The Birmingham Model for Transient Ischaemic Attack

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Status

This paper was prepared for the 70th meeting of the Health Economists' Study Group, to be held at Birmingham in January 2007. It represents work in progress and should not be cited or quoted.

Background

The model is a discrete event simulation model, programmed in Borland Delphi using an event-based executive. Important features of the model are that it tracks individuals who are occasionally competing for resources in a realistic representation of calendar time. In particular, the availability of certain services depends on time of day and day of week. The population to be modelled consists of patients who contact the National Health Service (NHS) with symptoms which could be taken for a Transient Ischaemic Attack (TIA). This includes "TIA mimics" as well as genuine TIAs and minor strokes.

Basic Research Question

To compare different configurations of services for the above patient group. This includes four different outpatient booking systems. These include weekly and twice-weekly clinics with a fixed number of appointments, twice-weekly clinics with extra appointments added to avoid excess waiting, and same day booking.

Patient Pathways

Patients may contact the NHS either through GP or through Accident and Emergency (A&E). They are then followed for a period of 12 months. Patient pathways include management in primary care, specialist outpatient clinics, inpatient admission, thrombolysis and carotid endarterectomy.

Data Sources

Data for the model are derived from the Oxford Vascular Study, the Newcastle Rapid Ambulance Protocol study, the Midlands Consortium of Research Practices electronic network, primary cost data and a literature review.

Costs and Outcomes

Costs in the model include cost of treatments, cost of providing a clinic and cost of use of clinics. Outcomes include strokes averted within the 12 month follow-up period.

The Birmingham Model for Transient Ischaemic Attack

Introduction

This paper reports the current progress in construction of the Birmingham Model for Transient Ischaemic Attack. The population modelled consists of patients who contact the National Health Service (NHS) with symptoms which could be taken for a Transient Ischaemic Attack (TIA). This can in fact be (in increasing order of seriousness) a TIA mimic, a genuine TIA, or a minor stroke. The proportion of minor strokes to be included within the model coverage will be varied as part of the analysis of the model.

Patients who have a genuine TIA but do not contact the NHS as a result are not included in the model. (This includes patients who seek private healthcare as well as those who do not seek any form of care.)

In this model we have only modelled the effect of treatment on the risk of further TIA/stroke (not ischaemic heart disease or other vascular events). This means that a date of "other causes" death can be sampled on initialising an individual patient's record, and need not be resampled if the patient changes treatment.

ABCD Score

It is possible to classify transient ischaemic attacks (TIAs) according to a simple risk score based upon Age, Blood pressure, Clinical features and Duration of symptoms to give a score of 0-6. This score, known as the ABCD score has been demonstrated to be highly predictive of risk of subsequent stroke within the next seven days (Rothwell *et al* 2005), and therefore offers a plausible method by which patients with TIA might be triaged.

Policy and Service Options

The main purpose of the model is to compare different configurations of services for the patient group described above.

Policy options relate to the mix between use of accident and emergency service, use of outpatient clinics, and management in primary care. There are two aspects to this mix. First is the propensity of the patient to dial 999, which is set to either "standard", which is the use pattern consistent with current data sources, or "increased". Second is the action of a GP in the case where the patient sees the GP as the first point of contact with the NHS. One possibility is for the GP to refer all suspected TIAs to an outpatient clinic. An alternative is for the GP to make a diagnosis, and, for those diagnosed as either genuine TIA or stroke, either to refer to A&E, refer to OP clinic, or manage in primary care, according to thresholds of ABCD score. Note that this alternative option includes the possibility that thresholds are set so that all patients are handled in the same way.

A separate dimension of model configuration is the outpatient booking system. The model includes four different outpatient booking systems. These comprise weekly and twice-weekly clinics with a fixed number of appointments, twice-weekly clinics with extra appointments added to avoid excess waiting, and same day booking.

Further policy options within the model include medication from GPs and actions by A&E doctors.

Model Specification

The model is a discrete event simulation model, programmed in Borland Delphi. Important features of the model are that it tracks individuals who are occasionally competing for resources in a realistic representation of calendar time. In particular, the availability of certain services depends on time of day and day of week.

The model runs using an event-based executive. The core of the model is the events list, each entry of which consists of a patient number and the time and nature of the next event involving that patient. Initially, the events list consists of the first occurrences of each of TIA mimic, genuine TIA, and minor stroke.

At each step in the running of the model, (simulated) time is advanced to the earliest event on the events list, and the relevant event is processed. If the event is the entry into the model of a new patient, a new event is added to the list for the entry of the next patient of a similar type. (This ensures that the events list can never be empty.)

In all cases, the event is processed. The patient's condition is updated, as are any relevant totals of resources used. If the event is the exit of a patient from the model, then no new event is scheduled for that patient. In other cases, the next event for that patient is scheduled. This may be the intended next event, such as attendance at an outpatient clinic. However, the risk of an adverse event (stroke or other cause death) is taken into account. Such an adverse event would prevent the intended next event from taking place. Note that any appointments missed as a result of adverse events are lost.

The model is described in terms of the various events which occur in the model, and the way in which they are handled.

Entry to the model

Three separate groups enter the model. These are TIA mimic, genuine TIA, and minor stroke. On entry, patients are given the following characteristics:

- Actual condition type (TIA mimic, Genuine TIA, minor stroke);
- Age group (see note below);
- Sex;
- Systolic blood pressure (mmHg);
- High or not high blood pressure on onset (see note below);
- Clinical symptoms score (0=neither weakness nor speech disturbance, 1=speech disturbance without weakness, 2=any weakness);
- Duration score (0=0-9 mins; 1=10-59 mins; 2=60 mins or more);
- ABCD score (calculated from above);
- Total cholesterol (in mmol/l);
- AF status (no AF, AF no warfarin, AF warfarin);
- Already on antiplatelet therapy (monotherapy – see note below);
- Already on statin;
- Previous diagnosis of diabetes;
- Suitable for carotid endarterectomy;
- Date of "other cause" death;

Age groups are defined in units of 5 years. For ease of interpretation, they are numbered from 4 (20 to 25) to 19 (95 to 100) inclusive.

High blood pressure on onset is selected if the systolic blood pressure is greater than 140mmHg. The OXVASC data set contains a small number of individuals with a systolic blood pressure below 140mmHg but a diastolic blood pressure over 90mmHg, who are regarded as having high blood pressure on onset. For simplicity this model uses SBP only; the distribution used is adjusted to give the correct proportion of patients classified as having high blood pressure.

It is assumed that all patients have the potential to benefit from blood lowering treatment on entering the model.

The status of the patient with regard to antiplatelet therapy may be no therapy, monotherapy, or dual therapy (aspirin + dipyridamole). OXVASC data gives the proportion of patients on monotherapy: it is assumed that no patient is on dual therapy on entry to the model.

The date of "other cause" death is sampled by taking account of the appropriate age/sex-related probability of death during the following year. Given the generally low values of this death rate, it is a reasonable approximation that death dates are uniformly distributed through the year.

When the patient characteristics have been sampled, the patient is set to no management, and the time of onset of symptoms is recorded. For modelling convenience, the patient taking action is modelled as a separate event. As noted above, processing entry into the model of a new patient also includes scheduling the entry of the next new patient of the same type (TIA mimic, genuine TIA, or stroke).

Patient first action

The patient may either to go to accident and emergency (A&E) or contact GP. NHS direct is not modelled as the proportion of relevant patients using it is negligible.

Patient goes to A&E

This can be either under own resources or through a 999 call. The relevant time here is the time at which the patient is seen by a clinician in A&E.

Patient contacts GP

In the case of ringing GP, this will normally result in face-to-face contact with the GP, either home visit or surgery appointment. The only exception is if the patient is still symptomatic on calling the GP, in which case an ambulance is dispatched to send the patient directly to A&E. In modelling terms, this applies to all strokes and to a fraction of the genuine TIAs for which the duration of symptoms is 60 minutes or more.

The model will compare scenarios where different proportions of patients use the various routes described above.

GP Visit

Action here depends on policy option.

Policy Option 1 – maximum use of OP clinics
In this case, the GP refers the patient to OP clinic.

Policy Option 2 – action according to diagnosis
In this case, the GP makes a diagnosis of "real TIA/stroke" or "mimic". If the diagnosis is "mimic", then the patient is discharged.

If the diagnosis is "real", then the GP action depends on the ABCD score. There are two thresholds set as policy variables. If the ABCD score is at least equal to the higher threshold, then the patient is referred directly to a specialist at A&E. If the ABCD score is below the higher threshold, but at least equal to the lower threshold, then the patient is referred to an outpatient clinic. If the ABCD score is below the lower threshold, then the patient is managed in primary care.

(Note that setting both thresholds to a value of 7 means that all patients are managed in primary care, while setting both thresholds to a value of 0 means that all patients are referred to the specialist at A&E.)

The only case in which the GP alters the patient's treatment is if the patient is to be managed in primary care. There are two policy options here – "standard" and "optimal" treatment.

Standard treatment will be based on QRESEARCH data when this becomes available. In the meantime, standard treatment is defined as follows:

- antiplatelet monotherapy given to 50% of those not already on antiplatelet;
- if not already on statin, there is a 20% chance that cholesterol will be measured, in which case statin will be given if total cholesterol is greater than 3.5;
- no antihypertensive treatment;
- will include 20% referral for assessment for carotid endarterectomy.

(The various proportions here are sampled independently of each other and also independently of any patient characteristics other.)

Optimal treatment is:

- antiplatelet dual therapy for all;
- statin if total cholesterol is greater than 3.5;
- antihypertensive if SBP is greater than 130mmHg;
- will also include referral for assessment for carotid endarterectomy.

Note that we have not modelled any delay in the measurement of cholesterol.

If antihypertensive treatment is given, then it is assumed to lower the SBP by 9mmHg (PROGRESS collaborative group, 2001).

We have not yet modelled diagnosis of atrial fibrillation and consequent warfarin treatment.

Accident and Emergency Department
Two options are modelled here.

A&E Option 1 – all to specialist
In this case, all patients are referred to a specialist.

A&E Option 2 – A&E diagnosis
A&E doctor makes diagnosis. If the diagnosis is "mimic" then the patient is discharged. If the diagnosis is "real TIA/ stroke", then the patient is referred to a specialist in A&E.

Note that the diagnosis by the A&E doctor cannot conflict with a GP diagnosis because any referral from GP with a positive diagnosis will be directly to a specialist.

Referral to a specialist involves a further wait in A&E and is thus modelled as a separate event.

Accident and Emergency Department Specialist Referral
The specialist will make the correct diagnosis. Patients with TIA mimics will be discharged. Those with genuine TIAs and strokes will be put on to appropriate treatment (same as optimal GP treatment). They will be admitted to hospital as inpatients if the ABCD score is at least equal to the upper GP threshold (make sense of this later). The purpose of hospital admission is to allow for immediate thrombolysis in case of repeat stroke within a short time frame.

If not admitted, the patient will be discharged. Follow up appointments, including referral for carotid endarterectomy not yet modelled.

Outpatient Appointment
Actions are exactly as for A&E department specialist referral. The event is modelled separately to count resources used appropriately.

Admit as Inpatient
The patient status is changed to inpatient and the patient is set to be discharged at 12.00 noon on the first day which gives a stay of a minimum of 72 hours after admission.

Discharge as Inpatient
The patient status is changed to not inpatient. Follow up appointments, including referral for carotid endarterectomy not yet modelled.

Adverse Events
These are still to be modelled.

Modelling initial patient actions
There are two aspects of patient actions to consider for the model. The first is the choice between contacting A&E or GP and the second is the time from onset to the first contact with A&E or the GP. The aim here is to produce a reasonable representation of reality without overcomplicating the model. The relevant data source is the OXVASC data set, and important summary information is reported in Giles *et al* (2006).

Patient response is classified as emergency or non-emergency. Essentially, an emergency response is defined as one where the patient responds as soon as physically capable of so doing.

The following description is a first attempt at modelling patient responses. Programming code will be added to the model to reproduce the Giles *et al* study with the modelled patient group. The results of the model will be compared to the findings of Giles *et al* and the parameters of the model adjusted if necessary.

The baseline probability of an emergency response was taken according to ABCD score as follows:

ABCD score	0 to 3	4	5	6
P(Emergency)	0.3	0.5	0.55	0.6

This is then increased by 0.1 on Monday and Tuesday and decreased by 0.1 on Friday and Saturday.

Only 20 percent of emergency responses involve a direct call to A&E. Others involve a call to GP. Emergency calls to GP are deflected to A&E if the patient is still symptomatic. This is interpreted as applying to all strokes, and to 30 percent of TIAs for which the symptom duration is over 60 minutes.

Calls to A&E are assumed to involve seeing the A&E doctor at a time uniformly distributed between 1 and 5 hours from onset. This applies whether the patient attends A&E directly or calls the GP first. (Data to confirm or amend this assumption may become available – this is not yet known.)

In case of emergency contact with GP, the time to appointment is again taken uniformly between 1 and 5 hours of onset. This can be either a visit to the GP surgery or a GP home visit.

Non-emergency contact with GP is taken to be available only between 9.30am and 5.30pm on Monday to Friday. It is assumed that the earliest possible contact time for non-emergency contact is 5 hours after onset. The actual contact time is determined by first sampling the day on which contact is made, and then sampling the time for that day.

For day of non-emergency GP contact, the basic rule is that if the earliest possible contact time is before 2.00pm on any day, then it is equally likely that contact will be made on any of three days including that day. If the earliest possible contact time is after 2.00pm on any day, then it is equally likely that contact will be made on any of the next three days. If application of this basic rule gives contact on a Saturday or Sunday, then contact is postponed to the following Monday.

The time of day for non-emergency GP contact is sampled uniformly between 9.30am and 5.30pm where possible. The only exception is for same day contact when the earliest possible contact time is between 9.30am and 2.00pm. In that case the time is sampled uniformly between the earliest possible contact time and 5.30pm.

The following table gives some examples of the application of this rule:

Earliest possible contact time	Actual contact time
4.00pm Tuesday	Equal probability of Wednesday, Thursday, or Friday of that week. Time sampled uniformly between 9.30am and 5.30pm.
11.00am Friday	One-third probability between 11.00am and 5.30pm that Friday. Two-thirds probability between 9.30am and 5.30pm following Monday.
11.00am Saturday	Uniformly between 9.30am and 5.30pm the following Monday.

Outpatient appointment booking systems

Four outpatient booking systems are implemented in the model, as described below. Although there will be some variability in the time taken to see each patient, this variability is not important in the time scales of the model. Appointments are set at fixed intervals of 30 minutes each. If a patient does not attend the appointment, the appointment is lost. Note that the choice of day of the week for these clinics is somewhat arbitrary. The difference between the four service patterns is such that the model should be able to discriminate between them. It is not sensible to expect the model to determine an optimum time of week for outpatient clinics.

It is assumed that patients are booked in sequence into the earliest available appointment. Allowing patients a choice of time within a particular day's clinic would complicate the model to very little advantage.

Weekly fixed

Outpatient clinics occur once a week on Tuesday mornings. In each clinic, there are a total of six appointments, which are set at half-hourly intervals from 9.00am onwards. Appointments must be booked no later than 5.00pm on Monday. The next available appointment time is selected, no matter how far in the future that may be.

Twice weekly fixed

Outpatient clinics occur on Tuesday and Friday mornings. In each clinic, there are a total of six appointments, which are set at half-hourly intervals from 9.00am onwards. Appointments must be booked no later than 5.00pm on the day before the clinic. The next available appointment time is selected, no matter how far in the future that may be.

Twice weekly flexible

Outpatient clinics occur on Tuesday and Friday mornings. In each clinic, there are a minimum of six appointments, which are set at half-hourly intervals from 9.00am onwards. Appointments must be booked no later than 5.00pm on the day before the clinic. The number of appointments in any clinic is extended if necessary so that no patient waits more that 7 days for an appointment.

Same Day
Appointments are available daily (Monday to Friday) at half-hourly intervals from 4.00pm onwards up to a limited number. They must be booked by 4.00pm on that day. For simplicity, the issue of travelling time between booking and arrival at appointment is not considered in the model.

Data Sources
An important data source is the OXVASC data set. This contains patient-level data for 290 TIA patients and 299 stroke patients. The data set was tested for significant correlations between patient characteristics. Correlations were used as appropriate for creating distributions from which patient characteristics could be sampled.

(Note that the alternative method of sampling a complete patient record would involve serious overfitting of the data, as well as requiring some method of handling missing data.)

Input parameters for the model
Input parameters for the model belong to a variety of categories. Each parameter is described individually. Some data values here are provisional, and will be replaced when better data becomes available. The current paper gives a full description of each parameter. Duplication in descriptions will be removed when the parameter sets have been finalised.

Initial Patient Characteristics
For programming reasons it is necessary to assign a complete set of values to all patient characteristics, although some are only applicable to one or two of the three types of patient.

Age group
Initial probability of age group, based on OXVASC data, is as follows:

	Actual condition		
Age group	TIA mimic	Genuine TIA	Stroke
20-25	0.0034	0.0034	0.0000
25-30	0.0069	0.0069	0.0000
30-35	0.0000	0.0000	0.0000
35-40	0.0000	0.0000	0.0100
40-45	0.0207	0.0207	0.0201
45-50	0.0069	0.0069	0.0201
50-55	0.0380	0.0380	0.0267
55-60	0.0551	0.0551	0.0368
60-65	0.0724	0.0724	0.0870
65-70	0.1414	0.1414	0.1404
70-75	0.1242	0.1242	0.1572
75-80	0.1655	0.1655	0.1572
80-85	0.1965	0.1965	0.1739
85-90	0.0897	0.0897	0.1037

	Actual condition		
Age group	TIA mimic	Genuine TIA	Stroke
90-95	0.0655	0.0655	0.0636
95-100	0.0138	0.0138	0.0033

(TIA mimic assumed as for TIA; OXVASC data to be adjusted to general population. Note – because numbers at the lower end of the age range are so low, these groups will be merged for the purpose of adjustment.)

Sex

Patient is male with probability p depending on age group j (j = 4, …, 19), where

$$\log\left(\frac{p}{1-p}\right) = \alpha + \beta j,$$

and the parameters α and β are given in the following table (OXVASC data):

Parameter	value
α	1.534
β	-0.121

Blood pressure

Systolic blood pressure is drawn from a normal distribution dependent on patient type as shown below. It is rounded to the nearest mmHg.

Patient type	Mean	S.D.	Source
TIA mimic	140	30	Assumption
Genuine TIA	153.8	29.9	OXVASC data
Stroke	155.4	26.3	OXVASC data

High blood pressure is taken to be a systolic blood pressure of over 140mmHg.

Clinical symptoms score

This variable can take values 0=neither weakness nor speech disturbance, 1=speech disturbance without weakness, 2=any weakness. It is strictly only relevant for prognosis in the case of genuine TIAs. For programming convenience, it is set to value 0 for TIA mimics, and to value 2 for strokes. For genuine TIAs, C score is sampled from an age-dependent distribution. The probability p_i of a C score of at most i (i = 0, 1) for a patient in age group j (j = 4, …, 19) is given by

$$\log\left(\frac{p_i}{1-p_i}\right) = \alpha_i + \beta j,$$

where the parameters α_i and β were found by ordinal logistic regression from the OXVASC dataset, using only the TIA data, as follows:

Parameter	value
α_0	0.336
α_1	1.278
β	-0.082

Duration of symptoms score

This variable can take values 0=0-9 mins, 1=10-59 mins, 2=60 mins or more. It is strictly only relevant for prognosis in the case of genuine TIAs. For programming convenience, it is set to value 0 for TIA mimics, and to value 2 for strokes. For

genuine TIAs, D score is sampled from an age-dependent distribution. The probability p_i of a D score of at most i (i = 0, 1) for a patient in age group j (j = 4, …, 19) is given by

$$\log\left(\frac{p_i}{1-p_i}\right) = \alpha_i + \beta j,$$

where the parameters α_i and β were found by ordinal logistic regression from the OXVASC dataset, which only contained data on this parameter for TIA patients, as follows:

Parameter	value
α_0	-0.407
α_1	1.330
β	-0.093

Total Cholesterol
This is sampled from a normal distribution with mean 5.34 and standard deviation 1.24 (OXVASC data).

Atrial Fibrillation status
This variable can take values 0=no AF, 1=undiagnosed AF, 2=diagnosed AF. The OXVASC dataset contained information about AF status and whether on warfarin pre-event. Patients without AF were coded 0, although a small number of these were on warfarin. Those with AF were coded 1 or 2 according to warfarin status. The probability p_i of a score of at most i (i = 0, 1) for a patient in age group j (j = 4, …, 19) is given by

$$\log\left(\frac{p_i}{1-p_i}\right) = \alpha_i + \beta j,$$

where the parameters α_i and β were found by ordinal logistic regression from the OXVASC dataset (interpreted as described above) as follows:

Parameter	value
α_0	4.894
α_1	6.383
β	-0.226

Diabetes
Diabetes is set with probability p depending on age group j (j = 4, …, 19), where

$$\log\left(\frac{p}{1-p}\right) = \alpha + \beta j,$$

and the parameters α and β are given in the following table (OXVASC data):

Parameter	Value
α	-0.460
β	-0.116

Antiplatelet therapy pre-event
The patient is already on antiplatelet therapy with probability p depending on age group j (j = 4, …, 19), where

$$\log\left(\frac{p}{1-p}\right) = \alpha + \beta j,$$

and the parameters α and β are given in the following table (OXVASC data):

Parameter	Value
α	-2.591
β	0.162

Statin pre-event
Based on OXVASC data, the probability is set to 0.233. This is not correlated with any other patient characteristic.

Suitable for Carotid Endarterectomy
Based on OXVASC data, the probability is set to 0.046. This is not correlated with any other patient characteristic.

Other Cause Death
The probability of "other cause" death within one year of entry to the model is given by age group as follows. This is based on data from the government actuary's department (http://www.gad.gov.uk/Life_Tables/Interim_life_tables.htm, accessed 16 November 2006). The values here are for England and Wales, and need to be adjusted for stroke deaths.

Age group	Males	Females
20-25	0.000778	0.000274
25-30	0.000765	0.000331
30-35	0.001037	0.000476
35-40	0.001302	0.000695
40-45	0.001822	0.001143
45-50	0.002956	0.001990
50-55	0.004641	0.002921
55-60	0.007306	0.004541
60-65	0.012447	0.007417
65-70	0.019556	0.011958
70-75	0.032947	0.020876
75-80	0.056151	0.036755
80-85	0.091501	0.064235
85-90	0.148454	0.113293
90-95	0.220085	0.187454
95-100	0.310996	0.278753

Clinician Behaviour
Diagnostic accuracy for GP and A&E doctor

Parameter	Value	Source
Sensitivity	0.9	Assumption
Specificity	0.9	Assumption

Resource Use
Unit costs are to be applied to medication and use of services. For A&E and daily OP clinics, only the time actually used is to be costed. For the weekly OP clinics, the appointments are staffed even if not all of them are used, and so the cost of running the clinics (for the standard three hours in the case of "twice weekly flexible" clinics) must be included.

Outcomes
The principal outcome is number of strokes averted during the time frame of the model. Other outcomes include the waiting time for "rapid access" OP clinics.

Results will be reported initially using a cost consequence approach. We will then proceed to a cost utility analysis which will incorporate the impact of stroke in terms of costs of managing the stroke and in terms of effect on quality adjusted life years. Sensitivity analysis will test the robustness of the results to changing the underlying assumptions in the model, and the effect of changing waiting times and clinic capacity. Plausible extremes for the sensitivity analysis will have been derived from the data collection phase. A particularly important aspect of the sensitivity analysis will be to vary the risk of stroke following TIA, to determine whether different patterns of service provision would be warranted for 'high' risk and 'low' risk sub-sets of the population.

Running the model
Since the model starts with outpatient queues empty, it will be necessary to run the model for a "warm up" period before starting to collect results. The model can then be run for an "enrolment" period, in which all new patients contribute to the outcomes from the model. There will also be a "follow up" period, which will last until all "enrolled" patients have exited the model (this will be one year of simulated time). New patients will enter the model during the follow up period, but they will not be included in the outcomes collected.

It will be necessary to run the model long enough to eliminate effects due to stochastic effects within the model. Therefore estimates will be made of the variability around summary statistics collected within the model. It is not yet clear whether it will be better to run the model once for a sufficiently long period or a large number of times with correspondingly shorter enrolment periods.

Results so far
The model has not yet been developed to the point where results in terms of costs and principal outcomes can be estimated. The only results so far relate to the cases where the waiting time for "rapid access" OP clinics increases without limit. This occurs (with current input data) for the following combinations of policy options:

Weekly fixed OP clinics with any of:
GP refers all to OP clinic;
GP refers all positive diagnoses to OP clinic;
GP refers all positive diagnoses with ABCD scores 1 to 6 inclusive to OP clinic.

Twice weekly fixed OP clinics with GP refers all to OP clinic.

Work still to be done

The patient pathways need to be completed by including assessment for carotid endarterectomy and taking proper account of adverse events occurring within the modelled time frame.

Unit costs must then be attached to appropriate points in the model, and the model can then be run to compare various options.

References

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