

Stroke: diagnosis and initial  
management of acute stroke and  
transient ischaemic attack (TIA)

## Costing report

Implementing NICE guidance

July 2008

This costing report accompanies the clinical guideline: 'Stroke: diagnosis and initial management of acute stroke and transient ischaemic attack (TIA)' (available online at [www.nice.org.uk/CG068](http://www.nice.org.uk/CG068)).

**Issue date:** July 2008

### **This guidance is written in the following context**

This report represents the view of the Institute, which was arrived at after careful consideration of the available data and through consulting healthcare professionals. It should be read in conjunction with the NICE guideline. The report and templates are implementation tools and focus on those areas that were considered to have significant impact on resource utilisation.

The cost and activity assessments in the reports are estimates based on a number of assumptions. They provide an indication of the likely impact of the principal recommendations and are not absolute figures. Assumptions used in the report are based on assessment of the national average. Local practice may be different from this, and the template can be amended to reflect local practice to estimate local impact.

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## Contents

Executive summary.....	5
<i>Supporting implementation.....</i>	<i>5</i>
<i>Significant resource-impact recommendations.....</i>	<i>5</i>
<i>Total cost impact .....</i>	<i>6</i>
<i>Benefits and savings .....</i>	<i>7</i>
<i>Local costing template.....</i>	<i>7</i>
1 Introduction.....	8
1.1 <i>Supporting implementation .....</i>	<i>8</i>
1.2 <i>What is the aim of this report? .....</i>	<i>8</i>
1.3 <i>Epidemiology of stroke and TIA .....</i>	<i>9</i>
1.4 <i>Models of care .....</i>	<i>10</i>
2 Costing methodology.....	10
2.1 <i>Process.....</i>	<i>10</i>
2.2 <i>Scope of the cost-impact analysis.....</i>	<i>11</i>
2.3 <i>General assumptions made .....</i>	<i>15</i>
2.4 <i>Basis of unit costs .....</i>	<i>15</i>
3 Cost of significant resource-impact recommendations .....	17
3.1 <i>Assessment and treatment of people who have had a suspected TIA who are at high risk of stroke .....</i>	<i>17</i>
3.2 <i>Magnetic resonance imaging for people who have had a suspected TIA .....</i>	<i>19</i>
3.3 <i>Referral for carotid endarterectomy.....</i>	<i>21</i>
3.4 <i>Admission to a specialist stroke unit .....</i>	<i>27</i>
3.5 <i>Brain imaging for the early assessment of people with acute stroke 29</i>	
4 Sensitivity analysis .....	31
4.1 <i>Methodology .....</i>	<i>31</i>
4.2 <i>Impact of sensitivity analysis on costs.....</i>	<i>32</i>
5 Impact of guidance for commissioners .....	33
6 Conclusion.....	34
6.1 <i>Total national cost for England.....</i>	<i>34</i>
6.2 <i>Next steps.....</i>	<i>34</i>

Appendix A. Approach to costing guidelines .....	35
Appendix B. Results of sensitivity analysis .....	36
Appendix C. References .....	37

## **Executive summary**

This costing report looks at the resource impact of implementing the NICE guideline 'Stroke: diagnosis and initial management of acute stroke and transient ischaemic attack (TIA)' in England.

The costing method adopted is outlined in appendix A; it uses the most accurate data available, was produced in conjunction with key clinicians, and reviewed by clinical and financial professionals.

### ***Supporting implementation***

The NICE clinical guideline on stroke is supported by a range of implementation tools available on our website <http://www.nice.org.uk/CG068> and detailed in the main body of this report.

### ***Significant resource-impact recommendations***

Because of the breadth and complexity of the guideline, this report focuses on recommendations that are considered to have the greatest resource impact and therefore require the most additional resources to implement or can potentially generate savings. They are:

- assessment of people who have had a suspected transient ischaemic attack (TIA), and identifying those at high risk of stroke
- magnetic resonance imaging for people who have had a suspected TIA
- referral for carotid endarterectomy
- admission to a specialist stroke unit
- performing brain imaging immediately where indicated for people with acute stroke.

This report has not quantified the impact of recommendations that are consistent with the [National Stroke Strategy](#) published by the Department of Health in December 2007.

The National Stroke Strategy was accompanied by an 'Impact assessment' document (Department of Health 2007b), which sets out the major costs and benefits that may result from implementation of the strategy.

### **Total cost impact**

The annual change in revenue costs arising from implementing the guideline recommendation that has been costed in this report is shown in the table below.

<b>Recommendation</b>	<b>£000s</b>
Referral for carotid endarterectomy	2768

As highlighted above, recommendations that are consistent with the National Stroke Strategy have not been quantified in this report, but it is recommended that these costs are further investigated at a local level.

The impact assessment report that accompanied the Department of Health National Stroke Strategy estimated the total annual cost of implementation of the strategy to be £189 million (range £133 to £245 million). It should be highlighted that the costs identified by the Department of Health cover other aspects of care in addition to those associated with diagnosis and initial management.

### **Estimated cost of implementing the National Stroke Strategy as calculated by the Department of Health – December 2007**

<b>Recommendation</b>	<b>Base Case</b>	<b>Min</b>	<b>Max</b>
Information provision	6.1	5.6	6.6
Peer support	4.4	0.5	8.3
Transient ischaemic attack	16.2	15.6	16.8
Brain imaging and thrombolysis	8.9	4.6	13.2
Stroke units	89.3	59.6	118.9
Psychological services	7.8	6.8	8.8
Early supported discharge	35.1	24.5	45.6
Community-based stroke rehabilitation	11.4	7.6	15.3
6-week and 6-month reviews	1.6	1.1	2.2
Training	8.2	7.1	9.2
<b>Total</b>	<b>189.0</b>	<b>133.1</b>	<b>245.0</b>

## ***Benefits and savings***

Implementing the clinical guideline should bring the following benefits:

- a reduction in length of stay in hospital for people who have had a stroke
- an increase in the number of strokes avoided
- savings to social care services through decreased dependency following stroke.

It is estimated that the increased use of carotid endarterectomy would be reflected by a reduction in the number of strokes. Increasing the annual number of carotid endarterectomy procedures for people who have had a stroke or TIA by 806 could result direct savings to the NHS of £2.7 million, or savings of £5.3 million when both direct and informal care are taken into account.

## ***Local costing template***

An Excel template has been produced to support this guideline that enables organisations in England, Wales and Northern Ireland to estimate the annual incidence of TIA and stroke for their health community.

The template also allows local users to estimate the number of people who have had a stroke or TIA who would be eligible for carotid endarterectomy, and the number of strokes that may be avoided as a result of carrying out this procedure.

# 1 Introduction

## 1.1 *Supporting implementation*

1.1.1 The NICE clinical guideline on stroke is supported by the following implementation tools available on our website [www.nice.org.uk/CG068](http://www.nice.org.uk/CG068):

- costing tools:
  - a national costing report; this document
  - a local costing template; a simple spreadsheet that can be used to estimate the local cost of implementation
- a slide set; key messages for local discussion
- audit support.

1.1.2 A practical guide to implementation, 'How to put NICE guidance into practice: a guide to implementation for organisations', is also available to download from the NICE website. It includes advice on establishing organisational level implementation processes as well as detailed steps for people working to implement different types of guidance on the ground.

1.1.3 Readers are also advised to consult the [National Stroke Strategy](#) (Department of Health 2007a) and accompanying support documents, including the impact assessment (Department of Health 2007b).

## 1.2 *What is the aim of this report?*

1.2.1 This report provides estimates of the national cost impact arising from implementation of guidance on stroke and TIA in England. These estimates are based on assumptions made about current practice and predictions of how current practice might change following implementation.

1.2.2 This report aims to help organisations plan for the financial implications of implementing NICE guidance.

1.2.3 This report does not reproduce the NICE guideline on stroke and should be read in conjunction with it (see [www.nice.org.uk/CG068](http://www.nice.org.uk/CG068)).

1.2.4 NICE clinical guidelines are developmental standards in the Department of Health's document '[Standards for better health](#)'. The costing template may help inform local action plans demonstrating how implementation of the guideline will be achieved.

### **1.3 *Epidemiology of stroke and TIA***

1.3.1 Stroke is defined by the World Health Organization (Hatano 1976) as a clinical syndrome consisting of 'rapidly developing clinical signs of focal (at times global) disturbance of cerebral function, lasting more than 24 h or leading to death with no apparent cause other than that of vascular origin'.

1.3.2 A transient ischaemic attack (TIA) is defined as stroke symptoms and signs that resolve within 24 hours.

1.3.3 In England, approximately 110,000 people per year suffer a first or recurrent stroke.

1.3.4 The annual incidence of TIA is thought to be around 0.51 per 1000 of population, equivalent to about 25,777 cases per year in England (Lovett et al. 2004)

**Table 1 Annual incidence of stroke and TIA in England**

<b>Description</b>	<b>Incidence</b>
Stroke	110,000
TIA	25,777

## **1.4 *Models of care***

- 1.4.1 The guideline covers interventions in the acute stage of a stroke or TIA. Most of the evidence considered relates to interventions in the first 48 hours after onset of symptoms, although some interventions up to 2 weeks are covered.
- 1.4.2 Stroke and TIA will be managed in secondary care, although successful implementation of this guidance will require prompt referrals for people presenting to primary care and a coordinated response from the emergency services, NHS Direct and members of the public.

## **2 *Costing methodology***

### **2.1 *Process***

- 2.1.1 We use a structured approach for costing clinical guidelines (see appendix A).
- 2.1.2 Good-quality data have been systematically collected for the Sentinel audit. The most recent audit was based on patients admitted between 1 April and 30 June 2006 (Clinical Effectiveness and Evaluation Unit 2007). Data were submitted on a total of 13,625 patients at 224 sites from 203 trusts. This represents 100% of acute trusts admitting stroke patients in England, Wales, Northern Ireland and the islands.
- 2.1.3 The Sentinel audit reported in 2007 was the fifth round; the audit has been undertaken on a 2-year cycle since 1998.
- 2.1.4 Hospital episode statistics (HES) data have also been used to estimate the current care received by stroke patients.
- 2.1.5 Any assumptions made in the costing report have been tested for reasonableness with members of the Guideline Development Group (GDG) and key clinical practitioners in the NHS.

## **2.2      *Scope of the cost-impact analysis***

- 2.2.1      The guideline offers best practice advice on the diagnosis and initial management of acute stroke and TIA.
  
- 2.2.2      This costing work does not quantify recommendations that are in line with guidance included in the National Stroke Strategy (Department of Health 2007a), because the Department of Health has already assessed the impact of implementing the strategy. However, where possible it will investigate current implementation of the guidance and will report costs already identified by the Department of Health in the National Stroke Strategy.
  
- 2.2.3      It is recommended that people responsible for implementing stroke services read the 'Impact assessment' paper (Department of Health 2007b) that accompanied the National Stroke Strategy. This assessment investigates the national costs associated with implementing the strategy.
  
- 2.2.4      Due to the breadth and complexity of the guideline, we worked with the GDG and other professionals to identify the recommendations that would have the most significant resource impact (see table 2). Costing work has focused on these recommendations.

**Table 2 Recommendations with a significant resource impact**

<b>High-cost recommendations</b>	<b>Recommendation number</b>	<b>Key priority?</b>
<p>People who have had a suspected TIA who are at high risk of stroke (that is, with an ABCD<sup>2</sup> score of 4 or above) should have:</p> <ul style="list-style-type: none"> <li>• aspirin (300 mg daily) started immediately</li> <li>• specialist assessment and investigation within 24 hours of onset of symptoms</li> <li>• measures for secondary prevention introduced as soon as the diagnosis is confirmed, including discussion of individual risk factors.</li> </ul>	1.1.2.2	✓
<p>People who have had a suspected TIA who need brain imaging (that is, those in whom the vascular territory or pathology is uncertain) should undergo diffusion-weighted MRI (magnetic resonance imaging) except where contraindicated, in which cases CT (computed tomography) should be used.</p>	1.2.2.1	
<p>All people with suspected non-disabling stroke or TIA who after specialist assessment are considered as candidates for carotid endarterectomy should have carotid imaging within 1 week of onset of symptoms. People who present more than 1 week after their last symptoms of TIA has resolved should be managed using the lower-risk pathway.</p>	1.2.3.1	
<p>People with stable neurological symptoms from acute non-disabling stroke or TIA who have symptomatic carotid stenosis of 50–99% according to the NASCET (North American Carotid Endarterectomy Trial) criteria, or 70–99% according to the ECST (European Carotid Surgery Trialists' Collaborative Group) criteria, should:</p> <ul style="list-style-type: none"> <li>• be assessed and referred for carotid endarterectomy within 1 week of onset of stroke or TIA symptoms</li> <li>• undergo surgery within a maximum of 2 weeks of onset of stroke or TIA symptoms.</li> <li>• receive best medical treatment (control of blood pressure, antiplatelet agents, cholesterol lowering through diet and drugs, lifestyle advice).</li> </ul>	1.2.4.1	
<p>All people with suspected stroke should be admitted directly to a specialist acute stroke unit following initial assessment, either from the community or from the A&amp;E department.</p>	1.3.1.1	✓

<p>Brain imaging should be performed immediately* for people with acute stroke if any of the following apply:</p> <ul style="list-style-type: none"> <li>• indications for thrombolysis or early anticoagulation</li> <li>• on anticoagulation treatment</li> <li>• a known bleeding tendency</li> <li>• a depressed level of consciousness (Glasgow Coma Score below 13)</li> <li>• unexplained progressive or fluctuating symptoms</li> <li>• papilloedema, neck stiffness or fever</li> <li>• severe headache at onset of stroke symptoms</li> </ul>	1.3.2.1	✓
<p>* The GDG felt that 'immediately' is defined as 'ideally the next slot and definitely within 1 hour, whichever is sooner', in line with the National Stroke Strategy.</p>		

2.2.5 Six of the recommendations in the guideline have been identified as key priorities for implementation, and three of these are also among the six recommendations considered to have significant resource impact.

2.2.6 The three key priorities for implementation that have not been included in the costing are implementing the use of a validated tool such as FAST (Face Arm Speech Test) to screen for a diagnosis of stroke outside hospital, screening of swallowing on admission and the treatment of people with crescendo TIA.

2.2.7 Implementing the use of a tool such as FAST by ambulance and emergency medical services is unlikely to have significant resource consequences. The FAST tool was designed to be a simple test that would complement existing assessments used by paramedics and emergency medical services. At its most simple, it can be a one-page document containing a 'tick list'.

2.2.8 Data from the Sentinel audit (Clinical Effectiveness and Evaluation Unit 2007) suggest that currently only 66% of stroke patients have their swallowing screened within 24 hours of admission. The proportion of patients in stroke units whose swallowing is screened is much greater. It is assumed that the cost of screening for swallowing disorders will be included in the additional costs

associated with admitting patients directly to stroke units (see section 3.4).

2.2.9 We have limited the consideration of costs and savings to direct costs to the NHS that will arise from implementation. We have not included consequences for the individual, the private sector or the not-for-profit sector. Where applicable, any realisable cost savings arising from a change in practice have been offset against the cost of implementing the change.

2.2.10 We compared the recommendations in the guideline identified as having significant resource implications with those in the National Stroke Strategy (table 3).

**Table 3 Recommendations with significant resource implications identified in the NICE guideline compared with those in the National Stroke Strategy**

<b>Recommendation from NICE guideline identified as having significant resource implications</b>	<b>Recommendation from National Stroke Strategy</b>
<p>People who have had a suspected TIA who are at high risk of stroke (that is, with an ABCD<sup>2</sup> score of 4 or above) should have:</p> <ul style="list-style-type: none"> <li>• aspirin (300 mg daily) started immediately</li> <li>• specialist assessment and investigation within 24 hours of onset of symptoms</li> <li>• measures for secondary prevention introduced as soon as the diagnosis is confirmed, including discussion of individual risk factors.</li> </ul>	<p>All patients with minor stroke and all higher-risk patients with TIA and minor stroke (e.g. ABCD<sup>2</sup> score ≥4) need to be assessed by a specialist and treated within 24 hours. (Chapter 2, section 5)</p>
<p>People who have had a suspected TIA who need brain imaging (that is, those in whom vascular territory or pathology is uncertain) should undergo diffusion-weighted MRI (magnetic resonance imaging) except where contraindicated, in which case CT (computed tomography) scanning should be used.</p>	<p>MRI, including diffusion-weighted imaging (DWI), gradient echo imaging and MRA, is the most useful imaging for TIA and minor stroke. (Chapter 2, section 10)</p>
<p>All people with suspected non-disabling stroke or TIA who after specialist assessment are considered as candidates for carotid endarterectomy should have carotid imaging within 1 week of onset of symptoms. People who present more than 1 week after their last symptom of TIA has resolved should be managed using the lower-risk pathway.</p>	<p>Lower risk patients with TIA or minor stroke are best investigated within seven days of the event. Non-urgent referral for TIA or minor stroke is appropriate only for very low-risk patients, such as those presenting with events that occurred several weeks or months previously. (Chapter 2, section 8)</p>

<p>People with stable neurological symptoms from acute non-disabling stroke or TIA who have symptomatic carotid stenosis of 50–99% according to the NASCET (North American Symptomatic Carotid Endarterectomy Trial) criteria, or 70–99% according to the ECST (European Carotid Surgery Trialists' Collaborative Group) criteria, should:</p> <ul style="list-style-type: none"> <li>• be assessed and referred for carotid endarterectomy within 1 week of onset of stroke or TIA symptoms</li> <li>• undergo surgery within a maximum of 2 weeks of onset of stroke or TIA symptoms.</li> <li>• receive best medical treatment (control of blood pressure, antiplatelet agents, cholesterol lowering through diet and drugs, lifestyle advice).</li> </ul>	<p>Carotid intervention for recently symptomatic severe carotid stenosis should be regarded as an emergency procedure in patients who are neurologically stable, and should ideally be performed within 48 hours of a TIA or minor stroke. (Chapter 2, section 14)</p>
<p>All people with suspected stroke should be admitted directly to a specialist acute stroke unit either from the community or from the A&amp;E department.</p>	<p>The majority of stroke patients will require high-dependency care on an acute stroke unit for the first 24 hours of their illness. (Chapter 2, section 33)</p>
<p>Brain imaging should be performed immediately* for people with acute stroke if any of the following apply:</p> <ul style="list-style-type: none"> <li>• indications for thrombolysis or early anticoagulation treatment</li> <li>• on anticoagulant treatment</li> <li>• a known bleeding tendency</li> <li>• a depressed level of consciousness (Glasgow Coma Score below 13)</li> <li>• unexplained progressive or fluctuating symptoms</li> <li>• papilloedema, neck stiffness or fever</li> <li>• severe headache at onset of stroke symptoms.</li> </ul>	<p>A quick decision is needed within a short time window to determine whether or not the patient has had a hemorrhage. Currently, CT scanning is adequate for this and will allow decisions about thrombolysis to be made for most patients. It is suggested that these patients be scanned in the next scan slot within usual working hours, and within 60 minutes of a request out-of-hours. (Chapter 2, section 26)</p>
<p>* The GDG felt that 'immediately' is defined as 'ideally the next slot and definitely within 1 hour, whichever is sooner', in line with the National Stroke Strategy.</p>	

## 2.3 **General assumptions made**

2.3.1 The model is based on the annual incidence of stroke and TIA and population estimates (see table 1).

## 2.4 **Basis of unit costs**

2.4.1 The way the NHS is funded has undergone reform with the introduction of 'Payment by results', based on a national tariff. The national tariff will be applied to all activity for which Healthcare Resource Groups (HRGs) or other appropriate case-mix measures

are available. Where a national tariff price or indicative price exists for an activity this has been used as the unit cost; this has then been inflated by the national average market forces factor.

2.4.2 Using these prices ensures that the costs in the report are the cost to the primary care trust (PCT) of commissioning predicted changes in activity at the tariff price, but may not represent the actual cost to individual trusts of delivering the activity.

2.4.3 For new or developing services, where there is no national average unit cost, organisations already undertaking this activity have been asked their current unit cost.

2.4.4 The individual financial burden of stroke per patient is difficult to estimate. Youman and co-workers suggested that the approximate 5-year cost of stroke per patient in 2001/2002 was £15,000 for direct NHS care, and £29,400 when both direct and informal care were included (Youman et al. 2003).

2.4.5 When inflated to 2006/07 prices (the most recent available) using an inflation rate of 22% (Personal Social Services Research Unit 2007), the 5-year cost of stroke per patient is £18,300 for direct care and £35,868 for both direct and informal care.

### **3 Cost of significant resource-impact recommendations**

#### **3.1 *Assessment and treatment of people who have had a suspected TIA who are at high risk of stroke***

##### **Background**

3.1.1 People who have had a suspected TIA who are at high risk of stroke (that is, with an ABCD<sup>2</sup> score of 4 or above) should have:

- aspirin (300 mg daily) started immediately
- specialist assessment and investigation within 24 hours of onset of symptoms
- measures for secondary prevention introduced as soon as the diagnosis is confirmed, including discussion of individual risk factors.

(recommendation 1.1.2.2)

3.1.2 The risk of stroke within the first 4 weeks after a TIA can be as high as 20%.

##### **Assumptions made**

3.1.3 The Sentinel audit revealed that currently only 35% of people who have had a suspected TIA or minor stroke are seen and investigated in a neurovascular clinic within 7 days (Clinical Effectiveness and Evaluation Unit 2007). Limited data are available on people who have had a stroke or TIA who are seen outside neurovascular clinics.

3.1.4 This recommendation is in line with recommendations made in the National Stroke Strategy. The strategy recommended that 'all patients with minor stroke and all higher-risk patients with TIA and minor stroke (e.g. ABCD<sup>2</sup> score  $\geq$  4) need to be assessed by a specialist and treated within 24 hours'.

### **Cost summary**

- 3.1.5 The annual cost of implementing specialist assessment for people who have had a TIA was investigated in work completed for the National Stroke Strategy.
- 3.1.6 The cost of implementing specialist assessment within 24 hours of people who have had a TIA was estimated in the National Stroke Strategy 'Impact assessment' as £16.2 million (Department of Health 2007b).

### **Other considerations**

- 3.1.7 A TIA is a major warning sign of a future stroke. The correct treatment can reduce the number of people who have had a TIA who subsequently experience a full stroke.
- 3.1.8 Urgent assessment and early initiation of a combination of preventative treatments can reduce the relative risk of early recurrent stroke after TIA or minor stroke by about 80% (Rothwell et al. 2007).
- 3.1.9 The 5-year cost of stroke per person has been estimated as £18,300 for direct care and £35,868 when informal care is included.
- 3.1.10 It is reasonable to assume that investment in services for people who have had a TIA would be reflected in future savings through avoidance of future stroke.

## **3.2      *Magnetic resonance imaging for people who have had a suspected TIA***

### **Background**

3.2.1      People who have had a suspected TIA who need brain imaging (that is, those in whom vascular territory or pathology is uncertain) should undergo diffusion-weighted MRI (magnetic resonance imaging) except where contraindicated, in which case CT (computer tomography) scanning should be used.

#### Recommendation 1.2.2.1

3.2.2      Diffusion-weighted imaging (DWI) is an application package that is either incorporated in the core MRI scanner software or added as a cost option.

### **Assumptions made**

3.2.3      CT scanning is available in almost all UK hospitals that admit people with acute stroke or TIA. However, only 78% of such hospitals have access to MRI (Kane et al. 2008).

3.2.4      Kane and co-workers reported that although more than three-quarters of hospitals have MRI, access for people who have had a stroke or TIA is difficult. Access to MRI was difficult during working hours in 73% of hospitals, and access was difficult out of hours in 95% of hospitals (Kane et al. 2008).

3.2.5      Limited national data are available to allow estimation of the proportion of patients who receive a CT or MRI scan following a suspected TIA.

3.2.6      The price difference between a CT scan and an MRI scan as reported in '2006/07 reference costs' is significant. The estimated cost of a CT scan completed for an inpatient is £101 (RA08Z), whereas the cost of an MRI scan is £228 (RA01Z). Increasing the

number of patients receiving an MRI scan rather than a CT scan will have resource consequences.

### **Cost summary**

3.2.7 This recommendation is in line with recommendations made in the National Stroke Strategy. It is addressed in the impact assessment document (Department of Health 2007b), and so no additional costing work has been carried out.

### **Other considerations**

3.2.8 The additional cost of providing an MRI scan rather than a CT scan for people who have had a TIA is likely to be incurred by the service provider rather than the commissioner.

### **3.3 Referral for carotid endarterectomy**

#### **Background**

3.3.1 People with stable neurological symptoms from acute non-disabling stroke or TIA who have symptomatic carotid stenosis of 50–99% according to the NASCET (North American Symptomatic Carotid Endarterectomy Trial) criteria, or 70–99% according to the ECST (European Carotid Surgery Trialists' Collaborative Group) criteria, should:

- be assessed and referred for carotid endarterectomy within 1 week of onset of stroke or TIA symptoms
- undergo surgery within a maximum of 2 weeks of onset of stroke or TIA symptoms
- receive best medical treatment (control of blood pressure, antiplatelet agents, cholesterol lowering through diet and drugs, lifestyle advice)

#### Recommendation 1.2.4.1

3.3.2 Carotid endarterectomy is a surgical procedure in which an atherosclerotic plaque causing stenosis (narrowing) of the carotid artery is removed.

#### **Assumptions made**

3.3.3 The current number of carotid endarterectomy procedures carried out per year for people who have had a stroke or TIA in England has been estimated using 2006/07 hospital episode statistics (HES) data.

3.3.4 Initial analysis of HES data identified 4428 finished consultant episodes for all 'L29 carotid artery reconstructions'. Further analysis identified 4061 procedures undertaken per year for people with a diagnosis of either stroke or TIA (table 4).

**Table 4 Estimated current number of stroke and TIA patients receiving a carotid endarterectomy per year**

Admission description	ICD codes	Estimated number of carotid endarterectomy procedures (OPCS L29)
TIA & Stroke	G45 and I60 to I69	4061

3.3.5 The proposed number of carotid endarterectomy procedures for people who have had a stroke and TIA following implementation of the guidance has been estimated based on a number of published papers and expert opinion

3.3.6 The incidence of ischaemic stroke has been calculated assuming that 85% of the total of 110,000 strokes per year in England are ischaemic strokes (National Audit Office 2005).

3.3.7 Major and fatal strokes have been estimated to represent 75% of the total number of ischaemic strokes identified (Ferris et al. 1998). This equates to 70,125 major or fatal strokes per year, and these have been excluded from the calculation of the number of people potentially eligible for carotid endarterectomy.

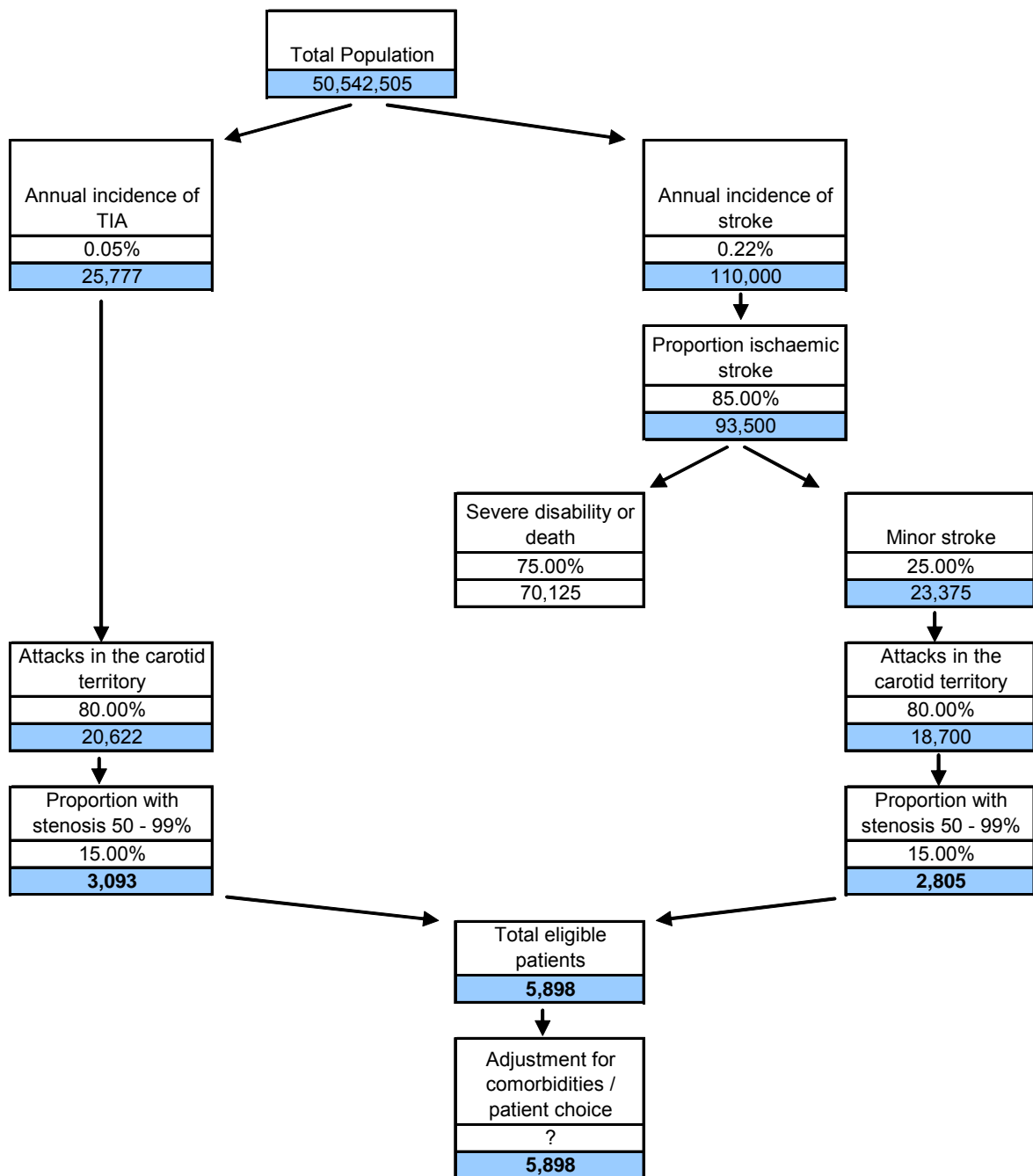
3.3.8 It is estimated that in 80% of people who have a TIA or minor (non-disabling) stroke, the attack is caused by a blockage in the carotid territory (Ferris et al. 1998).

3.3.9 The proportion of people who have had a minor (non-disabling) stroke or TIA who present with carotid stenosis of 50–99% is thought to be around 15% (Lovett et al. 2004)

3.3.10 No data could be identified to allow estimation of the proportion of patients who have significant comorbidities that may exclude carotid endarterectomy. Similarly, no data are available to allow estimation of the proportion of people who may choose not to have the procedure.

3.3.11 Using the assumptions outlined above and as illustrated in figure 1, the total number of people who would be eligible to receive carotid endarterectomy following a TIA or minor (non-disabling) stroke in England is calculated as 5898 per year.

**Figure 1 Estimated number of people eligible for carotid endarterectomy following a TIA or minor (non-disabling) stroke**



- 3.3.12 As shown in table 4, the estimated current number of carotid endarterectomy procedures undertaken for people who have had a TIA or stroke is 4061 per year.
- 3.3.13 The impact assessment work undertaken in conjunction with the National Stroke Strategy estimated that 4% of people who have had a TIA would have a carotid endarterectomy (Department of Health 2007b).
- 3.3.14 To avoid a 'double count' it is necessary to subtract the increase in the number of carotid endarterectomy procedures for people who have had a TIA already identified by the Department of Health. Assuming that the annual incidence of TIA in England is 25,777, the figure identified by the Department of Health is about 1031 procedures.

**Table 5 Estimated increase in the annual number of carotid endarterectomy procedures for people who have had a TIA or stroke.**

	Current number	Proposed number	Change	Adjustment for stroke strategy	Increase
Total	4061	5898	1837	-1031	806

- 3.3.15 The unit cost for a carotid endarterectomy is taken from the 2008/09 National Tariff, HRG Q05 'Extracranial or Upper Limb Arterial Surgery'. The elective cost for this procedure, including the national average 'market forces factor' at 1.1249, is £3434.

### **Cost summary**

- 3.3.16 The estimated increase in cost of providing carotid endarterectomy for all eligible people who have had a TIA or minor (non-disabling) stroke (above the figure already identified by the Department of Health impact assessment report) is £2.8 million per year.

**Table 6 Costs associated with an increase in the number of people who have had a TIA or minor (non-disabling) stroke who receive a carotid endarterectomy**

	Unit cost	Current		Proposed		Change	
		Numbers of procedures	Cost (£000)	Numbers of procedures	Cost (£000s)	Numbers of procedures	Cost (£000s)
Carotid endarterectomy	£3434	4061	13,945	5898	20,254	1837	6309
Adjustment	£3434			-1031	3,540	-1031	3540
<b>Total</b>		<b>4061</b>	<b>13,945</b>	<b>4867</b>	<b>16,713</b>	<b>806</b>	<b>2768</b>

### **Savings summary**

- 3.3.17 The number needed to treat (NNT) to prevent one stroke is estimated at 7–10 patients over a 2–3-year follow-up (Ferris et al. 1998).
- 3.3.18 Early intervention within 2 weeks of the event has been shown to reduce the likelihood of future stroke. Rothwell et al. (2004) estimated a NNT of 4 to avoid one stroke.
- 3.3.19 Undertaking an additional 806 carotid endarterectomy procedures would result in 115 strokes avoided at a NNT of 7 and 201 strokes avoided at a NNT of 4. Taking a midpoint figure for NNT of 5.5, the number of strokes avoided would be about 147.
- 3.3.20 As reported above, estimating the cost of stroke is subject to a high degree of uncertainty. The 5-year cost is estimated to be £18,300 for direct care, and £35,868 when informal care is also included. The cost of direct care is likely to reflect savings that will be achieved by the NHS.
- 3.3.21 Limited data are available to allow estimates to be made of when savings through strokes avoided will occur. However, it seems likely that the events avoided would have occurred within a few weeks or months of the initial TIA or stroke.

3.3.22 Assuming that 147 strokes can be avoided through the increased use of carotid endarterectomy, the 5-year savings to the NHS would be £2.7 million.

**Table 7 Estimated savings to the NHS resulting from increased use of carotid endarterectomy for TIA and stroke patients**

<b>Events avoided</b>	<b>Estimated 5-year savings to the NHS per stroke avoided</b>	<b>Total savings £000s</b>
147	£18,300	2690

### **Other considerations**

3.3.23 The savings of £2.7 million identified are direct savings to the NHS. If costs of both direct and informal care are included, the estimated savings increase to £5.3 million.

**Table 8 Estimated total savings resulting from increased use of carotid endarterectomy for TIA and stroke patients**

<b>Events avoided</b>	<b>Estimated 5-year savings per stroke avoided (direct and indirect care costs)</b>	<b>Total savings £000s</b>
147	£35,868	5273

### **3.4 Admission to a specialist stroke unit**

#### **Background**

3.4.1 All people with suspected stroke should be admitted directly to a specialist acute stroke unit following initial assessment, either from the community or from the A&E department.

#### Recommendation 1.3.1.1

3.4.2 Patients managed on a stroke unit have considerably better results for the key indicators than patients looked after in other care settings (Clinical Effectiveness and Evaluation Unit 2007).

3.4.3 The National Stroke Strategy demonstrates that there is overwhelming evidence that stroke units are associated with a decrease in death rates, and an increase the number of people who are independent and non-institutionalised after their stroke (Department of Health 2007b).

3.4.4 It has estimated that one death is avoided for every 33 people treated, in a stroke unit, and one person returns to independence for every 20 treated (Stroke Unit Trialists' Collaboration 1997).

3.4.5 The 'National service framework for older people' (Department of Health 2001) recommended that all people who may have had a stroke will usually require urgent hospital admission and should be treated by specialist stroke teams.

3.4.6 Quality marker 9 (QM9) in the National Stroke Strategy (Department of Health 2007a) recommended that all people who have had a stroke have prompt access to an acute stroke unit. They should also spend the majority of their time in hospital in a stroke unit with high-quality specialist stroke care.

### **Assumptions made**

- 3.4.7 Although both the NSF for older people and the National Stroke Strategy recommend that people who have had a stroke are admitted to a specialist stroke unit, evidence suggests that successful implementation has been limited.
- 3.4.8 The Sentinel study reported that only about 10% of people who have had a stroke are currently admitted directly to an acute stroke unit (Clinical Effectiveness and Evaluation Unit 2007).
- 3.4.9 In addition, 62% of people who have had a stroke are admitted to a stroke unit at some point during their stay in hospital, with 54% spending more than 50% of their stay in a stroke unit.

### **Cost summary**

- 3.4.10 The cost of implementing the National Stroke Strategy was investigated in the accompanying 'Impact assessment' paper (Department of Health 2007b). The estimated annual cost of implementing the recommendations relating to stroke units was £89.3 million (ranging from £59.6 million to £118.9 million).
- 3.4.11 The Department of Health identified annual savings to the NHS associated with implementation of admission to stroke units of £6.2 million (ranging from £5.3 million to £7.0 million).

### **Other considerations**

- 3.4.12 Under the current arrangements for stroke services, the additional cost of providing care for people who have had a stroke on a stroke unit rather than on a geriatric or general medicine ward is likely to be incurred by the service provider rather than the commissioner.
- 3.4.13 Admitting people who have had a stroke directly to a specialist stroke unit should be reflected in an increase in the proportion of people whose swallowing is screened.

### **3.5 *Brain imaging for the early assessment of people with acute stroke***

#### **Background**

3.5.1 Brain imaging should be performed immediately<sup>1</sup> for people with acute stroke if any of the following apply:

- indications for thrombolysis or early anticoagulation treatment
- on anticoagulant treatment
- a known bleeding tendency
- a depressed level of consciousness (Glasgow Coma Score below 13)
- unexplained progressive or fluctuating symptoms
- papilloedema, neck stiffness or fever
- severe headache at onset of stroke symptoms.

#### Recommendation 1.3.2.1

3.5.2 This recommendation is in line with recommendations made in the National Stroke Strategy (Department of Health 2007a), which recommended that 'patients be scanned in the next scan slot within usual working hours, and within 60 minutes of a request out of hours'.

#### **Assumptions made**

3.5.3 The Sentinel study reported that 42% of people with acute stroke had brain imaging to confirm their diagnosis within 24 hours of the onset of their symptoms. Of the patients who received brain imaging and for whom the time of the scan was reported, only 9% received a scan within 3 hours of stroke onset (Clinical Effectiveness and Evaluation Unit 2007).

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<sup>1</sup> The GDG felt that 'immediately' is defined as 'ideally the next slot and definitely within 1 hour, whichever is sooner', in line with the National Stroke Strategy.

- 3.5.4 Only 12% of hospitals have arrangements with the local ambulance service for emergency or rapid transfer to hospital for people with acute stroke over and above the regular system.

### **Cost summary**

- 3.5.5 As this recommendation is in line with the National Stroke Strategy, no additional costing work has been undertaken. That undertaken by the Department of Health is described in the 'Impact assessment' paper (Department of Health 2007b).

### **Other considerations**

- 3.5.6 Increasing the proportion of people who have had a stroke who receive brain imaging within 1 hour is likely to result in an increase in the number of people who are eligible to receive thrombolytic drugs.
- 3.5.7 NICE has produced guidance on the use of alteplase for the treatment of acute ischaemic stroke (NICE technology appraisal 122; available at [www.nice.org.uk/TA122](http://www.nice.org.uk/TA122)).

## **4 Sensitivity analysis**

### **4.1 Methodology**

- 4.1.1 There are a number of assumptions in the model for which no empirical evidence exists. Because of the limited data, the model developed is based mainly on discussions of typical values and predictions of how things might change as a result of implementing the guidance and is therefore subject to a degree of uncertainty.
- 4.1.2 As part of discussions with practitioners, we discussed possible minimum and maximum values of variables, and calculated their impact on costs across this range.
- 4.1.3 Wherever possible we have used the national tariff plus market forces factor to determine cost. We used the variation of costs for the 25th and 75th percentiles from reference costs compared with the reference cost national average as a guide to inform the maximum and minimum range of costs.
- 4.1.4 It is not possible to arrive at an overall range for total cost because the minimum or maximum of individual lines would not occur simultaneously. We undertook one-way simple sensitivity analysis, altering each variable independently to identify those that have greatest impact on the calculated total cost.
- 4.1.5 Appendix B contains a table detailing all variables modified and the key conclusions drawn are discussed below.

## **4.2      *Impact of sensitivity analysis on costs***

### **Proportion of people with non-disabling stroke or TIA with symptomatic stenosis of 50–99%**

- 4.2.1      In section 3.3.9 it is assumed that 15% of people who have had a minor (non-disabling) stroke or TIA present with carotid stenosis of 50–99% (Lovett et al. 2004). Others studies have reported that 20% of people who have had a minor (non-disabling) stroke or TIA present with stenosis of 50–99% (Ferris et al. 1998).
- 4.2.2      Varying the proportion of patients who present with stenosis of 50–99% from 15% to 20% results in implementation costs ranging from £2.8 to £9.5 million.
- 4.2.3      Any increase in the number of people eligible for carotid endarterectomy would also be reflected in increased savings because of strokes avoided. Assuming that 20% of people who have had a minor (non-disabling) stroke or TIA present with stenosis of 50–99% and are therefore eligible for surgery, savings to the NHS can be estimated at £9.2 million.

### **Carotid endarterectomy: number needed to treat (NNT) to avoid one stroke**

- 4.2.4      The costing work assumes that the NNT to avoid one stroke is 5.5 patients. This the midpoint figure of estimates of NNT of 4 and 7 (see section 3.3.19).
- 4.2.5      Varying the NNT from 4 to 7 results in total savings (direct and informal care costs) ranging from £4.1 to £7.2 million.

## **5 Impact of guidance for commissioners**

- 5.1.1 The cost of stroke care with secondary care services is within 'Payment by results'.
- 5.1.2 The 2008/09 national tariff has a specific uplift, called Thrombolysis for Stroke (Alteplase). This is to recognise the additional costs incurred in the administration of alteplase, and so adequately reward those trusts who administer alteplase for the treatment of an acute ischaemic stroke. This removes the need for local negotiation.
- 5.1.3 Stroke care will fall under programme budgeting category 210B 'Problems of circulation, cerebrovascular disease'.

## **6 Conclusion**

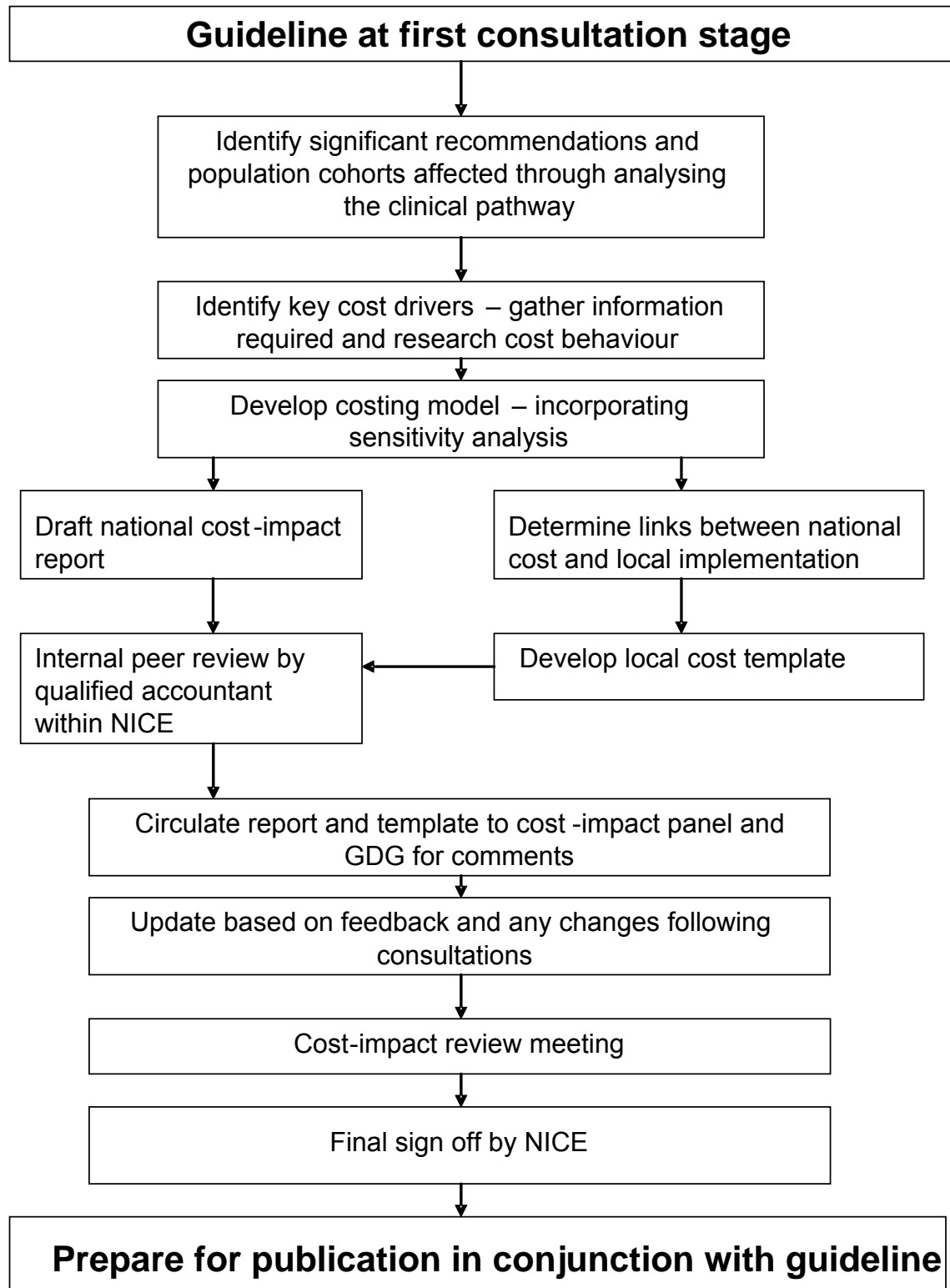
### **6.1 *Total national cost for England***

- 6.1.1 Using the significant resource-impact recommendations shown in table 3 and assumptions specified in section 3, we have estimated the annual cost impact of implementing the guideline in England to be £2.8 million. This is in addition to the cost of implementing the National Stroke Strategy already identified by the Department of Health.
- 6.1.2 Direct savings to the NHS are estimated as being £2.7 million. When NHS and wider informal care savings are included, a figure of £5.3 million is estimated.
- 6.1.3 We applied reality tests against existing data wherever possible, but this was limited by the availability of detailed data. We consider this assessment to be reasonable, given the limited detailed data regarding diagnosis and treatment paths and the time available. However, the costs presented are estimates and should not be taken as the full cost of implementing the guideline.

### **6.2 *Next steps***

- 6.2.1 The local costing template produced to support this guideline enables organisations such as primary care trusts (PCTs) or health boards in Wales and Northern Ireland to estimate the impact locally and replace variables with ones that depict the current local position. A sample calculation using this template showed that a population of 100,000 could expect to incur additional costs of £6731. Use this template to calculate the cost of implementing this guidance in your area.

## Appendix A. Approach to costing guidelines



## Appendix B. Results of sensitivity analysis

Assessment of sensitivity costs to a range of variables							
Parameter varied	Baseline value	Minimum value	Maximum value	Baseline costs (£000s)	Minimum costs (£000s)	Maximum costs (£000s)	Change (£000s)
<b>Identified costs</b>							
Incidence of stroke (+ and - 10%)	110,000	99,000	121,000	2,768	1,806	3,733	1,927
Incidence of TIA (+ and - 10%)	25,777	23,199	28,355	2,768	2,060	3,479	1,419
Unit cost of carotid endarterectomy	£3,434	£1,901	£3,897	2,768	1,532	3,141	1,609
Stenosis of 50-99%	15%	10%	20%	2,768	2,768	9,519	6,751
<b>Identified savings</b>							
Number needed to treat (NNT) - Direct NHS Savings	5.5	4.0	7.0	-2,690	-3,697	-2,105	1,592
Number needed to treat (NNT) - Direct NHS & Informal Care Savings	5.5	4.0	7.0	-5,273	-7,245	-4,125	3,120

## Appendix C. References

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