PUBLICATION ALERT NEWSLETTER

Please be aware that the purpose of this Newsletter is to make you familiar with the most recent scientific publications, and you must keep in mind that all aspects may not be covered by the label. Please always refer to the current prescribing information as in force in your country.

The process of improving AIS* care involves many stages: systematic analysis of current procedures to identify gaps and areas for improvement; gathering of a multidisciplinary team to devise new systems and approaches; educational efforts directed towards all stakeholders; data capture; and regular feedback on performance metrics. However, before all of this can begin, the crucial first step is taking the decision to try and improve patient care, generating the collective will to raise the standard of stroke treatment.

In this issue of the Actilyse® Publication Alert newsletter, we highlight the journey of one rural US hospital after the decision to try and meet standards to improve outcomes for stroke care. We also look at other process improvements, along with recent developments in mobile stroke care and telemedicine.

*Abbreviations are defined at the end of the newsletter.

THERE ARE MANY STAGES TO THE PROCESS OF IMPROVING THE TREATMENT OF AIS

Certification of a hospital as 'acute stroke ready' is an indicator that patients with AIS will receive timely and efficient care.[1] Becoming a certified ASRH is a multistep process that requires implementation of sustainable stroke care processes as well as interdisciplinary teamwork and collaboration.

To meet the needs of stroke patients in the community, a rural hospital in North Carolina set out to achieve certification as an ASRH. An interdisciplinary Continuous Process Improvement team was formed, a gap analysis was performed, and four key metrics were targeted. Several performance improvement measures were consequently implemented, which led to reductions in door-to-CT, door-to-INR, and door-to-needle times. Empowerment of ED nurses to call a code stroke, instead of waiting for the physician's assessment, had the biggest impact.

The authors end the description of their journey to ASRH certification by highlighting that:

"Interdisciplinary teamwork proved to be critical for improvement of stroke processes."

They acknowledge that the work was labour intensive, but it is producing better patient outcomes and they commit to continual monitoring and improvement of their process for stroke patients.
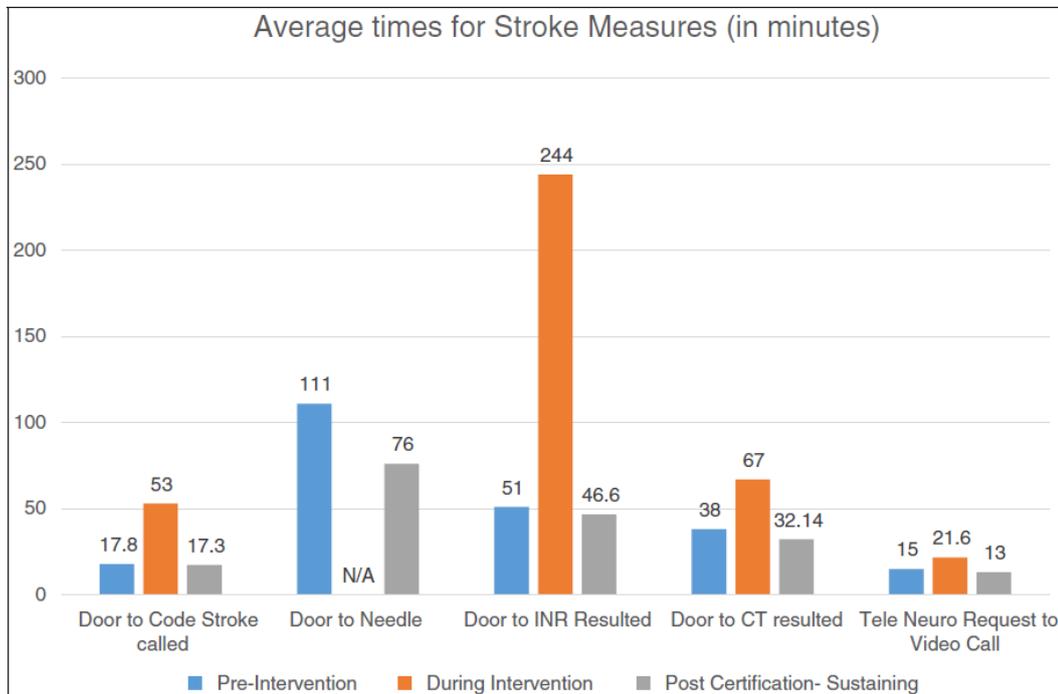
Study details

- Description of the ASRH certification process undergone by a rural hospital in North Carolina (2015–2016) after a decision was taken that the hospital should be a leader in providing evidence-based standards of care to stroke patients
- Several initiatives were introduced to address identified treatment gaps and to meet specified targets (see table)
- The Continuous Process Improvement team met monthly to review performance and discuss feedback
- Performance measures led to: 21% decrease in door-to-CT time; 8% decrease in door-to-INR time; 27% decrease in DNT

IDENTIFIED GAP OR GOAL	IMPROVEMENT INITIATIVE
Gap: Need for stroke training and education	ED nurses, technicians and physicians completed training EMS personnel were educated regarding pre-notification of incoming stroke patient
Gap: Delays in CT image sharing	Automated sending of CT images to teleneurology service
Gap: Delays in transfers to hub PSC	Handoff tool developed and added to current 'drip and ship' transfer protocol
Gap: Pharmacist not available 24/7	ED nurses trained on how to mix and administer rtPA
Gap: Poor compliance with code stroke protocols	ED nurses empowered to activate code stroke protocol
Goal: improve door-to-CT time	Code stroke group pager introduced
Goal: improve door-to-INR time	Standard policy implemented: lab technician to attend patient in CT
Goal: improve time to teleneurology consult	ED secretaries educated on how to initiate consultation request
Goal: improve DNT	Activation of code stroke protocol before ED physician evaluation

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Study details (continued)

Average times for Stroke Measures (in minutes)

	Door to Code Stroke called	Door to Needle	Door to INR Resulted	Door to CT resulted	Tele Neuro Request to Video Call
Pre-Intervention	17.8	111	51	38	15
During Intervention	53	N/A	244	67	21.6
Post Certification- Sustaining	17.3	76	46.6	32.14	13

> "It is imperative that rural hospitals seek best practices to decrease neurologic deficits and improve patient outcomes."[1]

EMERGENCY DEPARTMENT REORGANIZATION CAN IMPROVE ACUTE STROKE TREATMENT AND OUTCOMES

The timely management of patients with AIS upon arrival in the ED is dependent on rapid triage and access to imaging facilities. Reorganization of the ED, to create a separate intensive care unit (ED ICU) with a dedicated care team and direct access to MRI, led to sustainable improvements in acute stroke management at a teaching hospital.[2]

Following creation of the ED ICU, rtPA rate was increased, DNT was reduced, and functional and safety outcomes improved: almost 50% of patients had a DNT ≤60 min and almost 70% had a good functional outcome at 3 months.

Study details
- Analysis of data from 1334 patients with AIS at a university hospital in France (Oct 2013–Sep 2015) to explore the impact on rtPA treatment of ED reorganization to include an ICU
- Creation of the ED ICU led to an increased thrombolysis rate, decreased DNT, and improved clinical outcomes (see table)
  - Thrombolysis rate: OR 1.67 (95% CI: 1.08–2.60)
  - DNT: OR 4.30 (95% CI: 1.17–20.90)
  - 3-month mRS score ≤2: OR 1.30 (95%CI: 1.0–2.10)
- Significantly more patients with minor stroke (NIHSS score ≤4 on admission) were diagnosed and treated with rtPA after creation of the ED ICU than before (18% vs 3%; p=0.046)

OUTCOME IN rtPA-TREATED PATIENTS	BEFORE CREATION OF THE ED ICU (n=676)	AFTER CREATION OF THE ED ICU (n=668)	p VALUE
rtPA treatment rate, n (%)	39 (5.8)	62 (9.3)	**0.02**
Onset-to-door time, median (IQR) min	81.5 (58–103)	89 (70–134)	0.09
DNT ≤60 min, n (%)	14 (35.9)	28 (46.7)	**0.04**
SICH, n (%)	7 (17.9)	3 (4.8)	0.06
3-month mRS score ≤2, n (%)	17 (44.7)	41 (69.5)	**0.045**

> "Following the creation of the ED ICU, we observed an immediate, substantial increase in the number of IV rtPA administrations, which persisted over time."[2]

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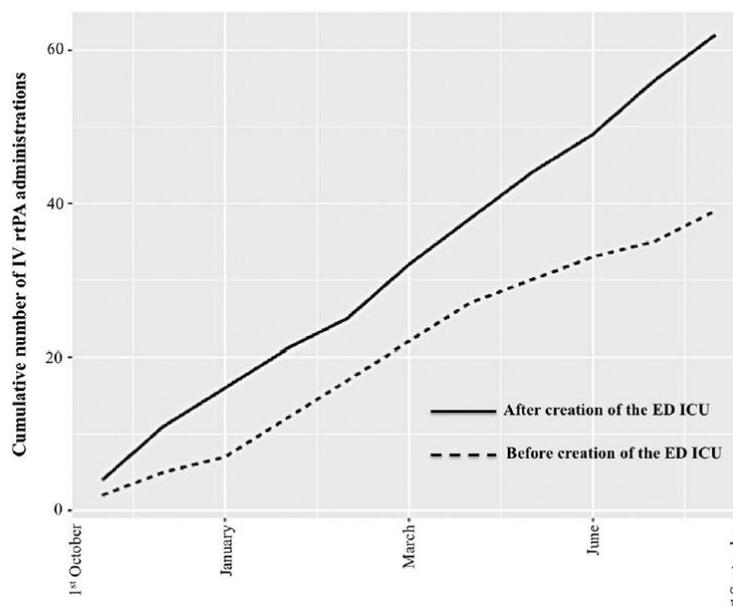
Comparison of the cumulative numbers of rtPA administrations before and after creation of the ED ICU (321 days of follow-up for each period). The distance between the two lines continued to grow over time, regardless of the time since ED ICU creation.

MODIFYING STROKE TEAM STAFFING CAN FACILITATE PARALLEL WORKFLOW AND REDUCE TREATMENT DELAYS

Expansion of the stroke care team to include round-the-clock, on-site, first responders for acute stroke code activations can reduce treatment delays among patients receiving rtPA.[3]

The introduction of nurse practitioners trained in neurocritical care to provide 24/7 on-site first responder coverage at a US PSC significantly shortened imaging-to-needle time and DNT for rtPA-treated patients.

The authors of the study believe that the presence of the ACNP first responder helped to facilitate communication and improved DNT by allowing the stroke team to work more efficiently.

Study details

- Analysis of data from 166 consecutive patients who received rtPA at a Joint Commission-accredited PSC in Hawaii (Jul 2009–Mar 2014), before and after the introduction of 24/7 ACNP first responders in July 2011
  - The role of the ACNP included reviewing imaging results and rtPA eligibility with the vascular neurologist
  - No other systematic changes were made to the staffing model or stroke code care pathway in this period
- Thrombolysis treatment rates were unchanged post-intervention
  - Pre-intervention: 394 acute stroke code activations: 151 patients with a diagnosis of AIS; 44 (29%) treated with rtPA
  - Post-intervention: 789 acute stroke code activations: 388 patients with a diagnosis of AIS; 122 (31%) treated with rtPA
- DNT was reduced post-intervention, mostly owing to a 15-minute reduction in imaging-to-needle time (see table)

OUTCOME	PRE-INTERVENTION (n=44)	POST-INTERVENTION (n=122)	p VALUE
Onset-to-needle time, median (IQR)	118 (96–157)	110 (80–141)	0.13
Imaging-to-needle time, median (IQR) min	36 (28–64)	21 (16–31)	**<0.0001**
DNT, median (IQR) min	53 (45–73)	45 (35–58)	**0.001**
DNT ≤60 min, n (%)	27 (61)	99 (81)	**0.004**
Hospital mortality, n (%)	8 (18)	15 (12)	0.33
Independent ambulation at discharge, n (%)	18 (41)	66 (54)	0.13

"Parallel workflows allowed treatment decisions to be made more rapidly and hastened drug administration."[3]

IMPLEMENTATION OF INDIVIDUAL TARGETED STRATEGIES CAN IMPROVE DOOR-TO-NEEDLE TIMES

Stepwise implementation of individual, specific, systems changes can independently reduce in-hospital treatment delays.

A prospective study of 350 consecutive patients with AIS treated with rtPA (Jun 2012–Jan 2015) found that four targeted strategies each independently improved DNT:[4]

- Pre-notification of the stroke team by EMS (or ED nurse):   11% reduction in DNT
- Rapid patient registration (using a unique 'unknown' ID number): 12% reduction in DNT
- Direct transfer to CT on EMS stretcher: 30% reduction in DNT
- rtPA administration at the CT scanner: 32% reduction in DNT

The authors conclude that moving the patient to the CT scanner on the EMS stretcher and administering rtPA in the scanner/imaging area were associated with the largest reductions in DNT because imaging is a mandatory step in acute stroke care, and therefore changes aimed at reducing delays around the imaging process have a substantial impact.

A STANDARDIZED STROKE CARE PROTOCOL CAN REDUCE IN-HOSPITAL DELAYS FOR ALL PATIENTS WITH AIS

Implementing a standardized care protocol for all patients admitted with suspected AIS has the potential to streamline care, improve efficiency, and reduce treatment delays.

At a tertiary-care comprehensive stroke centre, implementation of an institution-wide acute stroke algorithm was associated with significant and sustained improvements in door-to-CT and door-to-neurologist times (see table).[5]

The algorithm followed the same steps for each patient presenting with AIS, up to the point of treatment decision:

- Activate stroke alert protocol
- Immediate CT scan (primary goal after code stroke activation)
- If needed, pause CT scan (maximum 5 min) for neurological assessment to identify potential rtPA candidacy
- CT angiography and CT perfusion scans
- Review case with neurologist

The results demonstrate that goal-directed revision of acute stroke care at specialist centre, incorporating parallel workflow and regular reporting of care quality metrics, is associated with significant reductions in treatment delays for *all* patients with AIS – including those who receive rtPA.

MEASURE	JAN–MAR 2012 (n=71 FOR CT)	AUG–OCT 2012 (n=106 FOR CT)	JAN–MAR 2013 (n=130 FOR CT)	SEP–NOV 2013 (n=142 FOR CT)	*p* VALUES*
Door-to-CT time, mean (SD) min	39.9 (79)	**19.9 (29)**	**20.8 (23)**	**12.8 (20)**	<0.02
Door-to-neurology time, mean (SD) min	34.1 (70)	17.9 (25)	**6.5 (9)**	**8.2 (7)**	<0.001
Door-to-rtPA time, mean (SD) min	62.5 (45)	61.1 (28)	52.0 (23)	43.5 (22)	ns
Treated with rtPA, n	13	15	11	14	

**p* values are for each 3-month post-intervention period vs the pre-intervention period (Jan–Mar 2012), for numbers in bold text only.

> **"The intervention was a joint effort between multiple departments, physicians, nurses, and hospital staff to provide a unified, consistent method of assessment and treatment of suspected ischemic stroke patients."[5]**

A STREAMLINED STROKE CARE PROTOCOL INCORPORATING MRI SCREENING CAN REDUCE DOOR-TO-NEEDLE TIMES AND IMPROVE CLINICAL OUTCOMES

Initiatives to improve stroke treatment need to be sustainable to deliver long-term changes in care quality.

Sablot *et al*. developed a streamlined AIS protocol that assigned distinct and parallel tasks to existing stroke team members and used currently available resources (including MRI screening) to specifically target DNT during a 1-year 'quality improvement process'.[6] Implementation of the protocol reduced DNT without compromising safety; after the intervention, more than half of patients had a DNT ≤60 minutes and favourable functional outcomes at discharge.

The authors believe that the success of the intervention was due to its long-term approach and regular performance feedback.

Study details

- Analysis of data from 265 consecutive patients with AIS treated with rtPA at a stroke unit in a secondary-care general hospital in France, to evaluate the effect on DNT of a 1-year 'quality improvement process'
  - A new, streamlined AIS protocol incorporated stroke team activation, parallel workflow and monthly feedback
  - MRI was used as the first-line routine screening tool, with AIS patients given priority clearance
- Peri-intervention (Feb 2015–Feb 2016) median DNT was reduced by 30%, and the proportion of patients with a DNT ≤60 min more than doubled compared with pre-intervention (Jan 2014–Dec 2014) (see table)
  - Median DNT decreased during the quality improvement process, from 65 min at the start of the year to 55 min at the end (p=0.04)
  - Proportion of patients with a DNT ≤60 min also increased during the process, from 41% at the start of the year to 62% at the end (p=0.09)
- Improvement in DNT was associated with significantly better clinical outcomes at discharge (see table and figure)
- In-hospital mortality and SICH rates did not differ between the two groups

OUTCOME	Preintervention period (n=135)	Peri-intervention period (n=130)	p VALUE
Onset-to-door time, median (IQR) min	85 (60–120)	95 (63–125)	NS
Door-to-MRI time, median (IQR) min	42 (24–60)	32 (16–52)	**<0.003**
MRI-to-needle, median (IQR) min	40 (30–50)	29 (20–38)	**<0.02**
DNT, median (IQR) min	84 (65–105)	59 (47–87)	**<0.003**
≤60 min, %	21	52	**<0.0001**
≤50 min, %	10	35	**<0.001**
≤45 min, %	7	24	**<0.001**
OTT time, median (IQR) min	169 (140–195)	160 (120–200)	NS
mRS score 0–2 at discharge, %	42	59	**<0.01**
Discharge to home, %	17	40	**<0.0001**
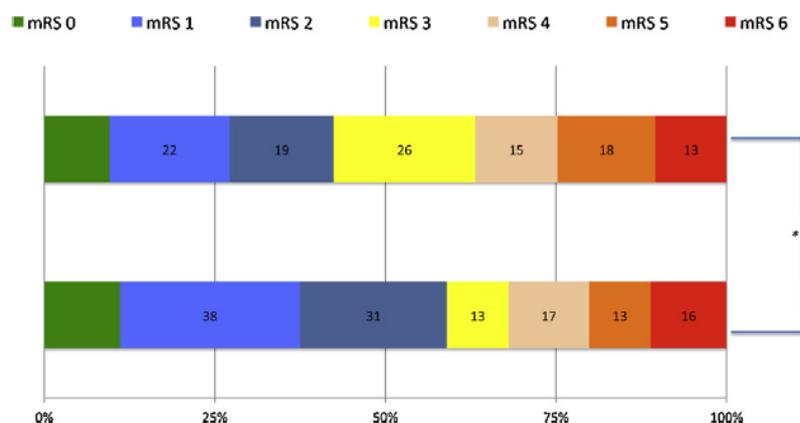
Outcome at time of discharge: (upper bar) the 2014 cohort before the quality improvement process; and (lower bar) the 2015 cohort with implementation of the process. *p<0.01 for mRS score 0–2.

"It is feasible to deliver rtPA to patients with AIS within 60 min in a general hospital, using MRI as the routine screening modality."[6]

FASTER REPERFUSION IN PATIENTS WITH ACUTE STROKE IMPROVES FUNCTIONAL OUTCOMES

In AIS patients treated with rtPA and thrombectomy, faster reperfusion is associated with better clinical outcomes. In an analysis by Goyal *et al.*, each 60-minute delay (beyond 3.5 h) from stroke onset to revascularization reduced the chance of a functionally independent outcome by 20%.[7]

The authors believe that faster treatment times in this patient group were achieved and maintained by focusing intensively on workflow speed and parallel care processes, and by tracking metrics and providing feedback. They suggest that the workflow efficiencies achieved are generalizable to multiple hospitals and national health systems, and conclude that time and efficiency are important in AIS management.

IMPROVING STROKE CARE REQUIRES THE TARGETING OF MULTIPLE SYSTEM-RELATED FACTORS

Quality-improvement or system-change interventions can be effective in increasing rtPA rates. By understanding which strategies are likely to have the greatest impact on rtPA rates, stroke service providers can target interventions accordingly.

Paul *et al.* identified the factors and approaches that influence rtPA rates after reviewing more than 40 studies of system-focussed intervention strategies aimed at increasing tPA rates (published between 1997 and 2014).[8]

Health systems factors with positive associations with rtPA treatment rates were:

- Hospital location (e.g. shorter transport time; urban rather than rural location; centralized [hub] model)
- Training and expertise (e.g. treatment by neurologist/in a neurology department; admission to a stroke unit; treatment at academic/teaching hospital or a hospital with higher volume of stroke admissions/neurology beds)
- Facilities and staffing (e.g. having a neurologist, stroke nurse or stroke team; neurological or neuroimaging services)
- Organization (e.g. use of stroke-specific protocols; transfer by EMS)

The authors observe that health systems should aim to ensure that most stroke patients are treated in a way that minimizes access disadvantages for rural populations; maximizes access to neurological and stroke-specific expertise and experience; ensures stroke units are widely available; and implements stroke-specific protocols.

> **"Systems-change interventions, based on multi-component quality improvement approaches, can increase the proportion of eligible stroke patients receiving IV rtPA"[8]**

EMS CAN EFFECTIVELY AND SAFELY REDIRECT PATIENTS WITH SUSPECTED STROKE TO STROKE CENTRES

An EMS acute stroke protocol that bypasses local hospitals in favour of designated stroke centres – provided the patient will arrive within 3.5 h of stroke onset and total transport time is <2 h – can be used accurately, safely and effectively.[9]

The Ontario Acute Stroke Medical Redirect Paramedic Protocol is a highly sensitive tool for identifying patients with stroke and requiring thrombolysis, and is also sufficiently specific to avoid many unnecessary transports to stroke centres. Analysis of 1277 potential stroke cases assessed by EMS using the protocol showed that 755 patients met criteria for direct transfer to a regional, district, or telemedicine stroke centre. Of these, 71% had a stroke code activation on arrival at hospital, 45% had a final diagnosis of AIS, and 23% received thrombolysis (median DNT 46 min).

The authors conclude that the acute stroke protocol is sensitive and reliable, and can be used by EMS to redirect potential stroke patients to hospitals with the ability to administer thrombolysis.

MOBILE STROKE UNITS EXTEND SPECIALIST STROKE CARE TO THE PRE-HOSPITAL PHASE

Fassbender *et al.* reviewed the benefits and challenges of MSUs and their potential to act synergistically with hospital stroke units to close treatment gaps for patients with AIS.[10] MSUs can:

- transport a single, specialized, interdisciplinary team (paramedics, physicians, nurses and technicians), that performs complete diagnostic work-up and acute treatment in a parallel workflow at one location
- deliver state-of-the-art pre-hospital diagnosis and treatment, as well as diagnosis-based triage of the patient to the most appropriate target hospital
- offer the unique option to provide the target hospital with detailed information about the cause of the disease and any information needed for subsequent specialized treatment
- increase the proportion of patients treated with rtPA within 60 minutes of symptom onset; these unprecedentedly short times to treatment could translate into improved clinical outcomes

The authors conclude that diagnosis and treatment in an MSU can occur with a level of expertise and equipment comparable to those in a hospital, but the MSU strategy cannot replace continuous efforts to improve pre- and in-hospital stroke care.

> **"Bringing swift treatment to the patient, instead of the conventional approach of awaiting the patient's arrival at the hospital for treatment, is a potential strategy to improve clinical outcomes after stroke."[10]**

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MOBILE STROKE UNITS IMPROVE THROMBOLYSIS RATES AND TREATMENT TIMES

Rasmussen reviewed the impact of MSUs on treatment times for patients with AIS.[11] Using the MSU model – 'taking the treatment to the patient' – reduces treatment times and increases the proportion of patients who receive rtPA.

The author concludes that MSUs have the potential to minimize stroke-related mortality and long-term morbidity.

> **"Overall, it has been shown that an MSTU equipped with the necessary imaging and laboratory testing equipment can provide appropriate, accurate, and safe ambulance-based prehospital rtPA administration, reduce the time to rtPA administration, and increase the number of patients who receive rtPA administration."[11]**

REMOTE VASCULAR NEUROLOGIST ASSESSMENT VIA TELEMEDICINE IS RELIABLE AND ACCURATE

Results from the BEST-MSU trial show that remote telemedicine neurologists provide reliable and accurate assessment of patients being treated in an MSU, comparable to that seen with in-person assessment.[12]

When assessing the rtPA eligibility of 174 MSU patients with suspected stroke (onset within 4.5 h), the telemedicine vascular neurologist agreed with the on-board vascular neurologist in 88% of cases (κ=0.73). This agreement is the same as that between two vascular neurologists assessing the same patients in person in the ED (κ=0.75). The most common cause of disagreement was the presence of minor or non-disabling symptoms.

The authors suggest that MSUs need no longer use on-board neurologists, because remote vascular neurologists can provide the same level of expertise for multiple MSUs, simultaneously.

TRANSFER TO A HUB HOSPITAL AFTER THROMBOLYSIS BENEFITS PATIENTS WITH MODERATE-TO-SEVERE STROKE

Patients with moderate-to-severe stroke are likely to have a better functional outcome if, after receiving rtPA at a telemedicine spoke hospital, they are transferred to a hub hospital for ongoing care.[13]

Among 204 patients who received rtPA at rural spoke hospitals after telestroke consultation, 78% were then transferred to a PSC-designated hub hospital. Overall, 3-month outcomes were similar whether patients were transferred to a hub or remained at the spoke hospital. However, patients with moderate to severe stroke were twice as likely to have a good 3-month outcome if they were transferred to a hub hospital rather than staying at the spoke hospital (50% vs 24%, p=0.03).

The article highlights that patients with more severe stroke may benefit from expert care at a stroke centre after receiving rtPA at a spoke hospital within a telestroke network.

THE TELEMEDICINE EXPERIENCE IS GENERALLY POSITIVE FROM A PATIENT PERSPECTIVE

A survey has found high levels of patient satisfaction with the telemedicine experience.[14]

Among 150 respondents to a patient satisfaction survey:

- 98% stated they were seen by a neurologist within 15 minutes of hospital arrival
- 89% experienced no technical problems during their consultation
- 80% felt that use of telemedicine impacted favourably on their care

Most of the respondents who received rtPA after their telemedicine consultation had favourable 3-month clinical outcomes.

In this surveyed group, the patient perspective of telemedicine treatment appears to be generally positive.

ACNPs, acute care nurse practitioners; AIS, acute ischaemic stroke; ASRH, acute stroke ready hospital; CT, computed tomography; DNT, door-to-needle time; ED, emergency department; EMS, emergency medical services; ICU, intensive care unit; INR, international normalized ratio; IQR, interquartile range; IV, intravenous; mRS, modified Rankin Scale; MSU, mobile stroke unit; MSTU, mobile stroke treatment unit; NIHSS, National Institutes of Health Stroke Scale; NS, not significant; OR, odds ratio; OTT, onset-to-treatment time; PSC, primary stroke centre; rtPA, recombinant tissue plasminogen activator; SICH, symptomatic intracranial haemorrhage.

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The Angels initiative aims to increase the number of patients treated in stroke ready hospitals and to optimise the quality of treatment in all existing stroke centres.
See more at:
https://angels-initiative.com//

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