

## Stroke Care in Europe – The Role of Stroke Units

a report by

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The stroke burden upon society is increasingly high. We expect around 1,800 new stroke cases and 600 stroke recurrences per one million people per year. Due to the changing age structure of most populations, these numbers are set to increase in the future.

An organised stroke unit is an infrastructure that provides certain key processes for acute stroke patients. Stroke unit care constitutes a highly effective treatment. It decreases mortality, disability and the need for institutional care.<sup>2</sup> This is true of all age groups and any stroke type or severity. Elderly patients and those with severe strokes benefit most.<sup>3</sup> The number needed to treat at organised stroke units has been calculated to be as low as 15 to avoid one death or disability.<sup>3</sup> This number may in fact be even lower, as thrombolysis with tissue plasminogen activator (tPA)<sup>4</sup> and multimodal automated monitoring<sup>5,6</sup> were not available in the trials of the Stroke Unit Trialists' Collaboration. A major component of the beneficial effect of stroke unit care is the increasing number of patients treated with thrombolytic therapy. The concomitant improvement of expertise leads to better outcomes and fewer complications.<sup>7-10</sup> Several recent publications have confirmed that organised stroke care leads to shorter hospital stay, fewer complications and a better functional outcome.<sup>6,11-14</sup> This is why the recent Helsingborg Declaration clearly stated that "all patients in Europe with stroke will have access to a continuum of care from organised stroke units in the acute phase to appropriate rehabilitation and secondary prevention by 2015."<sup>15</sup> Other recent papers argue for the same ideal.<sup>16-18</sup>

Five factors are particularly important for stroke units to have a beneficial effect: the dedicated stroke unit, i.e. care is confined exclusively to acute stroke patients; the multidisciplinary team approach, including physicians, nurses, physiotherapists, occupational therapists, speech and swallowing therapists, social workers and neuropsychologists, all specialised in stroke

treatment; the comprehensive stroke unit concept delivering both hyperacute treatment and early mobilisation and rehabilitation by the same multidisciplinary team; automated multimodal monitoring of vital functions within the first 72 hours; and thrombolysis within the time limits of up to three hours and beyond in selected patients.

European Stroke Initiative (EUSI) investigators<sup>19</sup> recently performed an interrogation of 83 European stroke specialists from 18 countries to establish what, in their opinion, are the essential components and necessary facilities on the various levels of hospital care where acute stroke patients are routinely treated. One hundred and seven potential components collected from the relevant literature were proposed for evaluation. Experts had to judge the items using a numerical scale ranging from 1 (irrelevant) to 5 (absolutely necessary). Items were derived from six categories: personnel, diagnostic procedures, monitoring, invasive treatments provided, infrastructures and protocols and procedures. Components considered as 'absolutely necessary' by at least 50% of the experts were classified as essential for acute stroke care in comprehensive stroke centres (CSCs) (see *Table 1*). The two upper levels defined on the basis of their answers corresponded to CSCs and primary stroke centres (PSCs).<sup>19</sup>

Eight components were considered as absolutely necessary by more than 75% of experts for PSCs: a multidisciplinary team; stroke-trained nurses; brain computed tomography (CT) scan available 24/7 (i.e. always);<sup>4</sup> CT priority for stroke patients; extracranial Doppler sonography; automated electrocardiogram (ECG) monitoring; intravenous (IV) recombinant (rt)-PA protocols 24/7; and in-house emergency department (see *Table 2*). These findings define what should be part of modern stroke care, as the opinion of the experts was based on the state-of-the-art technology and the latest scientific evidence in stroke research. A third level of stroke care was also defined, but this was considered the minimum, suboptimal level of care for stroke patients (see *Table 3*). The aspect of telemedicine in acute stroke care had to be removed due to disagreement between experts. The above classification, with the two highest levels of care recommended for acute stroke patients, is close to the ideas of the Brain Attack Coalition (BAC),<sup>20</sup> the Swiss,<sup>21</sup> the German and the Finnish ideals,<sup>17,22,23</sup> but does not perfectly match the models developed in the UK and Scandinavia.

What is the reality for acute stroke sufferers in Europe? The answer to this important question was provided by a subsequent study from the same group with a Europe-wide investigation of a large random sample of hospitals.<sup>24</sup> The objective of this study was to find out how many European hospitals are able to provide an appropriate level of care. The level of stroke care was analysed in 886 hospitals in 25



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**Table 1: Components Considered Absolutely Necessary for a Comprehensive Stroke Centre by 75% (Bold) or 50% (Normal) of Experts, Respectively**

Personnel	Multidisciplinary team Stroke-trained nurses Physiotherapy started within two days Neurologists available 24/7 Stroke-trained physician available 24/7 Interventional neuroradiologist on call Neurosurgeon on call CEA vascular surgeon Emergency department staff Physician expert in carotid ultrasonography Physician expert in echocardiography Speech therapy start within two days Physiotherapy start within two days
Diagnostic procedures	Brain CT scan available 24/7 CT priority for stroke patients Extracranial Doppler sonography Extracranial duplex sonography Transthoracic echocardiography MRI (T1, T2, T2*, FLAIR) available 24/7 Diffusion-weighted MRI Extracranial Doppler sonography available 24/7 Extracranial duplex sonography available 24/7 Transcranial Doppler available 24/7 CT angiography available 24/7 Magnetic resonance angiography available 24/7 Transfemoral cerebral angio available 24/7 Transoesophageal echo
Monitoring	Automated ECG monitoring at bedside Automated monitoring of pulseoximetry Automated monitoring of blood pressure Automated monitoring of breathing Monitoring of temperature
Invasive treatments provided	Intravenous rt-PA protocols available 24/7 Carotid surgery Angioplasty and stenting Intra-arterial thrombolysis available 24/7 Respiratory support Surgery for aneurysms Hemicraniectomy Ventricular drainage Surgery for haematoma
Infrastructures	Emergency department (in-house) Collaboration with outside rehabilitation centre Stroke outpatient clinic Multidisciplinary ICU Inpatient rehabilitation (in-house) Outpatient rehabilitation available Anticoagulation clinic
Protocols and procedures	Stroke faculty Intravenous rt-PA protocols Stroke pathways Clinical research Stroke care map for patient admission Stroke database Community stroke awareness programme Prevention programme Research grants Drug research Stroke clinical fellowship Stroke study co-ordinator Stroke research unit

**Table 2: Infrastructural Components Considered Absolutely Necessary or Important in the Primary Stroke Centre by More Than 75% (Bold) or 50% (Normal) of Experts**

Personnel	Multidisciplinary team Stroke-trained nurses Neurologists on call Neurologists on staff Stroke-trained physician available 24/7 Diagnostic radiologist on call Emergency department staff Physician expert in carotid ultrasonology Social worker Speech therapy start within two days Physiotherapy start within two days
Diagnostic procedures	Brain CT scan available 24/7 CT priority for stroke patients Extracranial Doppler sonography Extracranial Duplex sonography Transthoracic echocardiography Transoesophageal echocardiography
Monitoring	Automated ECG monitoring at bedside Automated monitoring of pulseoximetry Automated monitoring of blood pressure Automated monitoring of breathing Monitoring of temperature
Infrastructures	Emergency department (in-house) Stroke outpatient clinic Multidisciplinary ICU Inpatient rehabilitation (in-house) Outpatient rehabilitation available Collaboration with outside rehabilitation centre
Treatment, procedures and protocols	Intravenous rt-PA protocols available 24/7 Stroke care map for admission of patients Community stroke-awareness programme Prevention programme Stroke pathways

CEA = carotid endarterectomy; CT = computed tomography; MRI = magnetic resonance imaging; ECG = electrocardiogram; rt-PA = recombinant tissue plasminogen activator; ICU = intensive care unit.

countries of the 1,466 hospitals that answered the questionnaire and said that they treat acute stroke patients. These 25 countries were all members of the EU, with the exception of Malta and Cyprus, which were replaced by Switzerland and Norway. These 886 hospitals treat about one-third of stroke patients in the above-mentioned countries. The data refer to the year 2005.

One and a half to two hospitals per million inhabitants were randomly selected by a professional specialising in this type of investigation. In order to meet the criteria for CSCs, the hospital needed to have at least 80% of the components rated as absolutely necessary by at least 50% of the experts and the 20 components rated as absolutely necessary by more than 75% of the experts (see *Table 1*). To be rated as a PSC, the hospitals had to have at least 80% of the components rated as absolutely necessary by at least 50% of the experts (see *Table 2*). More than 60% of the contacted hospitals responded, corresponding to 52.5% of those hospitals admitting acute stroke patients. On average, each of these hospitals had treated 376 stroke patients in 2005. Only 4.9% of the hospitals met the above criteria for a CSC, and 3.6% for a PSC. Around 40% of the hospitals met the criteria of any hospital treating stroke patients (see *Table 3*), but 51.4% did not provide even

**Table 3: Infrastructure Components Considered Absolutely Necessary (Bold) or as Important (Normal) by More Than 50% of Experts in any Hospital Treating Acute Stroke Patients on a Regular Basis**

Personnel	Emergency department staff
	Multidisciplinary team
	Stroke-trained nurses
	Neurologists on call
	Stroke-trained physician on call
	Diagnostic radiologist on call
	Internist on staff
	Cardiologist on staff
	Social worker
	Speech therapy start within two days
	Physiotherapy start within two days
Diagnostic procedures	<b>Brain CT scan for all</b>
	<b>Brain CT scan available 24/7</b>
	<b>CT priority for stroke patients</b>
	Extracranial Doppler sonography
	Extracranial Duplex sonography
	Transthoracic echocardiography
Monitoring	Automated ECG monitoring at bedside
	Automated monitoring of pulseoximetry
	Automated monitoring of blood pressure
	Monitoring of temperature
Infrastructures	<b>Emergency department (in-house)</b>
	<b>Collaboration with outside rehabilitation centre</b>
	Stroke outpatient clinic
	Multidisciplinary ICU
	Respiratory support
Treatment, procedures and protocols	<b>Stroke pathways</b>
	<b>Stroke care map for admission of patients</b>
	<b>Prevention programme</b>
	Intravenous rt-PA protocols available 24/7
	Community stroke-awareness programme

Centres had to meet only 50% of these requirements within each category to qualify as suboptimal minimal standard. CT = computed tomography; ECG = electrocardiogram; ICU = intensive care unit; rt-PA = recombinant tissue plasminogen activator.

the lowest level of stroke care, as defined in Table 3. These data clearly indicate that fewer than 10% of European hospitals admitting acute stroke patients have optimal facilities.

## Discussion

All experts asked for their opinion were stroke specialists and most were neurologists working at secondary or tertiary care centres. On the basis of their judgement, three levels of care were established. CSCs are mainly academic facilities and university centres providing

research and teaching activities, and have neurosurgery, neuroradiology and cardiology available 24/7, whereas PSCs are high-level care facilities for stroke patients that do not provide specific investigations or therapies requiring the technical and medical expertise of CSCs.

On the basis of the expert questionnaire, the EUSI Investigators were also able to define a minimum level of care that should not be undercut for any acute stroke patient. The features of this basic level represent items judged absolutely necessary by more than 50% of the experts in any hospital admitting stroke patients routinely (see bold-printed items in Table 3). These items are: emergency department staff; brain CT scan available 24/7; CT priority for stroke patients; emergency department in-house; collaboration with outside rehabilitation centre; stroke care map for patient admission; prevention programme; and stroke pathways. Only a few components had to be removed from this list due to disagreement between experts. Hospitals not meeting these eight requirements were considered suboptimal by the stroke experts. IV rt-PA treatment should be performed in CSCs and PSCs as most experts considered rt-PA treatment as "important, but not absolutely necessary" for hospitals that did not reach the level of CSC or PSC.

Despite potential bias in the selection of experts and items for the questionnaire, our findings will help health authorities to implement modern stroke unit care for the future on the basis of expert consensus on appropriate stroke care. The definition of CSC or PSC used here differed from that used in randomised trials of the Stroke Unit Trialists' Collaboration. As those trials took place many years ago, and considerable progress in the management and treatment of stroke patients has taken place since then, the consensus reached by the EUSI experts comprises the current best available data. It is striking that more than 50% of hospitals do not have the minimum facilities required to treat acute stroke patients properly, although the same hospitals treat more than 40% of all stroke patients in their catchment area. This finding should alarm health authorities and encourage them to increase their efforts in Europe to improve available facilities. Major shortcomings are the lack of 24-hour availability of brain CT scan, protocols for IV thrombolysis, CT priority for stroke patients, hospital stroke pathways and stroke units with multidisciplinary teams.

## Conclusion

Two major efforts are needed. First, we must channel the flow of stroke patients away from underequipped small hospitals; second, we must ensure man-power and facilities for the creation of well-organised services that are certified by health authorities. ■

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