Prehospital management of acute ischaemic stroke: how can we do better?

Patrick Goldstein, MD,
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NIH-recommended emergency department response times

**DTN ≤60 min**: evaluating and treating acute stroke but QUICKER is BETTER

- **T=0** Suspected stroke patient arrives at stroke unit
- ≤10 min Initial MD evaluation (including patient history, lab work initiation, & NIHSS) **IDEALLY** performed prehospital
- ≤ 15 min Stroke team notified (including neurologic expertise)
- ≤ 25 min CT scan initiated
- ≤ 45 min CT & labs interpreted
- ≤ 60 min rt-PA given if patient is eligible

# Reasons for delay

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PREHOSPITAL delay</strong></td>
<td>89.3 %</td>
</tr>
<tr>
<td>Underestimation of symptoms</td>
<td>62.3 %</td>
</tr>
<tr>
<td>Living alone</td>
<td>7.1 %</td>
</tr>
<tr>
<td>Refusal to go to hospital</td>
<td>6.2 %</td>
</tr>
<tr>
<td>Emergency transport</td>
<td>4.6 %</td>
</tr>
<tr>
<td>Too far from hospital</td>
<td>3.8 %</td>
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<tr>
<td>Hoping that symptoms would clear</td>
<td>2.7 %</td>
</tr>
<tr>
<td>Waiting for relatives</td>
<td>1.8 %</td>
</tr>
<tr>
<td>Waiting for general practitioner</td>
<td>0.8 %</td>
</tr>
<tr>
<td><strong>IN-HOSPITAL delay</strong></td>
<td>10.7 %</td>
</tr>
<tr>
<td>Waiting time in ER</td>
<td>6.9 %</td>
</tr>
<tr>
<td>Waiting time due to internal transport</td>
<td>3.8 %</td>
</tr>
</tbody>
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Valeria Caso, Stroke Unit and Division of Cardiovascular Medicine, University of Perugia, Italy
Stroke: Care objectives

3 care stages

Stage 1: Warning signs in hospital
- Imagery +/- thrombolysis

Stage 2: Hospital phase
- Pre-hospital phase
- Hospital phase

Stage 3: First year after stroke
- Orientation
  - MRC*
  - HAH**

Alert
Hospital
Discharge
1 year

*Monitoring and rehabilitation care
** Hospitalisation at home
Stroke chain of survival

- Rapid patient/carer recognition and reaction to stroke warning signs
- Rapid emergency medical services (EMS) dispatch, assessment, and transportation with stroke unit/hospital pre-notification
- Rapid in-hospital diagnosis and treatment

Effective EMS systems can ultimately increase the number of patients reaching the hospital within the time window for thrombolytic therapy

Current role of emergency department (ED): Stroke care pathway

Tell-tale clinical symptoms for a stroke

- Identified by the EMS
- Appropriate referral
  Reference stroke unit

- Identified on arrival at ED
- Non-processed patient admission

IDEAL PATHWAY

Around 50% of strokes

Tools to build the pathway

• **User awareness information**
  - Role of GP / at-risk patients +++
  - Signs justifying calling emergency services

• **Training the people working in the network**
  - ED doctor
  - Emergency call operator (ECO)
  - Triage nurse
  - Paramedics
  - Radio operators
  - Assessment
    - NIHSS Score
  - Identification
    - FAST
    - ASA signs
Stroke awareness campaigns: Signs of stroke

Stroke awareness campaigns help to educate the general population on the signs of stroke.

Emergency medical services (EMS) need to be alerted immediately.

Rapid EMS response and pre-notification of stroke risk can improve the thrombolytic treatment rate for ischaemic stroke patients AND reduce the time to thrombolysis.

Effect of public awareness campaign on emergency calls

Number of patients with ischaemic stroke treated by rt-PA in the Nord Pas de Calais region (France) (approximately 5500 ischaemic strokes / year)

1st regional campaign promoting calls to emergency number (TV, newspapers, bus, metro …)

Goldstein P & Leys D, personal data on file
Suspected stroke: Key criteria for emergency services

CALL — Any sudden neurological deficit – prolonged or transient – needs to trigger an immediate call to the emergency services

ASSESS — Rapid telephone assessment by call centre to prioritise the call, using e.g. Dispatcher Identification Algorithm

TRANSPORT — All suspected stroke patients should be transported immediately to a stroke centre/specialist services

SCAN — Urgent imaging (preferably MRI) is required and the imaging department should be prepared to immediately receive the patient on arrival
First call to emergency services
Dispatcher identification algorithm

Reason for call

Typical stroke symptoms
- (Sudden) speech problems
- Unilateral neurological deficits (except pain)
- Sudden onset, severe headache
- Other sudden onset neurological symptoms

Caller spontaneously mentions “stroke”

Atypical stroke symptoms
- Falls
- Movement disorders (person is alert, but e.g. unable to get up off the floor)
- Confusion
- Impaired consciousness (person is breathing)

Other symptoms (definitely non-stroke)

Alarm code
STROKE

Symptom onset ≤4 h

Symptom onset >4 h

Time of onset unknown

Face-Arm-Speech test

Evidence for non-stroke aetiology?

Alarm code
NON-STROKE

Medical decision of the dispatching centre

FOCAL and SUDDEN neurological deficit = possible stroke

Onset: error risk +++

Witness
Stroke in awake patient

Stroke discovered by the witness
Waking stroke

Onset? Accuracy? (min)

Onset = time when the patient was normal for the last time

Send to the Stroke Unit the time of onset and time of call

Onset <4 1/2 h: direct admission to the nearest Stroke Unit with “thrombolysis” bed available

Main goal = decrease the delay “call medical transport team”

10–20 min
First call to emergency services
Dispatcher identification algorithm

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Agreement between ambulance paramedic- and physician-recorded neurological signs with Face Arm Speech Test (FAST) in acute stroke patients

- Facial paresis: 68% (Paramedic) vs. 70% (Physician)
- Arm paresis: 96% (Paramedic) vs. 95% (Physician)
- Speech disturbance: 79% (Paramedic) vs. 77% (Physician)
NIHSS assessment by emergency physicians

Time for scoring first 100 pts = 5.8 ± 2.6 min

\[ r^2 = 0.94 \]

NIHSS by emergency physicians in pre-hospital setting

NIHSS by neurologists in Stroke Unit

Evaluation of the quality of diagnosis reached by emergency medical services

Final hospital diagnosis of stroke (n=705)

- EMS correct: 578 (82%)
- EMS false negative: 127 (18%)
Emergency response team

Transporting the patient

Immediate transport to closest stroke centre
- Ambulance
- Air ambulance

Continued care of patient en route

Pre-notify hospital en route
- Alert stroke team
- Ensure immediate access to imaging on arrival (CT or MRI)
- Make aware of potential need for thrombolytic therapy

"Prehospital notification of suspected stroke patients reduces time to stroke team arrival, CT scan completion, and CT scan interpretation. IV thrombolysis occurred twice as often in the prenotification group."


"Pre-hospital notification by the EMS reduces intra-hospital delays in patients eligible for rt-PA, but the benefit is higher in the case of discussion between the EMS and the neurologist before admission."

"Prehospital notification of suspected stroke patients reduces time to stroke team arrival, CT scan completion, and CT scan interpretation. IV thrombolysis occurred twice as often in the prenotification group."


<table>
<thead>
<tr>
<th>Pre-admission notification</th>
<th>No (n = 56)</th>
<th>Low-level (n = 55)</th>
<th>High-level (n = 191)</th>
<th>p values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset-to-admission time</td>
<td>97 (49–144)</td>
<td>81 (64–150)</td>
<td>81 (61–120)</td>
<td>0.628</td>
</tr>
<tr>
<td>Admission-to-imaging time</td>
<td>36 (30–58)</td>
<td>35 (17–54)</td>
<td>27 (14–35)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Imaging-to-needle time</td>
<td>23 (16–35)</td>
<td>21 (15–29)</td>
<td>24 (17–33)</td>
<td>0.341</td>
</tr>
<tr>
<td>Door-to-needle time</td>
<td>63 (51–97)</td>
<td>57 (39–81)</td>
<td>49 (39–62)</td>
<td>0.003</td>
</tr>
<tr>
<td>Onset-to-needle time</td>
<td>182 (131–234)</td>
<td>155 (106–230)</td>
<td>140 (110–175)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

"Despite its limitations, this review suggests that the use of prehospital stroke code is an important intervention to improve the accessibility of the benefits of thrombolysis, especially when implemented together with educational campaigns to optimize the awareness and behavior of patients and bystanders."

Emergency response team

*Mobile stroke units*

Potential for mobile stroke units / ambulances equipped with:
- Computed tomography
- Point-of-care laboratory system (allows complete stroke laboratory work-up)
- Telemedicine equipment for contact with hospital experts

This approach could successfully be integrated into the routine emergency service chain

Stroke patients could be treated earlier according to their ischaemic or haemorrhagic aetiology
Prehospital thrombolysis in acute stroke: Phantom study

Ideal stroke pathway

Patient with suspected stroke

15

Emergency department

Imagery (Scan/MRI)

Stroke Unit

"TIME IS BRAIN"

Indication for thrombolysis?

Triage nurse training
  Importance of lead times
  Identification Assessment (ASA)
  Reception package

Report sending procedure
  Notify ED doctor
  Look for start time
  Severity assessment
  Calculate NIHSS score
  Differential diagnosis

Notify neurovascular
  Request imagery
  Referral depending on structure
Key words

- Education
- Networks
- Hub and spoke
Definite progress for patients, but maybe also for doctors whose progress together is even better as they get to know each other better.

A lobby or a task force? EUROPE AND UK (??) and maybe the planet IS SO SMALL.
Do you speak Neuro?!
Key message from neurologist’s perspective

Hospital somewhere

Common procedures to improve acute stroke care

Dr Stroke
Dr Emergency
Dr MRI-CT