

HWLG(3)-19-09 Paper 2

Inquiry into Stroke Services in Wales – Evidence from the British Medical Association Cymru / Wales

Fifth Floor, 2 Caspian Point, Caspian Way, Cardiff Bay, Cardiff, CF10 4DQ



British Medical Association Cymru / Wales

Written Evidence to the Health Wellbeing and Local Government Committee. Inquiry into Stroke Services in Wales

INTRODUCTION

BMA Cymru Wales is pleased to provide evidence to the Health, Well-being and Local Government Committee on stroke services in Wales.

The British Medical Association represents doctors from all branches of medicine all over the UK. It has a total membership of over 138,000 including more than 3,000 members overseas and over 19,000 medical student members.

The BMA is the largest voluntary professional association of doctors in the UK, who speak for doctors at home and abroad. It is also an independent trade union. BMA Cymru Wales represents some 6,000 members in Wales from every branch of the medical profession.

OVERVIEW

Stroke is a common and devastating condition and is the third most common cause of death in the UK; 11,000 people have a stroke in Wales each year.

Strokes leave one third of patients permanently dependent on the help of others and is the biggest cause of severe acquired disability in the UK.

The treatment and management of Stroke is now supported by a good body of quality evidence and we have witnessed a number of medical advances in recent years. As a result acute stroke is increasingly becoming a treatable condition.

BMA Cymru Wales welcomes the Welsh Assembly Government's decision to make improving stroke services a priority - as a result the last few years have seen improvement in stroke care across Wales. However so far, this has not gone far enough. In almost every area of stroke care Wales lags behind that of England and Northern Ireland. There are pockets of good practice but the patchy provision of services across the country indicates that much more needs to be done.

If we are to see real improvement in the treatment and services available to stroke patients across Wales, we need investment in the provision of more specialist stroke units and a larger specialist workforce.

MEDICAL NOTES

A stroke occurs when the blood supply to part of the brain is interrupted, the affected region no longer functions normally and may be due either to a blockage or bleeding from one of the arteries supplying the brain.

In most people, the symptoms of a stroke develop rapidly over a matter of seconds or minutes. The exact symptoms depend on the area of the brain affected. If the stroke is severe, areas of the brain that

control breathing and blood pressure may be affected or the person may lapse into a coma. In these circumstances, the outcome can be fatal.

Stroke symptoms can be hard to recognise and diagnose for those not specifically trained to do so - even for many healthcare professionals and physicians. Unlike acute heart attacks for example where diagnosis is confirmed from the typical symptoms and an ECG, there is no such way of diagnosing a stroke. Some health conditions – e.g. migraine, seizure and Transient Ischaemic Attack (TIA/co-called “mini-stroke”) – can mimic stroke symptoms of weakness and speech loss; and conversely many patients with stroke syndromes can be misdiagnosed by non-experienced clinicians. Stroke has many mimics and many conditions mimic stroke. Therefore, clot-busting thrombolysis treatments (which have a high rate of adverse effects) can be given to the wrong patients. We would recommend that the diagnostic process is prioritised and every effort made to enhance the skills of clinicians i.e. for those who have early contact with potential stroke patients and in general medical training. Expertise needs building up and concentrating in specialist centres.

There is usually little or no warning of a stroke. Immediate admission to hospital for assessment and treatment is essential so that a cause can be identified and treatment can begin. The after-effects of a stroke vary depending on the location and extent of the brain tissue affected. If the symptoms disappear within 24 hours, the condition is known as a transient ischaemic attack (TIA) which is a warning sign of a possible future stroke. Approximately 30 per cent of strokes are preceded by a TIA, or 'mini-stroke', and most subsequent strokes occur during the first few days after the initial warning event.

Drug treatment and prompt specialist care and rehabilitation are the greatest determinants of both survival and recovery.

Stroke can affect anyone. Traditionally strokes have been associated with males over the age of 70 but this is becoming increasingly less so.

Interestingly, a review published in the Oxford Journal in 2007¹ concluded that there is clear evidence of an age effect on the delivery of stroke care in England, Wales, and Northern Ireland, with older patients being less likely to receive care in line with current clinical guidelines. It found that older patients are less likely to be treated in a stroke unit than younger patients, are less likely than younger ones to receive secondary prevention and some aspects of rehabilitation, and that brain imaging was performed less often for older patients. This might be an issue which the Committee might wish to consider further.

The table below shows Wales' score on the nine key indicators identified in the National Sentinel Stroke Audit Phase II (clinical audit) 2008:

4.2 Overall results for 9 key indicators in 2008

	Table gives % compliance with each indicator, for applicable patients	National	England	Wales	N Ireland
Q1.10	Patients treated for 90% of stay in a Stroke Unit	58	59	41	59
Q3.3	Screened for swallowing disorders within first 24 hours of admission	72	74	52	70
Q1.13iv	Brain scan within 24 hours of stroke	59	59	54	56
Q3.4	Commenced aspirin by 48 hours after stroke	85	85	85	82
Q3.6	Physiotherapy assessment within first 72 hours of admission	84	85	70	85
Q4.2	Assessment by an Occupational Therapist within 4 working days of admission	66	68	43	73
Q5.1	Weighed at least once during admission	72	73	59	68
Q5.3	Mood assessed by discharge	65	66	46	80
Q5.5	Rehabilitation goals agreed by the multi-disciplinary team	86	87	74	83
Average for 9 indicators for 2008		72	73	58	73

Comment: Standards of care for all of the key indicators apart from starting aspirin within 48 hours remain lower in Wales than England and Northern Ireland. Until specialist stroke units are made available in all hospitals in Wales and are of sufficient capacity to manage all appropriate patients this situation is unlikely to be rectified. It is encouraging that the Welsh Assembly is making efforts to address the issue. There is clearly a need for urgent action.

A MEDICAL EMERGENCY

Rightly, stroke is increasingly being seen as a medical emergency which requires urgent and prompt specialist assessment and treatment.

Patients should be assessed at an acute hospital immediately after a stroke since hyperacute treatments such as thrombolysis must be administered within as little as three hours after stroke onset. Currently only 5% of hospitals in Wales offer thrombolysis.²

Most people who have suffered a stroke, should have a brain scan (CT or MRI) as soon as possible - within 24 hours / no later than 48 hours - of onset of symptoms. When thrombolysis is being considered it is imperative that the victim is imaged immediately. Time is brain.

There is clear evidence that admission to a stroke unit reduces deaths and disability and prevents the onset of further complications.

There needs to be an effective, integrated emergency response to stroke – i.e. multi-disciplinary teams across primary and secondary care, a public campaign to raise awareness of the signs of stroke and that it requires a 999 response, referral to a stroke unit rather than general hospital ward.

Ambulance crews should be trained specifically in stroke care, and in screening. Emergency medical services in administering a first-line response, should be trained and supported in recognising symptoms, ensuring initial stabilisation, possible administration of hyperacute therapies and communication with receiving hospitals/stroke units.

PREVENTION

Strokes are preventable, and like so many other health conditions, many are related to overall health and wellbeing. The National Service Framework for Older People states that “*about 40% of strokes could be prevented by regular blood pressure checks, treatment for hypertension and taking steps to improve overall health*”³

Primary prevention of stroke should therefore form part of the overall policy on public health (provision of information on healthy living, supporting healthy and active lifestyles, good nutrition, smoking cessation, access to green open spaces, active transport etc) which is also related to the prevention of a number of other critical illnesses – heart disease and diabetes for example.

Urgent preventative treatment following the initial warnings of transient ischaemic attack (TIA) could avoid many thousands of strokes in Wales each year. Delays to assessment after TIA are significant, sometimes due to delays on the part of patients in seeking medical attention. Education is therefore required to enable the public to recognise the symptoms of TIA and minor stroke, and to encourage people to seek medical attention immediately.⁴

Secondary prevention should start shortly after admission, and all patients should be offered lifestyle guidance.

² National Sentinel Stroke Audit Phase I (organisational audit) 2006 Phase II (clinical audit) 2006

³ National Service Framework for Older People in Wales, 2006, p99

⁴ Rothwell P, Giles M, Flossmann E, Lovelock C, Redgrave J, Warlow C, Mehta Z. A simple tool to identify individuals at high early risk of stroke after a transient ischaemic attack: the ABCD score. The Lancet 2005; 366:29-36.

STROKE UNITS

Acute stroke units are paramount to the effective provision of effective stroke care. However stroke Units need to be put into the wider context of acute services as a whole.

The problems presented by stroke and speedy access to thrombolysis can potentially be solved by putting the condition into a bigger picture – in each hospital and on a regional basis. In this way the Committee might wish to consider the development of ‘Acute Brain Units’ in some hospitals to treat any acute brain conditions (be it ischaemic, electrical (seizure), traumatic, infection etc). Enhancement of neurological services through such brain units would allow a far greater proportion of patients with neurological disorders to see a specialist in neurology, which at the moment rarely happens. This would ensure that patients with any form of brain injury would have access to speedy and effective assessment, investigation, diagnosis, treatment and rehabilitation. This, of course, would not work everywhere in Wales, but could on a more regional basis – as envisioned in the independent Steers report on the future of neuroscience services in Wales.

The National Sentinel Audit for Stroke (2006) stated that: “*Action required: Wales needs to identify systems to raise the quality of stroke across the whole patient pathway, particularly through the development of stroke units.*” Alongside this, in developing acute stroke (or brain) units radiology and radiography services should be prioritised as early clinical assessment and early scanning are vital – especially in the administration of thrombolysis.

An acute stroke unit concentrates patients, healthcare staff, resources, and specialist expertise into one area, and such units provide a better outcome. Patients are twice as likely to survive a stroke, and have fewer complications, if treated in a dedicated unit. Therefore, treatment in a stroke unit is associated with earlier discharge - which along with overall improved recovery rates also delivers certain efficiency and cost-saving benefits to the NHS.

The National Sentinel Audit for Stroke (2006) reported that less than half of Welsh hospitals (45%) currently have a stroke unit – compared to over 90% in both England and N Ireland – many are not large enough to accommodate all stroke patients, with the majority finding themselves admitted to general hospital wards. Only 15% of Welsh hospitals have acute stroke units compared to Englands 59%.⁵

We believe that nobody in Wales should be further than a travel-time of 30 minutes from a dedicated stroke unit, but this might not mean that an acute stroke unit is needed in every hospital in Wales. A network of ‘hyperacute’ units in centres with expertise for thrombolysis and its complications; coupled with rehabilitation units closer to home might be one model.

In developing its recommendations in relation to acute stroke services in Wales, the Committee may wish to consider the algorithm attached in Appendix 1, which is part of the recent US Review of current and emerging therapies in acute ischemic stroke.

The development of acute stroke centres and systems of care may revolutionize the medical community's ability to treat patients with stroke. Specialised stroke services have been effective in improving acute and long-term outcome measures.

Focusing clinical resources in neurocritical care units and stroke units provides greater specialist care, enhances knowledge in the field, and may also facilitate data collection and enrolment in clinical trials. Ideally, these measures will optimise patient access to the best of current medical and endovascular therapies⁶.

The current restructuring of the NHS in Wales provides an opportunity to improve stroke services, and bring them up to similar standards, across the country. Mechanisms to improve data collection might also form part of this.

⁵ National Sentinel Stroke Audit Phase II (clinical audit) 2008

⁶ J NeuroInterv Surg 2009;1:13-26 doi:10.1136/jnis.2009.000117 Review of current and emerging therapies in acute ischemic stroke

The table below is from the National Sentinel Stroke Audit Phase II (clinical audit) 2008 which was published earlier this year – it compares the differences in effective stroke treatment in a dedicated stroke unit and in a general hospital ward.

Evidence For The Benefits Of Stroke Unit Care

Comparison of compliance with 8 indicators for all sites depending on whether patients were admitted to a stroke unit or not.

Table gives % compliance with each indicator for applicable patients	% among patients admitted to stroke unit (8390 patients)	% among patients not admitted to a stroke unit (2967 patients)
Screened for swallowing disorders within first 24 hours of admission	78	50
Brain scan within 24 hours of stroke	64	59
Commenced aspirin by 48 hours after stroke	87	79
Physiotherapy assessment within first 72 hours of admission	88	65
Assessment by an Occupational Therapist within 4 working days of admission	70	42
Weighed at least once during admission	79	46
Mood assessed by discharge	72	36
Rehabilitation goals agreed by the multi-disciplinary team	91	57

These statistics clearly identify the importance of providing specialist stroke unit care. In the relevant key indicators, the compliance with the audit standards was higher when the patient was managed on a stroke unit.

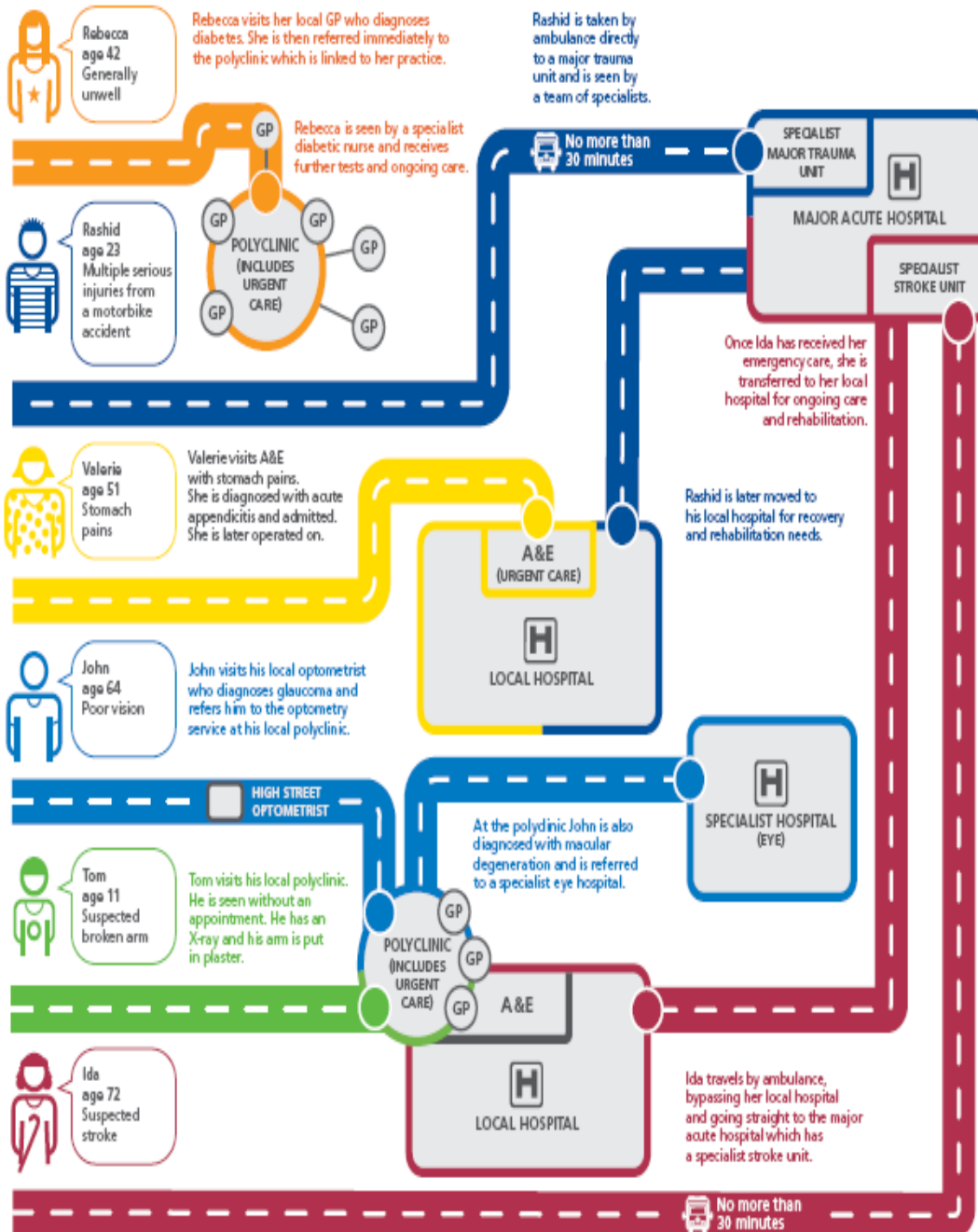
The diagram overleaf, from Healthcare for London⁷, shows what a future hospital in London might look like and how it will operate. It has been developed on the principle '*localise where possible, centralise where necessary*'. You can see how a stroke patient (represented in red) would expect to be treated. Each stroke unit would ensure 24 hour access to thrombolysis and would have the right clinical expertise to treat patients. An individual with stroke symptoms will be taken by ambulance, bypassing the local hospital, to an acute unit which would be expecting the patient and therefore has prepared scanning equipment ready for use.

This is an excellent example of effective acute stroke care, and is a far cry from the current acute care pathway we see at this end of the M4.

The Committee might want to consider this model in it's deliberations on this issue, (although 24 hour access to thrombolysis is vital in many hospitals in Wales, for others it might be just as effective to provide a 9 – 5 thrombolysis service).

⁷ Local hospitals in London Right treatment, right place, right time. See Also A local hospital model for London November 2008 <http://www.healthcareforlondon.nhs.uk/>

The right treatment, in the right place, at the right time



Patient benefits

- Rebecca receives ongoing care in one location. This includes retinal (eye) screening and information on managing diabetes, such as dietary advice.
- She avoids unnecessary trips to hospital and has better long-term management of her condition. Ultimately this leads to fewer medical complications as she gets older.
- Rashid is seen by an on-site team of skilled specialists including a neurosurgeon, cardiothoracic surgeon and orthopaedic surgeon.
- His survival rate increases by 25% because he has access to expert care in one location. He also makes a faster recovery and is later moved to a local hospital for rehabilitation.
- Valeria is promptly diagnosed with appendicitis at the urgent care centre, which is integrated with the A&E department. This ensures she is triaged as quickly as possible, avoiding a lengthy wait.
- She is assessed in the surgical assessment unit and is operated on by a skilled surgical team that handles emergency cases only, ensuring better clinical outcomes.
- Early detection of John's glaucoma and macular degeneration reduces his chances of going blind.
- At the polyclinic he gets advice on his housing needs from council services also based onsite.
- At the specialist hospital he is seen by one of the UK's top ophthalmologists and has access to groundbreaking treatment.
- Tom avoids a lengthy wait in an A&E department.
- He is seen by his local GP who is based at the local hospital and has access to X-ray and plaster facilities.
- He is directly referred to the fracture clinic based within the local hospital, at a time convenient to him.
- Ida receives an assessment by a specialist, CT scan and access to thrombolysis (clot-busting drugs) within 30 minutes of arrival at hospital.
- Thrombolysis treatment stops the impact of stroke and speeds up overall recovery.
- Three days later Ida is moved to a local stroke unit and is seen by the dedicated stroke rehabilitation team.

STAFF / TRAINING

Staff levels in almost all disciplines in stroke care in Wales are woefully inadequate, and all lag behind the equivalent found in both England and N.Ireland.⁵ The indicator that has shown the greatest improvement in Wales is access to physiotherapy which has risen from 49% to 70% since 2004.

Across NHS Wales there is a shortage of doctors in general. This is having an adverse effect on working conditions, medical training and on patient care. We believe that there is an urgent need for the development of a recruitment and retention strategy for doctors in Wales – and importantly Junior doctors.

There is a shortage of speciality doctors in stroke in Wales. Consultant physicians with a particular interest in stroke are over-stretched and are often unable to provide the amount of dedicated sessions required because of other clinical pressures. When one considers the need for a 24hr acute service this shortfall becomes even more obvious. The average number of formal sessions per week of consultant time for stroke management (including outpatient clinics) in Wales is just three - this is a long way from the recommendations of the British Association of Stroke Physicians of 2 WTE per district. As a result, expert acute stroke care is not being delivered as it should be, doctors are working under unacceptable pressure and patient care is suboptimal and is often compromised.

Consultant physicians with an interest in stroke should be supported in delivering specialist stroke care. There is increasing evidence to underline the fact that stroke services should be consultant-led⁸.

Neurologists have been heavily involved in recent years in setting standards for investigation and treatment of transient ischaemic attacks (TIAs) and stroke and this expertise is revealed by the lead that certain neurologists have taken in organising the UK TIA Aspirin and European Carotid Surgery trails. The Association of British Neurologists has produced a series of recommendations for the management of patients with TIA and stroke and the Royal College of Physicians has recommended that those responsible for stroke services should have had experience in neurology⁹. Wales has a particularly poor record in recruitment of Consultant Neurologists. Recommendations from the Association of British Neurologists are that to provide a basic outpatient clinic service along with review of some complex neurological admissions (not all) 1 neurologist/100,000 population is required.

Most patients with neurological conditions never see a neurologist. As many as 1 in 5 of all acute admissions to hospital are for neurological problems yet few neurologists are directly involved. This problem is multifactorial in origin including:

- Not enough neurologists - not every DGH in Wales has access to neurology sessions at all and some perhaps one day per week only
- Even in Neurology centres the emphasis is often exclusively or largely on elective outpatient work leaving no time in Consultant job plans for acute work

There is an increasing body of evidence that when “Liaison” Neurologists get involved in “front door” acute neurology that unnecessary investigations are avoided, bed-days are saved and patients are managed quicker and better. Dr Chris Rickards in Swansea is piloting this in Wales but models exist elsewhere e.g. Leeds.

There are just over 20 neurologists in Wales, many of which work part time for the NHS, either because they work part-time *per se* or their principal duties are with Universities (Clinical Academics). For Neurologists to be involved with acute neurology on a day-to-day basis in acute General Hospitals and for all patients with neurological problems to be under the direct care of a Consultant Neurologist it is

⁸ SEE: Reducing deaths from stroke: a focused review of the literature, Nursing Older People, (2004): What is the impact of consultant supervision on outpatient follow-up rate? Clinical Otolaryngology & Allied Sciences, April 2004: Rosen R, Jones R, Tomlin Z, Cavanagh M (2005). Evaluation of General Practitioners with Specialist Interests: Access, Cost, Evaluation and Satisfaction with Services. London: NHS Service Delivery and Organisation Research and Development Programme, (2007)

⁹ Neurology in the United Kingdom towards 2000 and beyond. Association of British Neurologists 1997.
[http://www.theabn.org/downloads/2000 and beyond.pdf](http://www.theabn.org/downloads/2000%20and%20beyond.pdf)

British Medical Association
bma.org.uk/wales

estimated the ratio should be 1:40,000¹⁰. A comprehensive acute liaison service could be provided if neurologists were present 5 days per week in all acute hospitals thus all patients needing to see a neurologist could do so within 24-48h of admission. This would require one Consultant Neurologist per 63,000 population.¹¹

This will only be achieved by an effective doctor recruitment and retention strategy and a significant increase in stroke care manpower across the board, including Neurology. The 2004 Wanless Report¹² states that the size and composition of the NHS workforce is one of the most important determinants of the capacity of the health service.

To compound this situation, there is not a single trainee in this sub-speciality in Wales. Those doctors who do want to sub-specialise in stroke go to England to train and do not return simply because they settle and find employment in local hospitals. For this reason local training and sub-speciality training within Wales is essential.

We support what Dr Anthony Rudd said in his evidence to the Committee last term *"It is important for you to encourage people to train in the treatment of stroke in Wales. It helps to put it on the agenda, and it is investing for your future. The majority of people who train in Wales will probably go on to work in Wales for the rest of their careers"*.

The role of social services in delivering stroke care is often overlooked; and the potential of social services to join up care provision is often not realised. 53% of stroke units in Wales have a social worker attached to the multidisciplinary stroke team, this compares to 73% in England and 100% in N.Ireland.¹³

REHABILITATION

The principal aims of rehabilitation are to restore function and reduce the effect of the stroke on patients and their carers. Rehabilitation should start early during recovery with assessment and mobilisation while the patient is in the stroke unit.

Formal rehabilitation in a stroke unit is associated with reduced death and disability and a shorter stay in hospital. Optimal care is multidisciplinary: doctors, nurses, physiotherapists, occupational therapists, speech and language therapists, dieticians, psychologists, and social workers all have a role. Mental well-being plays a large part in the recovery process for stroke survivors, this needs to be taken into account and mental health support should start early and community based provision needs to be supported to form part of the multidisciplinary care pathway.

The evidence to support community based rehabilitation is well established. Where stroke patients are discharged from early hospital, and receive the necessary support, they tend to do better. BMA Cymru has always supported the view that people should be treated as close to home as possible – as long as it is effective and safe to do so. In relation to Stroke, this is where ensuring that a specialist stroke team in the community is available and fully resourced is essential – and that the community team works closely with other partners to ensure that in and out patient services are as seamless as possible. Another advantage of early supported discharge is that it increases capacity in the acute care environment for other patients.

As previously mentioned, because of the advances in medical treatment for stroke more people are surviving than ever before. Of course with the provision of more stroke units in Wales this number could increase much further. This will mean that more people will require rehabilitation services and will be living with a disability and require on-going support. Rehabilitation needs should therefore be considered alongside the development of specialist stroke care.

Significant investment is needed at the acute care level, but the focus needs to be on the whole stroke journey.

¹⁰ UK Neurology the next ten years. Putting the patients first. ABN 2003.

http://www.theabn.org/documents/Next_10_years_final.pdf

¹¹ Acute Neurological Emergencies in Adults. ABN 2002. <http://www.theabn.org/documents/AcuteNeurology.pdf>

¹² April 2002. 'Securing Our Future Health: Taking A Long-Term View'

¹³ National Sentinel Stroke Audit Phase II (clinical audit) 2008

RECOMMENDATIONS

- A Wales wide doctor recruitment and retention strategy is needed across the Welsh NHS; this should include a drive to recruit / retain specialist stroke physicians and neurologists and to promote the speciality to junior doctors and medical students.
- Every person in Wales should have access to an Stroke Unit within 30 minutes travel distance from their home, the Unit should:
 - ❖ Offer high quality 24 hour care - including 24hour access to thrombolysis and scanning equipment.
 - ❖ Be of a similar high standard to other Units across Wales;
 - ❖ Have adequate staffing levels (doctors, nurses, physiotherapists, occupational therapists, speech and language therapists, dieticians, psychologists, and social workers) – including sufficient sessions dedicated to stroke care;
 - ❖ Have adequate bed capacity;
 - ❖ Have strong links with rehabilitation and support services.
- There should be no unnecessary delay in undertaking a brain-scan. Without a brain scan, treatment cannot commence safely or effectively.
- The new LHBs should:
 - ❖ Appoint a commissioner or a team to lead and champion the improvements within their areas and offer local solutions based on overcoming particular geographical challenges.
 - ❖ Dramatically increase the number of WTE medical hours allocated to stroke treatment and management in each hospital within their areas;
 - ❖ Increase staff levels and support the workforce in delivering stroke treatment and care;
 - ❖ Work closely with local authorities and others to create multi-disciplinary care partnerships ensuring joined up working and continuous care provision;
 - ❖ Interpret national guidance into effective local delivery by considering what is best to meet the challenges of that particular area. In this way national guidance should be broad and flexible;
 - ❖ Facilitate research and data gathering through, for example, local clinical research networks - working with other LHBs to take a Wales-wide view of stroke services;
 - ❖ Utilise the new Professional Forums and Stakeholder Reference Group as a mechanism to highlight stroke issues.
 - ❖ Facilitate public awareness and education campaigns.
- Given the importance in receiving treatment of the first few hours after a stroke people should be directed straight to hospital, ambulance staff should be specially trained in the early treatment of stroke victims, and information should be sent to GPs to support direct referral.
- A national public awareness campaign is needed to highlight the prevalence and severity of stroke, how to recognise the symptoms, and that it requires a 999 response. The FAST (Face, Arms, Speech, Time) campaign did some good work in relation to this but needs to be built on – for example, the ways to recognise transient ischaemic attacks (TIA), the risk factors such as high blood pressure and diabetes, high cholesterol, smoking, excess alcohol intake and recreational drug use should also be highlighted. Many people still do not realise that strokes are preventable, do not know the symptoms or risk factors, or how to manage them.
- A training programme should be developed for stroke treatment across the multi- disciplinary teams working within the primary and secondary care sector to ensure efficiency and confidence when treating or managing stroke. Training should also be extended to carers.
- The long-term impact of stroke on families and carers needs to be looked at and their views sought.
- Current policy on Stroke - the National Service Framework for Older People, the Stroke Improvement Programme and the Stroke Pathway – are useful but we would support the development of a Stroke Strategy for Wales accompanied by a solid and achievable Action Plan.

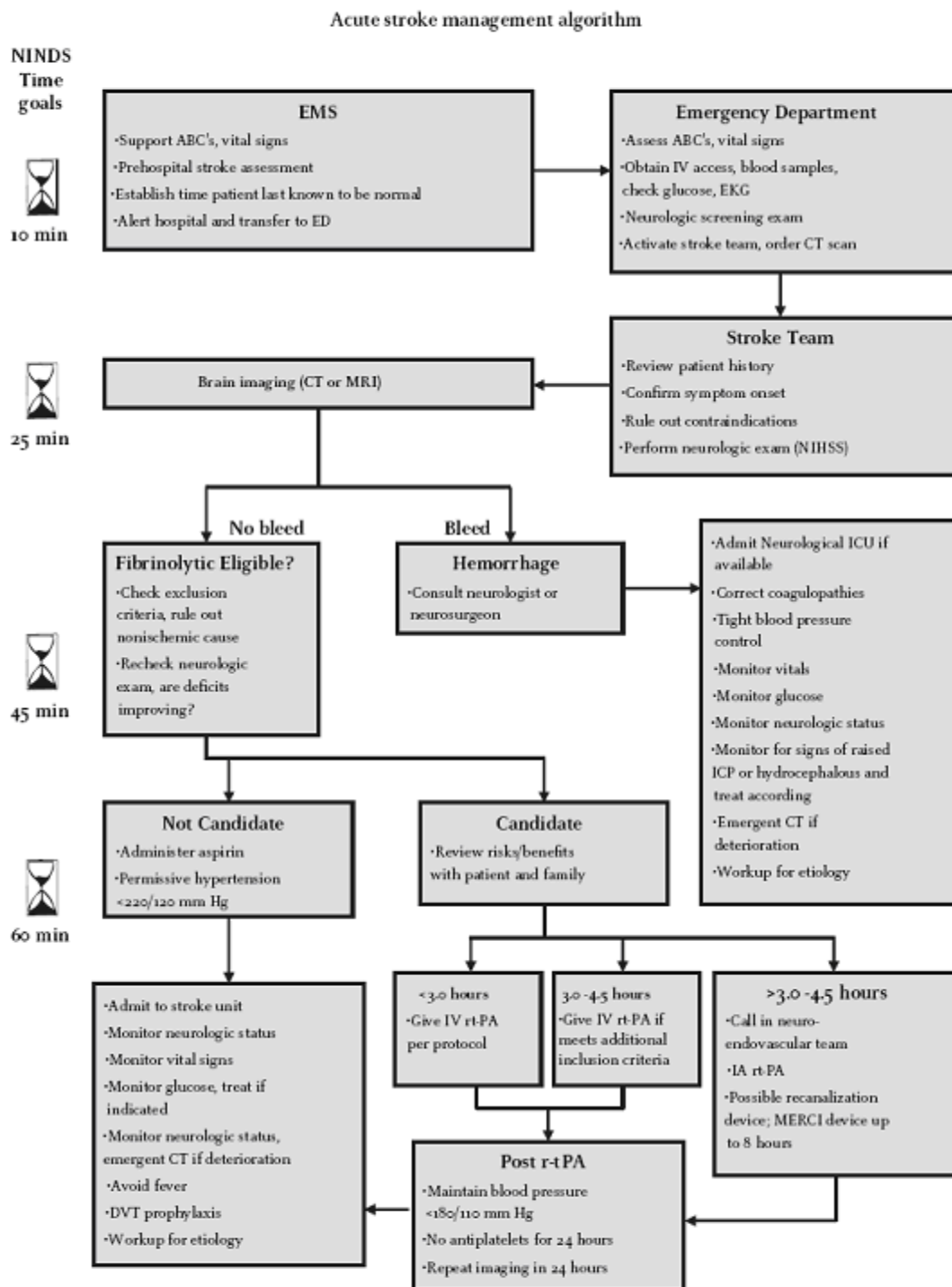


Figure 1 Acute stroke management algorithm. DVT, deep vein thrombosis; ED, Emergency Department; EMS, emergency medical services; IA, ICP, intracranial pressure; ICU, Intensive Care Unit; IV, intravenous; MERCI, Mechanical Embolus Removal in Cerebral Ischemia; MRI, magnetic resonance imaging; NIHSS, National Institutes of Health Stroke Scale; rt-PA, recombinant tissue plasminogen activator.