidence from different sources to be synthesised so that an estimate of the long term costs and benefits of new interventions can be found. As such, the model is limited by the quality of evidence that is available. The basecase model results suggest that patients experience on average 21 depressive episodes. This is derived from longitudinal studies which estimate a time to relapse after a particular number of episodes, however evidence about relapse past 5 episodes was not identified, and so the model simulates a potentially inaccurate number of episodes. Experts suggest that this number is likely to be too high, however it should be noted that there is still a low probability of patients presenting, and so these episodes may go undetected.

There is a significant evidence gap regarding the effectiveness of therapies at the higher steps (CMHTs and SPS). For this first attempt at modelling the service, the effectiveness of SPS psychotherapy has been assumed to be equal to CMHT psychotherapy. Because the IQuESTS project will establish a specialist depression clinic to pilot these service improvements, this will benefit the model in terms of collecting long term data regarding patients' experiences with depression, and the impact of specific therapies. This data will be used in an updated version of the model once the pilot study has been completed.

Mortality and serious adverse events have not yet been incorporated into the model. People who suffer a severe depressive episode have a significantly increased suicide risk, as well as increased risk of self-harm or the need for hospitalisation(1). These potential cost and QALY impacts will be incorporated when the model is updated, especially because at present the benefits of services which reduce the severity or frequency of depressive episodes may be underestimated.

The WDM framework provides a useful set of stages for a research project of this type. Because a change to a system can impact on other services, it is important to have a wide boundary and ensure that all possible costs and benefits are incorporated into the analysis. This aids decision-makers and commissioners, who are often challenged when trying to implement economic analyses which have a very specific boundary (i.e. a pairwise evaluation of treatments which does not capture the full downstream implications). Also, the WDM framework allows multiple evaluations of service changes to be undertaken. At this stage, 3 different service changes have been evaluated, however more can with minimal

work, which means the WDM framework allows efficient use of one (potentially more complex) model, rather than requiring several models. Although not presented in this set of results, a factorial design approach would be appropriate to estimate the combined impact of applying several of the service changes in combination(25). However this, along with looking to optimise the service, was not one of the objectives when looking to developed the WDM framework, and the appropriate use of WDM to inform local policy with a fixed budget could be further research project.

As mentioned, this analysis currently a work in progress, and full parameterisation and validation has yet to be undertaken. The IQuESTS project has provided several opportunities for the research team and service users to validate the conceptual and mathematical model, and scenario analysis will be undertaken to provide more ‘what if’ type questions to be evaluated.

CONCLUSION

The analysis has used the novel WDM framework to allow a single model to evaluate several changes to the local mental health NHS service for people with long term depression. The analysis is a work in progress, however both the cost effectiveness results, and the modelling framework have provide a positive contribution to the IQuESTS project. The cost effectiveness estimates have supported the development of service designs which aim to reduce drop out from services, allow patients to self-refer back to a therapist, and widen the access to non-therapy services. These service designs are now going to be evaluated in a pilot study as part of the IQuESTS CLAHRC-SY project. The results of the pilot study will be analysed using the same model, to provide more robust evidence, and refine the cost-effectiveness estimates. The model has been an integral component of seeing evidence being translated into service change and improvements for patients, and the WDM framework has allowed commissioners, providers and service users to aid the development of the conceptual and quantified model.

There are some significant limitations to the model, in its current form, however these will be addressed with updates to the evidence and assumptions. Because the model has been developed in an iterative process, and integrated into a wider research project, this has allowed the model to be continually validated and refined. The results, whilst currently relevant only to South Yorkshire, may have generalisable conclusions, which are being investigated via a comparison with another region. The application of the WDM framework for a chronic condition has been a challenge, although this is more due to the complexity of the service, rather than fundamental issues with the methodological framework. It is hoped that the output of this research will support the use of WDM, when the objective is to evaluated several service changes or interventions for a particular condition, and ensure all potential costs and benefits are captured.

REFERENCE LIST

(1) National Institute for Health and Clinical Excellence. Depression: the treatment and management of depression in adults (update). Clinical Guideline 2009;www.nice.org.uk/CG90.

(2) Meltzer H, Brugha T, Bebbington P, Jenkins R. Adult psychiatric morbidity in England, 2007 Results of a household survey. The NHS Information Centre for health and social care; 2007.

(3) Kupfer DJ. Long-term treatment of depression. Journal of Clinical Psychiatry 1991.

(4) Akiskal HS. A developmental perspective on recurrent mood disorders: a review of studies in man. Psychopharmacology bulletin 1986;22(3):579.

(5) Thomas CM, Morris S. Cost of depression among adults in England in 2000. The British Journal of Psychiatry 2003;183(6):514-9.

(6) Knapp M. Hidden costs of mental illness. The British Journal of Psychiatry 2003;183(6):477-8.

(7) Almond S, Healey A. Mental health and absence from work: new evidence from the UK Quarterly Labour Force Survey. Work, Employment & Society 2003;17(4):731.

(8) Weinstein MC, Stason WB. Foundations of cost-effectiveness analysis for health and medical practices. New England Journal of Medicine 1977;296(13):716-21.

(9) Drummond MF, Sculpher MJ, Torrance GW. Methods for the economic evaluation of health care programmes. Oxford University Press, USA; 2005.

(10) National Institute for Health and Clinical Excellence. Guide to the methods of technology appraisal. NICE 2008.

(11) Brennan A, Akehurst R. Modelling in health economic evaluation. Pharmacoeconomics 2000;17(5):445-59.

(12) Kupfer DJ, Frank E, Perel JM, Cornes C, Mallinger AG, Thase ME, McEachran AB, Grochocinski VJ. Five-year outcome for maintenance therapies in recurrent depression. Archives of General Psychiatry 1992;49(10):769.

(13) Le Lay A, Despiegel N, Fran+ºois C, Duru G. Can discrete event simulation be of use in modelling major depression? Cost Effectiveness and Resource Allocation 2006;4(1):19.

(14) National Institute for Health and Clinical Excellence. Depression: the treatment and management of depression in adults. Clinical Guideline 2004;www.nice.org.uk/CG90.

(15) Richards DA, Suckling R. Improving access to psychological therapy: The Doncaster demonstration site organisational model.: BRITISH PSYCHOLOGICAL SOCIETY; 2008 p. 9.

(16) Solomon DA, Keller MB, Leon AC, Mueller TI, Shea MT, Warshaw M, Maser JD, Coryell W, Endicott J. Recovery from major depression: a 10-year prospective follow-up across multiple episodes. Archives of General Psychiatry 1997;54(11):1001.

(17) American Psychiatric Association, American Psychiatric Association.Task Force on DSM-IV. Diagnostic and statistical manual of mental disorders: DSM-IV-TR. American Psychiatric Publishing, Inc.; 2000.

(18) Mueller TI, Leon AC, Keller MB, Solomon DA, Endicott J, Coryell W, Warshaw M, Maser JD. Recurrence after recovery from major depressive disorder during 15 years of observational follow-up. The American journal of psychiatry 1999;156(7):1000.

(19) Hirschfeld R, Keller MB, Panico S, Arons BS, Barlow D, Davidoff F, Endicott J, Froom J, Goldstein M, Gorman JM. The National Depressive and Manic-Depressive Association consensus statement on the undertreatment of depression. JAMA: the journal of the American Medical Association 1997;277(4):333.

(20) Fava GA, Rafanelli C, Grandi S, Conti S, Belluardo P. Prevention of recurrent depression with cognitive behavioral therapy: preliminary findings. Archives of General Psychiatry 1998;55(9):816.

(21) Cipriani A, Furukawa TA, Salanti G, Geddes JR, Higgins J, Churchill R, Watanabe N, Nakagawa A, Omori IM, McGuire H. Comparative efficacy and acceptability of 12 new-generation antidepressants: a multiple-treatments meta-analysis. The Lancet 2009;373(9665):746-58.

(22) Richards A, Barkham M, Cahill J, Richards D, Williams C, Heywood P. PHASE: a randomised, controlled trial of supervised self-help cognitive behavioural therapy in primary care. The British Journal of General Practice 2003;53(495):764.

(23) Pidd M. Computer simulation in management science. John Wiley & Sons, Inc.; 1986.

(24) Care Quality Commission. Count Me In: 2010 census. 2010.

(25) Wu CFJ, Hamada M, Wu CF. Experiments: planning, analysis, and parameter design optimization. Wiley New York; 2000.