Getting the priorities right for stroke care

Cathie Sudlow and Charles Warlow question whether the current emphasis on hyperacute stroke care to improve access to thrombolysis may distract attention and resources from a truly comprehensive stroke service.

The stroke strategy for London aims to be comprehensive, and so the need for a stroke prevention plan and for commissioning of rehabilitation and early supported discharge services is mentioned. However, the current and future costs of these crucial parts of the stroke service have unfortunately not yet been evaluated, even though the new acute stroke service will be phased in from later this year. This is of particular concern given that Dudley and Blacktop have suggested that the NAO report overemphasised the benefits and cost savings to be gained from thrombolysis and underestimated the gains from comprehensive care in a stroke unit. In the light of these criticisms, we have examined the current performance of stroke services against what we know works for acute stroke and revisited how the NAO reached its conclusions.

How are we doing now?

The three evidence based, effective interventions for stroke are organised stroke unit care (not specifically hyperacute care) for all patients with acute stroke, early administration of aspirin for almost all patients with acute ischaemic stroke, and intravenous thrombolysis for selected patients with acute ischaemic stroke. While aspirin can be given in primary or secondary care, and to outpatients as well as inpatients, admission to a stroke unit and thrombolysis clearly both require hospital admission, and thrombolysis is suitable only for those who arrive early enough to be assessed and have a brain scan to exclude intracranial haemorrhage within three hours of symptom onset, and who fulfil the other licence criteria, the most restrictive of which is age <80 years.

In the UK, hospital admission rates for acute stroke in recent community based stroke incidence studies range from 56% in Oxfordshire through 83% in South London to 91% in the Scottish Borders. At least part of this variation is the result of differences in definition of hospital admission: in the Oxford Vascular Study, this clearly implies admission for inpatient care; it is unclear for the South London Stroke Register (but admission rates may be higher in London given the relatively high proportion of stroke cases that occur among visitors to the city who are not registered with a general practitioner).
In 2008, 68% of patients admitted with an acute stroke spent more than half of their admission on a stroke unit, 85% of inpatients with acute ischaemic stroke and without a contraindication (which we estimate to be 72% of all acute stroke admissions) received early aspirin, and 1.4% of all inpatients with acute ischaemic stroke received intravenous thrombolysis (less than 10% of those deemed eligible because they were in hospital within three hours and younger than 80). All of these figures can—and should according to the existing evidence—be improved on. The question is, how much improvement can we realistically expect and what will be the net benefits and costs?

**NAO arithmetic**

The NAO addressed this question with reference to a formal and extensive analysis of the costs of stroke, the benefits of all the various interventions, and an economic model to predict the net benefits of changes from levels of service provision in 2004 to target levels. It summarised this analysis by reporting that increasing stroke unit admissions from 50% to 95% would cost up to £54m and would lead to 991 fewer deaths and 308 more people being independent each year in the population of England; while giving intravenous thrombolysis to 9% of all stroke patients in England would cost £9.9m. Because of higher rates of recovery to independence among those treated this would lead to savings of £26.4m, a net saving of about £16m. It is impossible directly to compare these two interventions because the report did not give the increase in numbers of patients recovering to independence for stroke units and for thrombolysis: this assumes that 56% of patients are admitted to hospital after a stroke and, for stroke units, that the 68% spending >50% of their admission on a stroke unit obtain the full benefit reported in the Cochrane stroke unit review; for aspirin this assumes that the proportion of patients with ischaemic stroke not admitted to hospital receiving aspirin within 48 hours is the same as the 85% of patients with ischaemic stroke without contraindications to aspirin who are admitted to hospital.

### Table 2: Effect of interventions for acute stroke on poor outcome (death or dependency) based on current performance and realistic and optimistic targets for future performance

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Current performance</th>
<th>Realistic target</th>
<th>Optimistic target</th>
<th>No needed to treat to prevent one poor outcome</th>
<th>Current performance</th>
<th>Realistic target</th>
<th>Optimistic target</th>
<th>Drug cost per poor outcome avoided (£s)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke unit</td>
<td>859 (38)</td>
<td>1356 (60)</td>
<td>1695 (75)</td>
<td>23</td>
<td>37 (3)</td>
<td>59 (5)</td>
<td>74 (6)</td>
<td>---</td>
</tr>
<tr>
<td>Aspirin</td>
<td>1627 (72)</td>
<td>1921 (85)</td>
<td>1921 (85)</td>
<td>67</td>
<td>24 (2)</td>
<td>29 (2)</td>
<td>29 (2)</td>
<td>67</td>
</tr>
<tr>
<td>Thrombolysis</td>
<td>23 (1)</td>
<td>113 (5)</td>
<td>226 (10)</td>
<td>10</td>
<td>2 (0.2)</td>
<td>11 (1)</td>
<td>23 (2)</td>
<td>4350</td>
</tr>
</tbody>
</table>

*For stroke units and for thrombolysis this assumes that 56% of patients are admitted to hospital after a stroke and, for stroke units, that the 68% spending >50% of their admission on a stroke unit obtain the full benefit reported in the Cochrane stroke unit review; for aspirin this assumes that the proportion of patients with ischaemic stroke not admitted to hospital receiving aspirin within 48 hours is the same as the 85% of patients with ischaemic stroke without contraindications to aspirin who are admitted to hospital.

†From table 1.

‡Drug costs to nearest pound (£1/patient for aspirin; £435/patient for intravenous alteplase).
thrombolysis, and only the costs but not the savings of stroke unit care were provided.

However, Dudley and Blacktop’s concerns about the calculations seem to be well founded. The NAO estimated the potential cost savings from intravenous thrombolysis for acute ischaemic stroke based on delivering treatment to 9% of all stroke patients in England, on the grounds that this was achieved at Box Hill Metropolitan Hospital in Melbourne, Australia. But the Box Hill figure was 9% of stroke patients admitted to the hospital (27/300 acute stroke admissions each year), which we calculate to be equivalent to just over 1% of all incident and recurrent stroke patients in the local population of 800,000 (estimated from a recent study of stroke incidence in another part of Melbourne to be about 2300 a year). Closer to home, the Southern General Hospital in Glasgow has one of the UK’s highest rates for thrombolysis; 11% of patients admitted to the stroke unit are treated, but we calculate this to be less than 4% of all strokes occurring annually in the local population of 370,000 (estimated from a recent study of stroke incidence in Oxfordshire to be about 840).

Furthermore, it is difficult to assess the reliability of the NAO’s estimates of potential benefits or cost savings from either stroke units or intravenous thrombolysis, since the description of the economic model it used is neither completely transparent nor consistent—for example, it produced figures for numbers of deaths prevented by intravenous thrombolysis and for numbers of recurrent strokes prevented by stroke unit care when the estimates used in the model for the effects of these interventions did not show reductions in either of these outcomes.

**Our arithmetic**

We have made our own transparent estimates of the net benefit (in terms of numbers avoiding death or dependency) of the three proved interventions for acute stroke at current UK levels of service provision (estimated from the 2008 national sentinel stroke audit figures) and at what we consider realistic and optimistic target levels (tables 1 and 2).

Subject to several explicit (and modifiable) assumptions (see table footnotes), these show that at present, in a notional UK population of one million people, intravenous thrombolysis is preventing two patients from having a poor outcome each year, while stroke unit care and aspirin are preventing 37 and 24 poor outcomes, respectively. If 5% of all 2260 stroke patients in our notional population of one million could be treated with intravenous thrombolysis within three hours (a greater than fivefold increase in what is currently being achieved UK-wide, and an improvement even on the highest rates in the UK), then 11 would avoid a poor outcome, while increased rates of stroke unit admission and early aspirin administration would lead to 59 and 29 patients avoiding a poor outcome, respectively. Even more optimistically, intravenous thrombolysis given to 10% of all acute stroke patients in the population could avoid 23 poor outcomes, and yet higher stroke unit admission rates (requiring an increase in the proportion of acute stroke patients currently managed as inpatients) could avoid 74 poor outcomes. Further increases in aspirin administration are unlikely to be achieved because patients with intracerebral haemorrhage and a proportion of those with ischaemic stroke are ineligible.

The absolute numbers of patients benefiting at current or realistic target levels are far larger for stroke units and aspirin than for intravenous thrombolysis (and they remain higher even at optimistic target levels), since the last is applicable to many fewer patients. Table 2 also shows that the drug costs per poor outcome avoided are much greater for intravenous thrombolysis than for aspirin, despite the much larger absolute benefit of thrombolysis (we have not attempted to estimate non-drug costs or the costs of stroke unit versus general medical ward care). If further evidence from ongoing randomised trials shows that a wider range of patients could benefit from intravenous thrombolysis than for aspirin, despite the much larger absolute benefit of thrombolysis (we have not attempted to estimate non-drug costs or the costs of stroke unit versus general medical ward care). If further evidence from ongoing randomised trials shows that a wider range of patients could benefit from intravenous thrombolysis than for aspirin, despite the much larger absolute benefit of thrombolysis, the estimates used in the model for the effects of these interventions did not show reductions in either of these outcomes.

**Beyond hyperacute care**

To achieve a higher rate of thrombolysis we will need to make radical changes to local
systems, such as those being planned for London. These may bring other benefits too, such as improved recruitment into much needed trials of interventions for acute stroke, but we must be careful that the emphasis on developing hyperacute stroke care, mainly to allow delivery of thrombolysis to the small proportion who may benefit, does not divert attention and resources from the other proved interventions. We might assume that so long as more patients with stroke can be transferred quickly to dedicated hyperacute stroke units, the rest will all fall into place. But this will happen only if the expertise in the excellent centres in London that will no longer be providing hyperacute care is maximally tapped into; if the additional transfers needed from hyperacute to non-hyperacute stroke units occur without discontinuity of care or duplication (requiring better than the usual standard of record keeping); and if adequate resources are made available for stroke prevention initiatives and for much needed developments in rehabilitation services.6

Although it is important to give intravenous thrombolysis in an appropriate setting to as many eligible patients as possible, it is crucial that this should not be at the expense of any of the other parts of a comprehensive stroke service. All elements of effective stroke care must be properly joined up, and funded, from hyperacute care to long term community support.

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Charles Warlow: emeritus professor of medical neurology, Division of Clinical Neurosciences, University of Edinburgh, Western General Hospital,
Provenance and peer review: CS is an epidemiologist and consultant neurologist at the University of Edinburgh and has research interests in epidemiology of and treatment and prevention of stroke. CW has contributed throughout his career to the evidence base for managing stroke; from acute treatment to prevention. Both authors drafted and revised the article together, using their knowledge of stroke, its management and service reorganisation, with extensive reference to all the relevant government documents and reports mentioned. CS did (and CW checked) the calculations in the table. CS is guarantor.
Competing interests: CW is on the steering committee of the third international stroke trial of thrombolysis for acute ischaemic stroke, and both authors are members of the Stroke Research Group in Edinburgh, where this trial has its coordinating centre.
Provenance and peer review: Commissioned; externally peer reviewed.

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ANSWERS TO ENDGAMES, p 1451. For long answers use advanced search at bmj.com and enter question details

PICTURE QUIZ

A 2 year old girl with fever, cough, and tachypnoea

1 The two major abnormalities that can be seen on the patient’s chest radiograph are a cavitating pulmonary lesion and widespread bilateral fine reticulogranular (miliary) shadowing.

2 On the basis of the history and the radiographic findings the most likely diagnosis is miliary tuberculosis.

3 A tuberculin skin test (Mantoux test), microscopy and culture of appropriate clinical specimens (such as sputum, gastric aspirates, bronchoalveolar lavage fluid, urine, cerebrospinal fluid, and blood), and an interferon-γ release assay are the most useful initial tests.

Chest radiograph showing bilateral miliary infiltrates and outlining the cavitating pulmonary lesion in the left lower lobe (arrows)

CASE REPORT

The management of accidental hypothermia

1 Basic life support should continue until core temperature is greater than 30°C. Cardioactive drugs and further defibrillation should be withheld until this temperature is reached.

2 Invasive rewarming methods should be used, such as airway warming; warm bladder, pleural, peritoneal, or nasogastric lavage; and, if available, partial cardiopulmonary bypass.

3 Resuscitation should continue until core temperature is more than 30°C or be discontinued if the patient has obvious lethal injuries.

STATISTICAL QUESTION

Sampling distributions