

Stroke care taking flight with the wings of ANGELS

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Abstract

The ANGELS Initiative, supported by Boehringer Ingelheim, was launched in Europe in 2016 in collaboration with the World Stroke Organisation (WSO) and the European Stroke Organisation (ESO). The ANGELS programme has now expanded rapidly and globally; its principal aims are to increase the number of patients treated in accredited stroke ready hospitals, and to optimize the quality of treatment in all existing stroke centres. **This review article summarizes the content of presentations given at a Boehringer Ingelheim-sponsored 2020 WSO-ESO virtual conference entitled: "The Angels Initiative: Stroke Care Taking Flight with the Wings of Angels".** The content of these symposium presentations, made by leading stroke professionals, illustrate how low-cost telemedicine programmes utilizing smartphone apps, can enable remote hospitals, and their emergency medical services, to access specialist stroke expertise and guidance from distant comprehensive stroke centres. This communication technology between hospital stroke teams is improving diagnosis, decision making, providing faster access to treatment, and is saving lives.

KEYWORDS: ANGELS INITIATIVE; ACUTE STROKE; TELESTROKE NETWORKS; STROKE-READY HOSPITAL; QUALITY MONITORING.

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The ANGELS journey across the world

Valeria Caso MD, PhD

The ANGELS Initiative has now been running for four years; its key aims are to implement and improve acute stroke care by establishing more and better stroke-ready hospitals, with a major focus on optimising and speeding up in-hospital patient work flow processes. To illustrate the rapid progress that has been made, Professor Caso highlighted the recent marked expansion of stroke-ready hospitals in Romania.



Professor Caso stressed the importance of unified partnerships for the development and maintenance of effective acute stroke networks. These partnerships and alliances include scientific organizations, patient organizations and industry partners. In addition, there are currently over 50 national stroke societies collaborating with partners to improve acute stroke care.

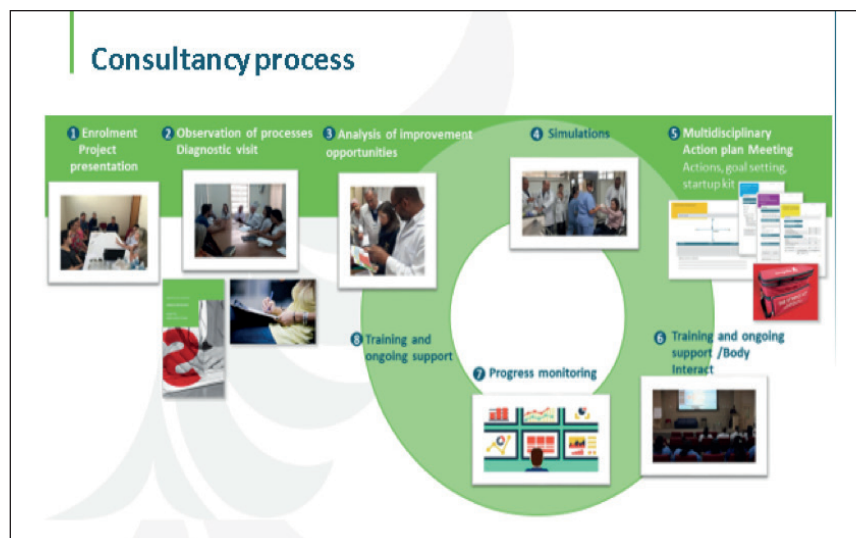
The ANGELS Initiative - based on five platforms: Professor Caso explained that the ANGELS initiative is based on five platforms: standardization, education, community building, quality assessments and rewards, and the ANGELS consultants. These individual elements are shown in the following illustration.



The ANGELS consultancy process starts with hospital enrolment, an initial ANGELS presentation, then discussion with the stroke team alongside ANGELS consultants observing the teams' work practices to understand how acute stroke care is currently organised in their unit. Analysis of current practices allows opportunities for improvements to be identified. Training provided by the ANGELS initiative involves *in situ* simulation exercises to practice, streamline, and coordinate patient admission, assessments, and treatment. Monitoring the performance of the team during simulations provides the basis for a mutually agreed Multidisciplinary Action Plan which will specify goals and remedial actions that will help optimize workflow and reduce timings. Further progress monitoring, leading to ongoing ANGELS support and training, using tools such as Body

Interact are used to improve the quality and consistency of treatment decisions in the hyperacute phase, ensuring patients receive appropriate therapy. These elements of the ANGELS consultancy process are shown in the following illustration on page 3.

The importance of standardization: Professor Caso emphasized that standardization of acute stroke patient care and in-hospital work practices removes variability in treatment and reduces timelines. The Helsinki Stroke Thrombolysis Model¹ showed that thrombolysis could be performed in the CT suite, thereby avoiding the time penalty



underestimated. Potentially fatal stroke complications such as dysphagia and respiratory problems such as pneumonia respond well to dedicated stroke nurse care. To date, 10,000 nurses have been enrolled into the ANGELS Stroke Nurse Certification Programme, and over 8,000 nurses have completed all 20 of the online course modules.

Due to global social distancing constraints and lockdowns imposed by the Covid-19 pandemic, ANGELS face-to-face stroke education and stroke community building events have not been able to go ahead.

of patient transfer to the stroke unit for treatment; however, adoption of this practice routinely is still not evident in all hospitals. The ANGELS stroke bag can provide the necessary equipment for treatment of acute stroke patients in the CT suite, thereby allowing the transfer of the Helsinki Stroke Model to a “real world” setting.

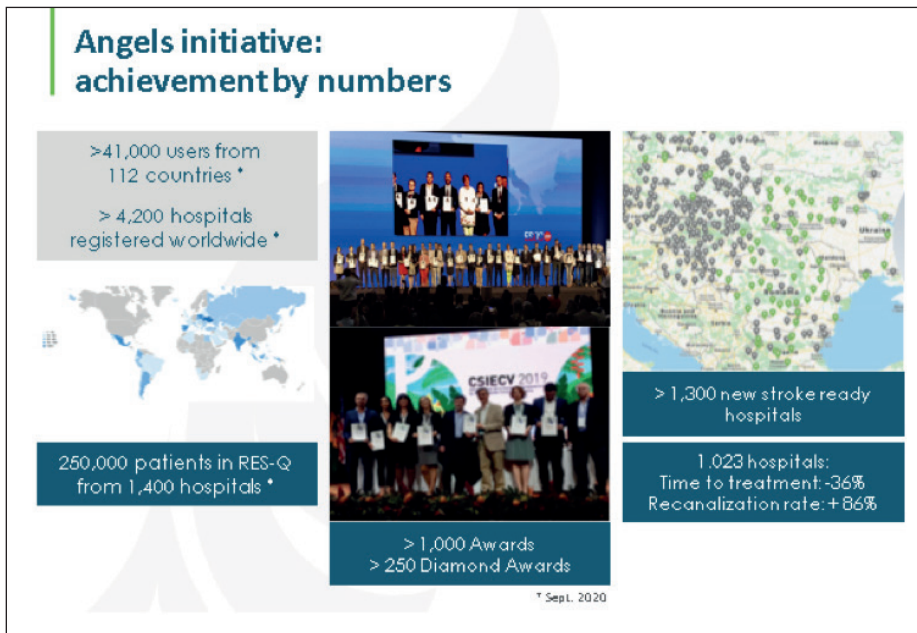
Online education provided by the ANGELS Initiative: Professor Caso reviewed the available ANGELS online education in stroke care; she stressed its increased significance and contribution in the absence of face-to-face educational events during the current Covid-19 pandemic. ANGELS online educational modules are now available in 17 languages. These include stroke education for patients, for emergency service workers, for stroke teams dealing with the hyperacute phase, interpretative CT imaging and decision-making modules, and post-acute stroke care. For example, the Emergency Services eLearning programme delivers comprehensive advanced stroke life support for prehospital medical teams. And for clinical situations where a physician skilled in interpreting CT imaging is unavailable, the ANGELS WOW (With and without support of artificial intelligence) training for CT scan interpretation, using e-ASPECTS software, provides a standardized online tool to identify early signs of ischaemic damage, and supports decisions on patient eligibility for thrombolysis.

Nurse education, leading to a formalised stroke nurse certification, is a key component in the ANGELS educational programme. Professor Caso stated that the contribution of skilled nursing practice in acute stroke care should not be

However, since lockdown, over 350 live online ANGELS events have been staged, with a total duration of 902 hours, and involving over 33,000 participants. In total, this equates to individual participants having spent over 30 million hours attending and contributing to ANGELS virtual events since lockdown. These online activities continue to build stroke community networks, deliver education to improve stroke care skills, and will maintain the impetus and reach of the ANGELS initiative.

Quality monitoring, stroke registries and the WSO ANGELS awards: Establishing a culture of in-hospital continuous quality monitoring is an ANGELS imperative. Consistently recorded patient records, assessments, timings, and metrics are essential, if progress is to be made and measured objectively. Professor Caso explained that hospitals generating consistent and high-quality stroke data can contribute their data to the SITS (Safe Implementation in the Treatment of Stroke) registry, or the RES-Q registry (Registry for Stroke Care Quality). Stroke registry data provides a quantitative and objective basis for the WSO ANGELS award system, because it allows identification of those hospitals showing the greatest degree of improvement in their stroke care and patient outcomes.

WSO ANGELS awards utilize performance data based on ESO quality measures from participating centres. Based on these measures, seven Key Performance Indicators (KPIs) are used to assess the performance of individual hospitals. A 3-tier system of awards recognises stroke-ready status, and with demonstrable increasing expertise, Gold, Platinum, or Diamond status can be awarded.



Professor Caso reviewed the major achievements of the ANGELS initiative. Key statistics include: over 4,200 hospitals are now registered with ANGELS worldwide; 250,000 patients from 1,400 stroke patients have contributed data to the RES-Q registry; over 1,300 new hospitals have achieved stroke-ready certification; over 1,000 WSO ANGELS awards (including over 250 Diamond awards) have been presented, and 1,023 hospitals are now acknowledged to provide excellent stroke care based on their reduced time to treatment and increased recanalization rates.

Public awareness of stroke: Public recognition of the signs and symptoms of a stroke, realising its seriousness, and calling the emergency medical services (EMS) promptly are

vital prerequisites for rapid hospitalization. Professor Caso stressed that stroke education for children is needed. Time is brain, and children who can recognize stroke and call EMS could save a parent or grandparent. A public awareness campaign and website, supported by ANGELS, features cartoon “Fast heroes” characters. This has been developed to reinforce stroke recognition and “call the ambulance” messages for a young audience. Versions of this campaign are now have been locally adapted and are running in 23 different countries.

Professor Caso highlighted stroke physicians’ concerns over the impact of the COVID-19 pandemic, where fear of infection is discouraging non-COVID patients from coming to hospital. Of note, in many countries, there has been a drop in numbers of patients attending hospital with stroke symptoms. It is important that critical stroke care is maintained during the COVID-19 pandemic and acute stroke patients continue to be hospitalized and receive life-saving treatment. In the light of these concerns, the ANGELS *#strokedontstayathome* campaign has now been launched in 20 countries. This campaign was designed to ensure people continue to see the need to seek urgent treatment when they experience stroke symptoms, or see the signs of stroke in others.

Professor Caso concluded by stressing that the risk factors for stroke and the demands for acute stroke care, and treatment, are set to rise significantly over the next decade. The ageing baby-boomer generation is expected to drive increased demand for acute stroke care. Additionally, the COVID-19 pandemic will inevitably increase global deprivation and poverty. This, in turn, will increase the risk of stroke and the global stroke community, together with continued support from the ANGELS Initiative, must be ready to face this challenge.

Public awareness: www.fastheroes.com

► Teaching children to educate their grandparents and parents

IF SOMEONE'S **FACE** SUDDENLY DROOPS TO ONE SIDE
THINK BRAIN ATTACK. CALL 112.

IF SOMEONE SUDDENLY LOSES POWER IN ONE **ARM**
THINK BRAIN ATTACK. CALL 112.

IF TWO INCHES OF **LIPS** OBSTRUCT THEIR **SPEECH**
THINK BRAIN ATTACK. CALL 112.

TIME IS THE BEST WEAPON AGAINST BRAIN ATTACKS
CALL AN AMBULANCE ON 112.

The Philippines: Success is possible even in challenging environments: Romulo Urgel Esagunde, MD, FPNA, in collaboration with Geraldine Siena L. Mariano, MD, FPCP, FPNA, FNCS.

Constraints in delivering stroke care in the Philippines: Dr Esagunde gave a brief geographical summary of the country and highlighted some of the difficult challenges faced when providing emergency medical care in such a diverse country. There are 7,641 islands inhabited by a population of 110 million who speak 186 individual languages. The landscape and climate are often unforgiving, with mountainous islands covered in tropical rainforest, high temperatures and humidity, heavy rainfall, and regular typhoons. There are constant risks of earthquakes and volcanic eruptions. In urban areas, very high-density traffic hampers road transportation, and the country has one of the slowest internet speeds in the world. Additionally, healthcare governance is not helped by a fast turnover of leadership in the Department of Health (DoH), and the COVID-19 pandemic now adds another layer of complexity in delivering emergency medical care.

Currently, the death rate due to stroke in the archipelago is 130 per 100,000 inhabitants. Healthcare is provided by 90,370 physicians and approximately 500,000 nurses. There are currently 495 neurologists in the country i.e. one neurologist per 244,457 inhabitants. Of the country's 1,791 hospitals, 1,080 are privately owned (estimated 46,054 beds) with 721 hospitals in the public sector (estimated 50,742 beds).

The Stroke Society of the Philippines (SSP) was founded in 1995 and members include: neurologists, neurosurgeons, cardiologists, rehabilitation medicine physicians, nurses, and physical therapists. Expanding and improving stroke care with more hospitals equipped for stroke represents a major challenge for the Society. Dr Esagunde listed the activities and events organised by the SSP. These include: establishing a Stroke Survivor Club; organizing a "Run for Stroke" day; running stroke awareness and prevention campaigns; running thrombolysis and stroke nurse workshops; and liaison and negotiation with the Department of Health and

CPOST & Thrombolysis workshops June 2016-August 2017

Number of Workshops:
CPOST: 12
Thrombolysis: 13

Total Number of Participants:
CPOST: 1,436
Thrombolysis: 833

- ILOILO
- BAGUIO:
- ZABOANGA
- BUTUAN:
- CDO:
- DAVAO:
- CEBU:
- PAMPANGA:
- BACOLOD:
- DUMAGUETE:



the Philippines health insurance system.

Moving forward with CPOST: In 2016, Professor Michael Brainin and Professor Stephen Davis of the WSO attended the Philippines Neurological Association Convention and introduced the Cardinal Principles in Stroke Treatment (CPOST) programme. Subsequently, CPOST was quickly adopted in the Philippines and cascaded through hospitals via workshops and educational events.

The CPOST programme is now focused on a "Train the Champions" campaign. The objectives of this educational and training process are to teach and empower health care professionals to manage stroke patients; to assist participating hospitals to become stroke-ready, with standardized protocols, and to encourage all participating hospitals to provide stroke patient data to the national and RES.Q registries.

Dr Esagunde explained that the SSP has established a partnership with the Department of Health (DoH), in the Philippines, to develop a National Stroke Policy that will authorize provision of free recombinant tissue plasminogen activator (rtPA) for eligible acute stroke patients in government hospitals. In addition, efforts are being made to extend the government insurance covering post-stroke rehabilitation, provide certification of stroke-ready hospitals and acute stroke units, and build extended stroke care capacity in key government hospitals. The SSP has received endorsement from the DoH for its nationwide stroke awareness and healthy lifestyle campaigns. DoH-SSP posters are widely displayed

in train and bus stations, airports, markets, health centres, and government offices. Stroke awareness videos are played in health centres and government hospitals, and stroke awareness bulletins are broadcast on radio and TV. DoH-SSP partnership initiatives also include stroke care training for physicians and health workers in DoH hospitals, and the SSP now requests all government hospitals to submit data on all their stroke patients to a centralized census.

Achievements and progress: Dr Esagunde reviewed the progress that has been achieved in the Philippines since June 2016. CPOST thrombolysis workshops and Train the Champions workshops were staged in 192 hospitals, involving 2,816 participants, and three new SSP chapters were established. In the early 2000s, there were very few acute stroke-ready hospitals in the Philippines; however, with the help of the SSP, the number of stroke-ready hospitals started to increase in 2006. The arrival and implementation of CPOST in 2016 had a major effect, and by 2020, 56 hospitals had achieved stroke-ready status. The growth in stroke-ready hospitals in the Philippines over the last 20 years is illustrated in the figure shown below.

Currently the average door-to-needle (DTN) time in the Philippines is 72 minutes and the recanalization procedure rate is steadily increasing; this was 2.2% in 2017, 2.5% in 2018 and 2.84% in 2019.

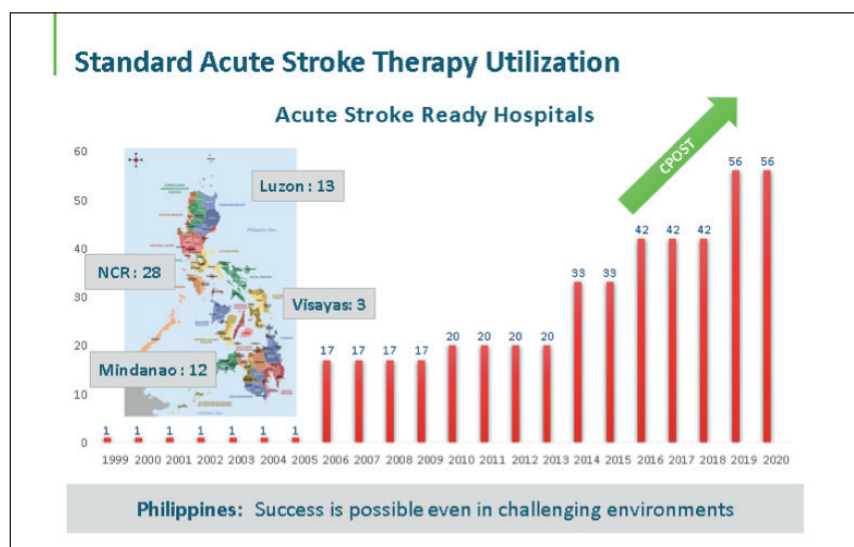
The ANGELS Initiative was launched in the Philippines three years ago and this has led to a growing community of stroke centres and stroke-ready hospitals. Currently over

100 hospitals are enrolled in the ANGELS Initiative website; of these, 19 hospital sites are contributing stroke data to the RES-Q registry. So far, data from 3,174 patients have been collated in RES-Q. This progress has been recognized, and three WSO-ANGELS awards (2 gold and 1 platinum) have already been awarded to stroke hospital teams in the Philippines.

The challenges ahead: An immediate challenge is to deal with COVID-19 and eradicate the virus. The country has already moved from Enhanced Community Quarantine (ECQ) status to General Community Quarantine (GCQ), and with a test/trace/treat strategy in place, Dr Esagunde expected further reductions in the COVID-19 infection rate. Other challenges include keeping up the morale of frontline workers providing acute stroke care, and keeping these staff safe and free from infection. Patients' fears of COVID-19 infection must be allayed so they continue to arrive at hospitals and seek emergency stroke care. Moving CPOST activities online is in progress but is hampered in many areas by poor internet services. The SSP must continue to work collaboratively and in partnership with the DoH to secure government backing and endorsement of initiatives that will improve and sustain acute stroke care and treatment.

Dr Esagunde listed the priority strategies to help meet these challenges:

- Strengthen the partnership between the SSP and the DoH;
- Establish more stroke-ready hospitals and increase their capacity;
- Implement CPOST more widely in hospitals, with workshops and simulation exercises;
- Improve quality monitoring and standardization in hospitals so more stroke data can be included in RES-Q;
- Strengthen and extend Emergency Medical services (EMS);
- Increase public awareness of stroke and the urgent need for emergency hospital treatment via public awareness campaigns.



In summary, Dr Esagunde stressed the importance of stroke education for the

public, EMS, stroke patients, and the whole community of healthcare professionals involved with acute stroke care. Education is the foundation for improved stroke care and patient outcomes in the Philippines. Coordination with local medical and international stroke organizations will be important in disseminating education and skills. The Philippines, as a low-middle income country, will have to be creative in order to embrace educational opportunities. Despite the COVID-19 pandemic, the SSP, in conjunction with support from the ANGELS initiative, will be centre-stage in delivering future stroke education throughout the Philippines.

Gaining momentum through simulation:

The Egyptian Experience Hany Aref MD, FAAN

Professor Aref stated that the incidence of stroke has declined by 40% over the past four decades in high income countries; however, it has doubled in the rest of the world. In Egypt, the prevalence is estimated to be between 1-2 million people. Of these, the estimated number of stroke sufferers who present as patients can reach up to 210,000 per year. At least 75,000 of these patients are left morbidly dependent due to their stroke.

The history of stroke services in Egypt: The first dedicated stroke unit was established in 1991 at Ain Shams University. With a catchment of over five million, stroke services were initially provided to 600 patients annually. Initial experience of thrombolysis was gained by conducting a study comparing rtPA with streptokinase in 1997, and subsequently in 2003, another thesis was conducted in 40 patients, where rtPA injections were based on MRI diffusion/perfusion mismatch. Prior to 2015, although Egypt had eminent stroke physicians, and a long history of local research, documentation of interventions in stroke patients and publications in international journals were limited. No stroke patient database was available, and there was very limited use of rtPA thrombolysis; furthermore, Ministry of Health (MoH) approval for thrombolytic therapy was not available.

Professor Aref explained that in 2015, stroke physicians in Egypt began to question why thrombolysis was used

so infrequently, and what were the obstacles causing the pre-hospital delay of acute stroke patients? An observational study and survey of 269 acute stroke patients revealed that delayed hospitalization was mainly (57.1%) the result of a lack of awareness in patients, their relatives, and primary care physicians, of the urgent need for emergency hospitalization when stroke symptoms occur. Additional reasons for delayed patient presentation are shown in the following table.

Studying the obstacles (2015)
Pre-hospital delay

Main cause of delayed presentation	N=198	Percentage
Lack of patient or relative awareness about symptoms of stroke or acute intervention for stroke or waiting for symptoms to resolve spontaneously	113	57.1%
Misdiagnosis by the first physician examining patient or non-directing to acute intervention	26	18.2%
Traffic or far away residence	19	9.6%
Unequipped medical facility such as lack of investigatory tools or expertise personnel	18	9.1%
Minor symptoms or insidious onset of symptoms	5	2.5%
Patient alone at onset	5	2.5%
Stroke on awakening	2	1%

In this study only 53 patients (19.7%) arrived within a 4.5-hour post-stroke window, and only seven patients (13.2%) received reperfusion therapy. Hence, only 2.4% of the enrolled ischaemic stroke patients received thrombolysis.



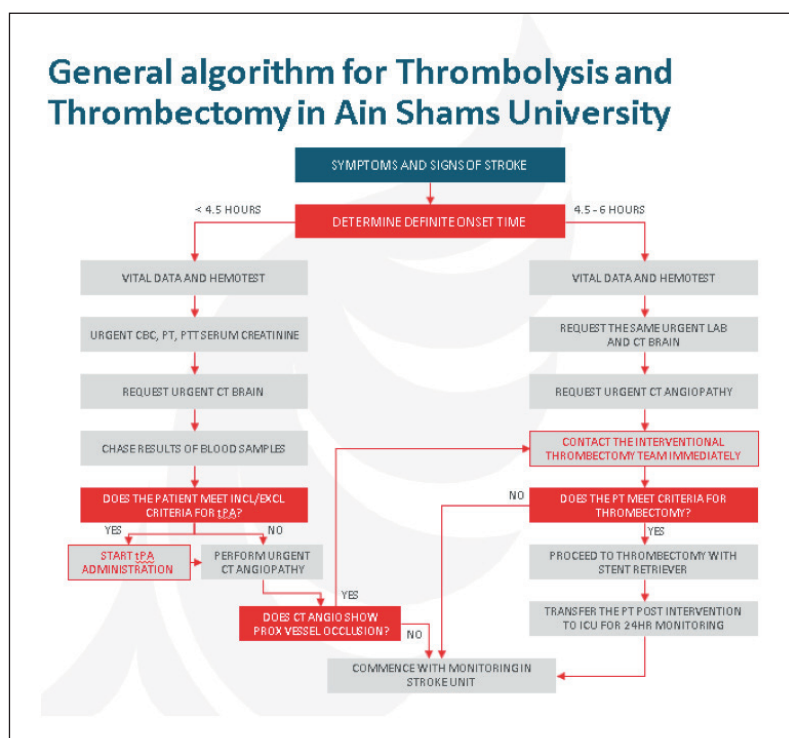
Professor Aref examined the reasons for such limited use of reperfusion therapy. The main reason (56.6%) was that rtPA was unavailable at the hospital. Other reasons are illustrated in the following figure.

Implementing a corrective action plan: At Ain Shams hospital, rtPA was obtained by negotiating donations, and a training programme for reperfusion therapies in acute ischaemic stroke was jointly developed with the Radiology Department. This was implemented as part of the routine training programme for the hospital’s Neurology residents. To support this training, a Manual of Management of Thrombolysis and Thrombectomy in Acute Ischemic Stroke

Comparison between stroke patients' numbers before & after corrective action plan

	1 ST STUDY	2 ND STUDY
Total number of admitted patients	269	284
Total number of eligible patients for acute treatment	53	37
Total number of patients who received acute treatment	7	35
Percentage of eligible patients for acute treatment	2.6%	12.3%
Percentage of eligible patients who received acute treatment	13.2%	94.3%

total ischemic stroke admissions. The percentage of patients eligible for treatment, who received reperfusion therapy, was therefore markedly higher (94.3%) in the second study compared with the initial study (13.2%). These statistics are summarized in the following table.



was developed, with clear inclusion and exclusion criteria for rtPA. In addition, a treatment algorithm for thrombolysis and thrombectomy interventions for use up to six hours post-stroke was introduced and put into practice at Ain Shams. This algorithm is illustrated below.

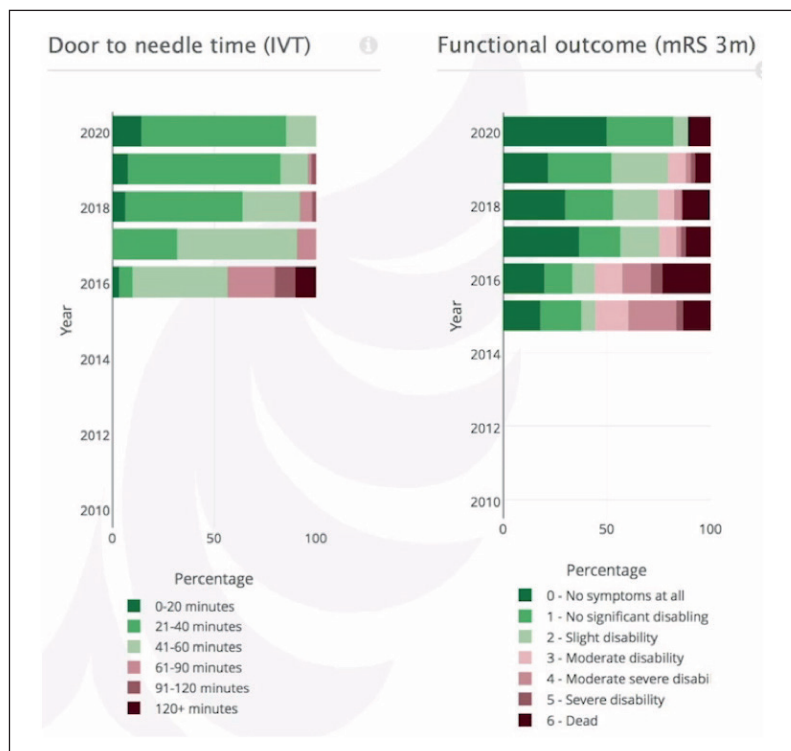
The impact of the training programme and the newly implemented protocol-led treatment practices were assessed in a second observational study conducted at Ain Shams in 2016. This study showed that out of 284 cases admitted with acute ischemic stroke, 37 were eligible for thrombolysis and 35 received alteplase(tPA) (94.3%), representing 12.3% of the

Professor Aref commented that in a low-income country, a comprehensive action plan based on making the drug available, and supported by standardized protocol-led training, resulted in a significant improvement of reperfusion therapy utilization in Egypt.² These data were included in a regulatory submission which led to the approval, in June 2016, of intravenous thrombolysis as a government-covered, free of charge, reimbursed treatment for any national eligible Egyptian stroke patient in government hospitals.

Measurable progress: Thrombolysis and thrombectomy procedures are now increasing rapidly throughout hospitals in Egypt. Professor Aref explained that key performance indicators such as door-to-needle (DTN) time, and modified Rankin Scale (mRS) functional outcomes for the patient,

have significantly improved following widespread implementation of the Ain Shams action plan. The improvements in DTN and mRS assessment at three months, in Ain Shams stroke unit, over the period from 2016-2020, are illustrated in the following figure on page 9.

Bigger and better equipped stroke hospitals such as the new 40 bed Cairo University Stroke Unit are helping to improve acute stroke services in Egypt. Additionally, a stroke chapter of the Egyptian Society of Neurology, Psychiatry and Neurosurgery (ESNPN) has been established with representatives from the major University hospitals to improve acute



to have 16 comprehensive stroke centres. Of these, three university centres are already active: Cairo, Ain Shams and Tanta. National coordination of stroke care and services now involves three important organizations: the Egyptian Ministry of Health, the SCUH and the Stroke Chapter of the Egyptian Society of Neurology, Psychiatry and Neurosurgery (ESNPN).

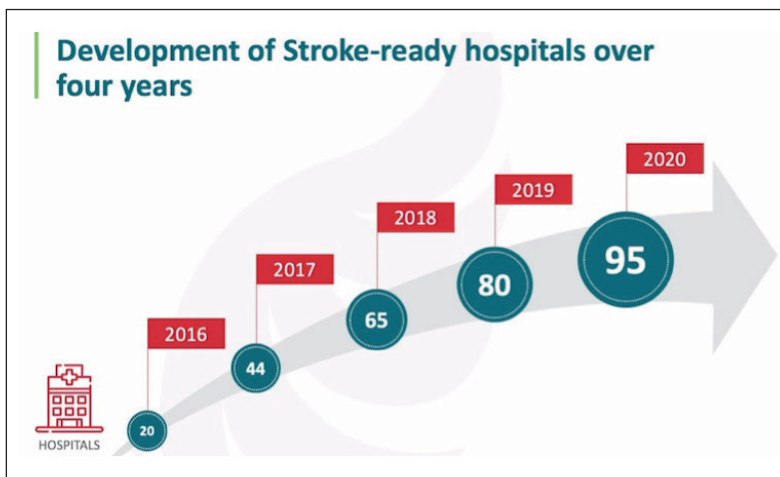
The number of stroke-ready hospitals in Egypt has expanded significantly in recent years, and Professor Aref acknowledged the support from the ANGELS Initiative that has contributed to this rapid expansion.

The Regional Ain Shams Telestroke Network (TREATS): More stroke-ready hospitals are needed in Egypt; it is estimated that 500 will be required to meet the needs of the growing population and the increasing incidence of stroke. Currently, acute

stroke care services. The ESNPN stroke chapter has produced a manual of protocols and procedures for thrombolysis and thrombectomy in acute ischemic stroke for implementation across all stroke units in Egypt.

Recent Milestones: Further milestones emerged from the Middle East and North Africa (MENA) Stroke Organization Conference, in 2017, held in Cairo. The Egyptian Minister of Health announced that a National Stroke Committee was to be formed, acute stroke units in all MoH hospitals in Egypt would be established, and the Safe Implementation of Treatment in Stroke (SITS) registry would be adopted as the Egyptian national stroke registry. In the following year (December 2018), the Egyptian MoH granted reimbursement status for thrombectomy procedures.

Professor Aref described the developing role of the Supreme Council of University Hospitals (SCUH). This body oversees all the university hospitals and their stroke centres in Egypt. In 2019, the SCUH decided that all university hospital stroke units will be converted into state-of-the-art, comprehensive stroke centres, with the aims of improving the level of stroke services, providing accreditation, and opening more stroke centers of excellence. It is planned



stroke patients in remote areas of Egypt are least likely to receive rapid assessment and treatment. These patients' risks are not due to a lack of equipment or drug availability; the biggest challenge is the scarcity of fully trained physicians and nurses skilled in administering emergency acute stroke care. This skill deficiency is being addressed with the introduction of The Regional Ain Shams Telestroke Network (TREATS). The TREATS programme is a blend of onsite and online approaches and its principal components are illustrated in the following figure displayed on page 10.

The aims of TREATS are to improve the quality of acute stroke



care in current stroke network locations, and to expand the number of accredited stroke-ready hospitals. The TREATS programme links comprehensive stroke hospitals with less specialized hospitals and allows live sharing of patients' imaging and case reviews. The TREATS network is expanding internationally, and recently helped to establish a new stroke unit in the East Africa University Hospital in Bosaso, Somalia.

Recognition and certification: Professor Aref explained that Egypt's significant improvement in acute stroke care is receiving international recognition. In 2019, Ain Shams University Hospital and Cairo University Hospitals received Diamond WSO-ANGELS awards, and Tanta University Hospital received a Gold award. Additionally, the comprehensive centres at Ain Shams University hospital (Ain Shams Specialized Hospitals and Ain Shams University Hospitals Neurology Department) applied for and received the German LGAD Comprehensive Stroke Unit Certification. Professor Aref added that since this certification, Ain Shams in conjunction with colleagues from Czech Republic, had staged their first online stroke simulation training programme so their expertise could be passed on to other hospitals.

To conclude, Professor Aref made the following key points:

- Egypt needs at least 500 stroke units to provide stroke

services across the whole country.

- Increased public and primary care awareness of the urgent need for immediate emergency care is needed to increase the number of acute ischemic stroke patients admitted to hospital within the limited time window for effective treatment.
- Training in emergency stroke care is vital; exchange experience between different stroke centres in Egypt will facilitate this.
- Establishing telestroke services based on a hub and spoke model will allow distant hospitals to access the expertise and receive guidance from specialist comprehensive stroke centres.
- More cooperation with the international interventional neuroradiology community is required to expand thrombectomy interventions in the acute stroke setting in Egypt.

Brazil – The next frontier: Connecting pre with in-hospital Stroke Care

Sheila Cristina Ouriques Martins, Professor of Neurology Universidade Federal do Rio Grande do Sul.

Professor Martins stressed that organization of stroke units and their ability to perform rapid recanalization in acute stroke patients is paramount. To achieve rapid recanalization, the patient should arrive, without delay, at the right stroke centre, with stroke experts available at all times. With endovascular interventions, transferring the patient to the nearest stroke centre is not always the best decision. A more distant comprehensive stroke centre may achieve a better outcome for the patient than a local primary centre.

The healthcare system and stroke services in Brazil: Brazil has a population of 211 million with huge disparities in wealth across the population. Public health assistance is provided by the federal government, and only about 20% of inhabitants have additional private healthcare insurance. Most stroke patients (around 80%) are assisted by the public health care system. In 2012, the Ministry of Health (MoH) introduced a national policy for stroke and approved rtPA for use in the public healthcare system. Central to this policy was the creation of stroke centres to organize stroke prevention, treatment, and rehabilitation.

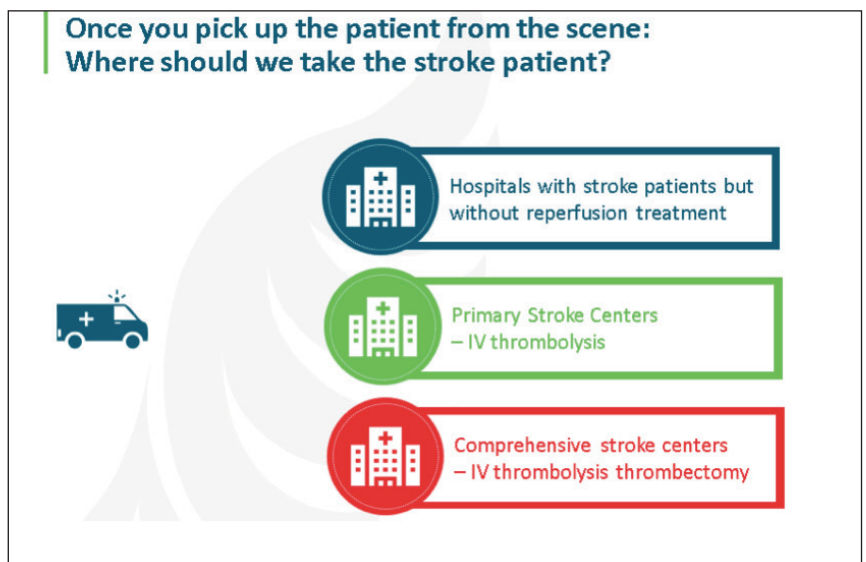


Integrating Pre, Inter, and the Intra-hospital Stroke Team: The Experience of the Brazilian Stroke Network Professor Martins examined the decision-making process once the EMS have arrived at the patient's location.

In Professor Martin's Porto Alegre region, there are four million inhabitants, 16 public sector hospitals, and two privately owned hospitals. The availability of the FAST ED smartphone app, developed at Emory University, allows field assessment stroke

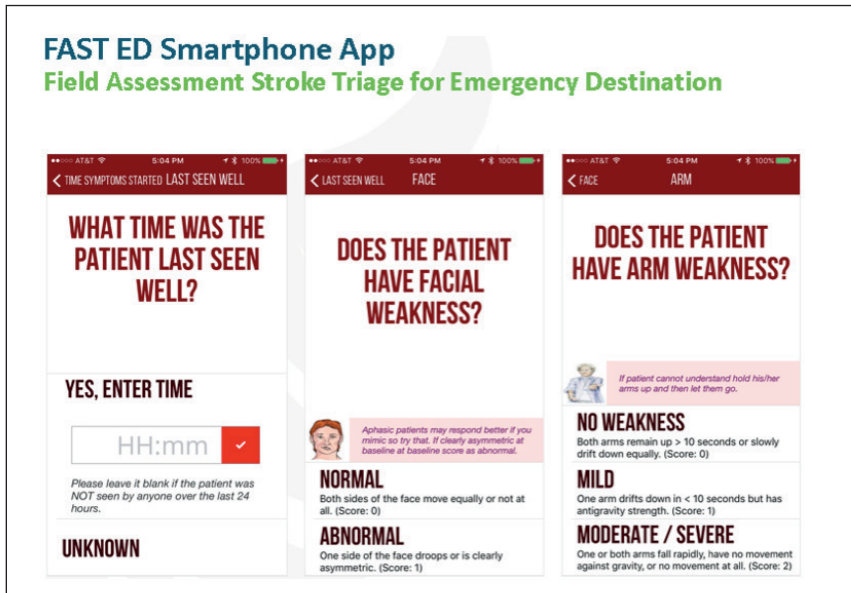
Educating the population and EMS training: Professor Martins described the SAMU public awareness campaign running in Brazil. The key message is: "if there are signs of stroke, don't waste time: call 192".

Because prehospital Emergency Medical Services (EMS) have a fundamental role in the integration and organization of acute stroke systems of care, EMS workers must be adequately trained in emergency stroke care and rapid patient transfers to the correct stroke centre. Professor Martins stressed that EMS professionals should receive training every six months, to ensure recognition of the signs and symptoms of acute stroke, and the requirement for urgent hospitalization. EMS training should include familiarization of the capabilities of individual stroke centres in the local network; in particular, whether CT scanning and experienced stroke physicians are available on a 24-hour, round-the-clock basis. This is vital to reduce unnecessary patient transfers to centres that may be insufficiently equipped or staffed for reperfusion treatment in acute stroke emergencies. A longer patient transfer to a comprehensive stroke centre can save time, compared with a 2-stage transfer to a primary stroke centre, followed by onward transfer to the comprehensive stroke centre. A further logistical consideration is the size of Brazil, and the often considerable distances involved in hospitalizing the patient; this means that a decision to deploy a standard ambulance, an ambulance with a stroke physician, or a helicopter has to be taken.



triage to be carried out; this provides an objective basis for EMS to decide the best emergency destination for the patient under assessment. The FAST ED app prompts EMS to ask the patient a series of diagnostic questions and to ask the patient to respond to specific instructions. The assessments are then scored. An example screen from the app is shown in the following illustration on page 12.

The final app summary score allows EMS to determine whether the patient has a low or high probability of large vessel occlusion (LVO). For example, A FAST ED score of 1 indicates a low probability of LVO (<15%), and EMS are informed to transfer the patient to the nearest stroke centre, regardless of whether it is a primary or comprehensive stroke unit. The app will provide best route directions for this hospital location. In contrast, a FAST ED score of 4 or more indicates a 60-80% probability of LVO. This



ED pre-hospital triage and communication system has markedly increased access to reperfusion therapy for acute stroke patients in Brazil. The improved pre-hospital notification and telestroke communication, between EMS and stroke specialist teams at comprehensive stroke centres, has decreased average door-to-needle time by 17 minutes, and reduced unnecessary hospital transfers by 60%. The JOIN app functions connect different hospitals and stroke team members. They permit individual stroke cases to be shared in real time, the recording and storage of quality indicators, and the viewing, storage and transfer of CT and MRI images via the Digital Imaging and Communications in Medicine

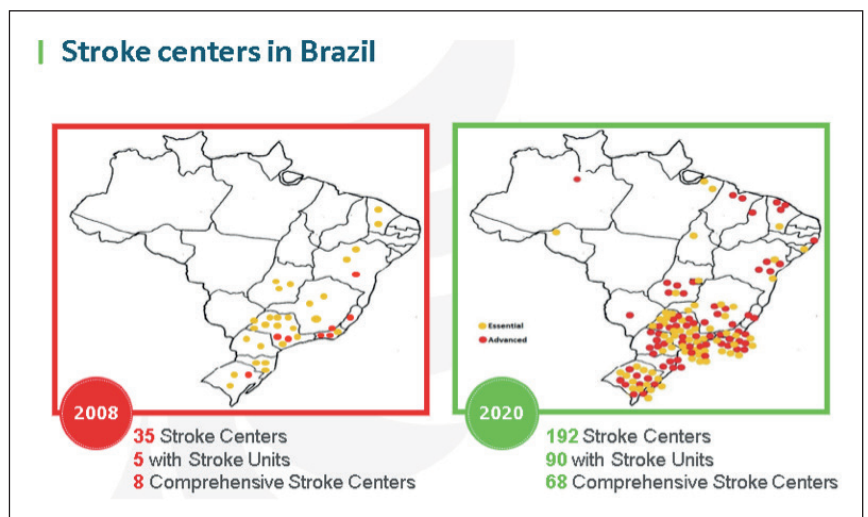
assessment indicates the patient should be transferred to the nearest comprehensive stroke centre, and best route directions for this location are provided. Most importantly, the diagnostic patient information collated by the app can then be forwarded, as a case summary, to pre-notify and prepare the stroke team at the selected receiving hospital for thrombolysis or thrombectomy treatment.

The JOIN communication app integrates the FAST-ED triage app with hospitals and is used to communicate between hospitals. This app is proving to be very useful in connecting community hospitals, where facilities for reperfusion or doctors trained in thrombolysis are unavailable, to more comprehensive stroke centres. When an acute stroke patient arrives at the community hospital, the pre-hospital triage assessments are completed using the app and, together with the CT scans, these details are forwarded to the telestroke team for specialist evaluation. The community hospital will then be advised on the best option for this patient. This could be (1) the patient should be thrombolysed and cared for at the community hospital; (2) the patient is unlikely to benefit from reperfusion treatment, or (3) thrombolysis should be started and the patient then transferred to our comprehensive stroke centre.

Benefits of Smartphone app technology:
Professor Martins confirmed that the FAST

(DICOM) viewer. Additional functions allow the progress of ambulance patient transfers to be tracked, and users can text and make and receive audio and video calls. Professor Martins' experience with the JOIN app and its validation as an aid to evaluation and treatment of acute stroke, within a comprehensive stroke centre, has been published recently.³

Expansion of stroke centres and bridging gaps with Telestroke communications: Professor Martins reviewed the expansion of stroke centres in Brazil, comparing the situation in 2008 with 2020. Although there has been a considerable expansion in both primary and comprehensive stroke centres during this period, there are still large areas of Brazil with no access to emergency acute stroke services in their vicinity. This is shown in the following figure.



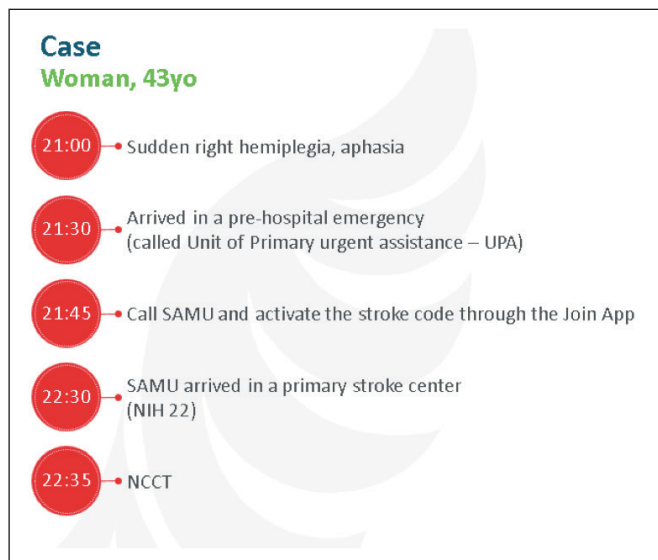
To address the disparities in acute stroke care across regions, a telestroke programme has been initiated in Brazil. This has been running for around a year. The programme is based on six “hubs” or zones each having a leader and three stroke neurologists. These teams provide real time consultancy and decision support, for up to 20 “spoke” hospitals, on whether they should perform reperfusion treatment, or transfer individual acute stroke patients to a comprehensive stroke centre. Professor Martins explained that, so far, 12 hospitals now have emergency physicians currently treating acute stroke patients with telestroke support. The majority of these physicians had no previous experience of thrombolysis. Within a year, these hospitals have assisted 457 stroke patients. Of these, 302 were ischaemic stroke patients, and 160 of these received thrombolysis (53%). No symptomatic intracranial haemorrhage was evident in these thrombolysed patients.

Professor Martins reviewed current key performance statistics achieved by hospitals assisted by the telestroke initiative. The average time to response from stroke specialists via the app to outlying spoke hospitals is two minutes. Average door-to-CT scan time is 18 minutes, and average door-to-needle time is 63 minutes. Professor Martins acknowledged there is room for improvement with current performance; however, she stressed that most of these hospitals have had no prior experience with reperfusion treatment, and all were coping with very high numbers of patients in their emergency departments.

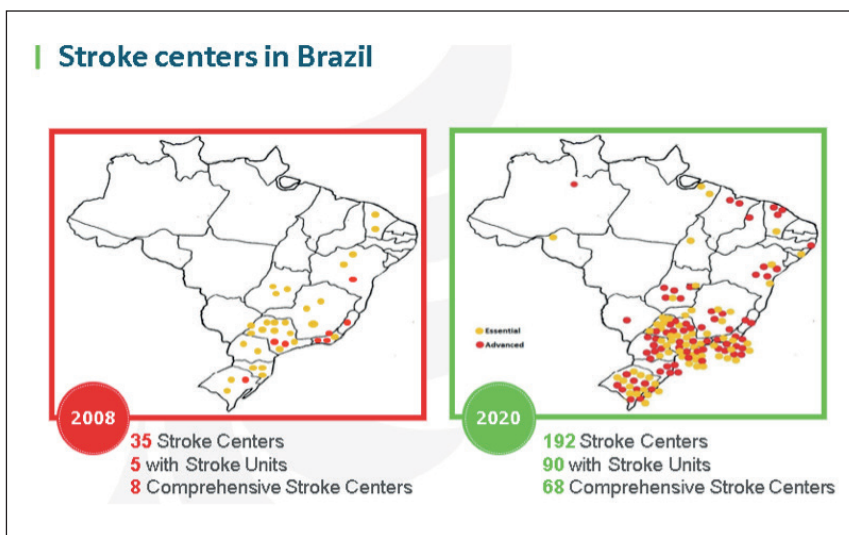
A case study aided by the FAST-ED and JOIN apps:

Professor Martins presented a case study with a positive patient outcome achieved in large part due to multiple FAST-ED and Join app functions. The patient, a 43-year woman with right hemiplegia and aphasia arrived independently by car to a Unit of Primary Assistance (UPA). Pre-hospital triage was performed on the FAST-Ed app, and activation of the stroke code via the Join app led to transfer of the patient to a primary stroke centre. Here, the patient was assessed on the National Institutes of Health (NIH) stroke scale score at 22 (severe) and CT scanning was performed. This sequence of events and timings are shown in the following illustration (above right).

Non-contrast CT scanning revealed a



thrombus in the middle cerebral artery (MCA) and a small infarction area. The patient’s assessment details and CT scans were entered into the JOIN communication app and forwarded for expert evaluation at a comprehensive stroke centre. A thrombolysis go-ahead decision was received and rtPA administration commenced 20 minutes after the patient was admitted to the primary hospital. After the FAST-ED App showed a high score (more than 4), suggesting a possible large vessel occlusion (LVO) and a hyperdense MCA the patient’s diagnostic information was forwarded using the JOIN app to the comprehensive stroke centre and the decision was taken to “drip and ship” the patient to the comprehensive stroke centre. Shipping time with active tracking of the ambulance was 45 minutes, and app communication enabled the patient to be referred directly to the angiography suite at the comprehensive stroke centre.



Further treatment at the comprehensive stroke centre led to reperfusion of the occluded vessel three hours and 41 minutes after the patient's initial symptoms.

Three months after reperfusion treatment the patient was speaking and walking normally. Professor Martins stressed that this patient's recovery (and many others in Brazil) was made possible due to the telestroke programme and improved communications via smartphone apps between EMS, separate hospital locations, and stroke physicians.

To conclude, Professor Martins highlighted the critical role of EMS in their initial support of acute stroke patients, assessing their symptoms, pre-notifying hospital stroke teams, and distributing patients rapidly to the most appropriate centre that can meet the patient's treatment needs. Low cost communication systems based on smartphone technology are highly effective, and proving to be essential tools for connecting pre-, inter-, and intra-hospital stroke teams. Use of smartphone apps can markedly increase acute stroke patients' access to reperfusion therapy, reduce door-to-needle time, and reduce unnecessary transfers between hospitals. This increased efficiency saves money, resources, and most importantly, lives.

Czech Republic: From hospitals to region

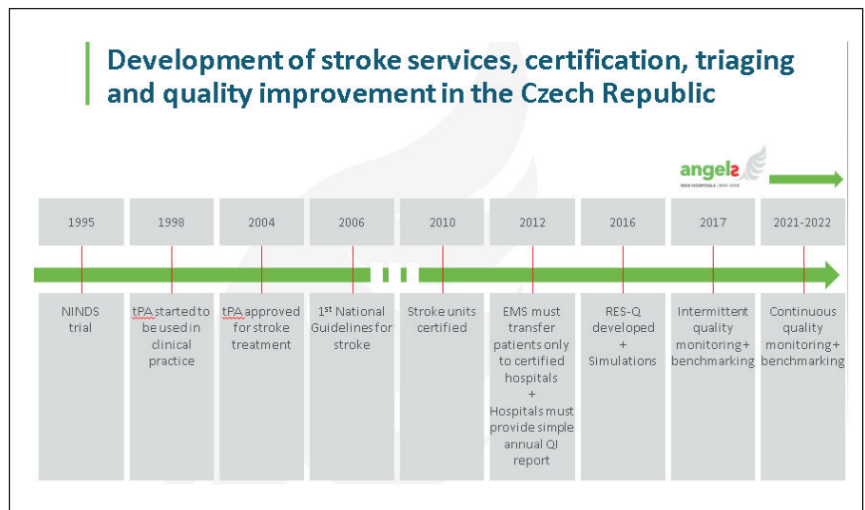
Professor Robert Mikulik MD, PhD

The development of stroke services in Czech Republic.

Professor Mikulik reviewed the currently available stroke services in Czech Republic. There are 13 comprehensive and 32 primary stroke centres serving a population of 10 million. All stroke centres are certified with quality monitoring procedures in place. Consequently, any patient showing the signs and symptoms of acute stroke will be triaged within this certified stroke network and can expect a good standard of care. A number of significant milestone events have contributed to the present-day minimum standard of acute stroke care in Czech Republic.

The National Institute of Neurological Disorder and Stroke (NINDS) demonstrated the effectiveness of thrombolysis

with rtPA in 1995, and subsequently, regulatory approval for rtPA use as a stroke treatment in Czech Republic was granted in 2004. National guidelines for stroke were published in 2006, and stroke unit certification commenced in 2010. It became mandatory for EMS to transfer acute stroke patients only to certified stroke-ready hospitals in 2012. Czech stroke patient data began to be collated in the RES-Q registry in 2016, and widespread acute stroke care simulation training was implemented in hospitals at this time. Quality monitoring and benchmarking assessment



procedures in stroke units began in 2017 and continue to expand. Continuous quality monitoring in stroke centres in the Czech Republic is expected in 2021/22. These milestone events are summarized in the following chart.

Professor Mikulik noted that following regulatory approval of rtPA, and availability of national stroke guidelines, access to thrombolysis became much more evenly distributed across the country. In 2010, the Ministry of Health (MoH) invited hospitals to apply to become certified stroke centres; 70 hospitals applied, but only 45 were selected. This had the effect of defining the current stroke network in Czech Republic, and concentrated acute stroke care resources in a reduced number of hospitals. Furthermore, the MoH stipulated that EMS could only transfer patients with the symptoms of acute stroke for mandatory triage to the 45 selected hospitals.

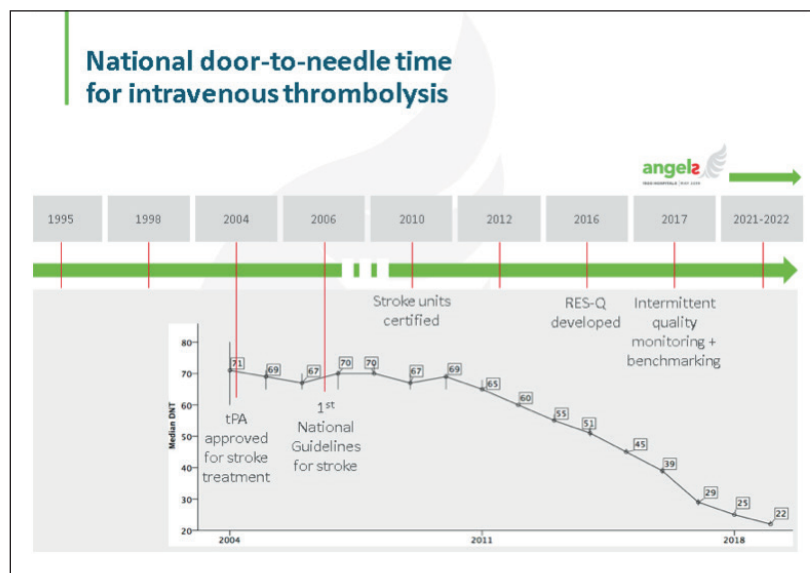
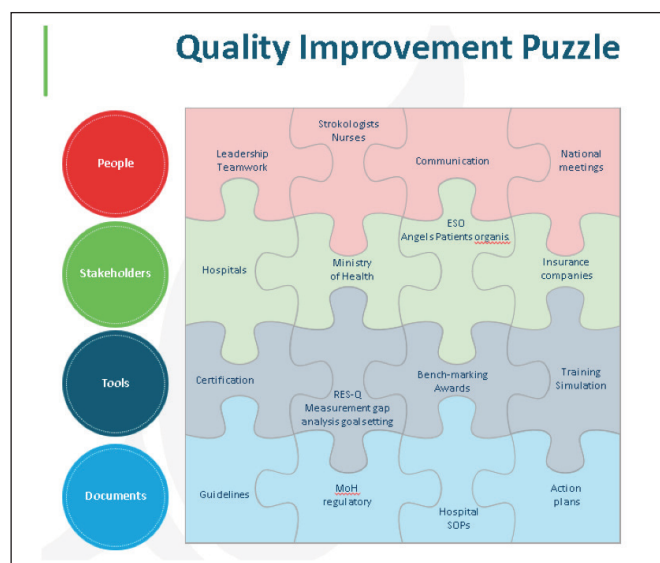
Once this stroke hospital network had been established, Professor Mikulik explained that quality monitoring and quality improvement assessments were introduced within stroke hospitals. Initially these were based on 12 quality

indicators provided by the MoH. Summary statistics were compiled within an annual hospital report, but comparability of performance between hospitals was not clear-cut. As a result, there was a switch in the Czech Republic, in 2017, to the RES-Q platform- the first global registry focused on improving stroke care. RES-Q allows standardized data from individual stroke patients to be entered and retained regarding admission, management and recanalization, post-acute care, and rehabilitation and discharge. These data are easily accessed on online and provide an objective basis for quality of stroke care benchmarking.

The impact of stroke centre certification, quality monitoring and benchmarking. Inspection of RES-Q data can identify those areas of acute stroke care where improvements are most urgently needed, in hospitals, or across the network. Identifying the current “gaps” in stroke care assists goal setting and performance targets. In 2017, following adoption of the RES-Q platform, the 20-20-20 campaign was established in the Czech Republic; its goals, by 2020, were: (1) to treat at least 20% of ischaemic strokes with intravenous thrombolysis, and (2) to reduce the median time from hospital admission to treatment by ≤ 20 minutes. Professor Mikulik confirmed that the 20% target for treating ischaemic strokes with rTPA has been achieved, and the national median DTN time was currently 22 minutes. The progressive reduction in national DTN time is illustrated in the following graph (shown below), where the impact of adopting the RES-Q platform, quality monitoring and benchmarking can be clearly seen.

Professor Mikulik acknowledged the contribution of the Steering Committee of the Czech Stroke Society (CSS) in achieving major nationwide improvements in acute stroke care. Following recent collaboration and support from the ANGELS programme, a new focus is investigating how EMS and pre-hospital stroke care can be improved and more closely integrated within the Czech stroke hospital network. Professor Mikulik also confirmed that the CSS together with ANGELS are working much more closely with nurses to optimize the contributions they can make in improving acute stroke care.

Completing the jigsaw of Quality Improvement. Professor Mikulik likened the process of building quality improvement

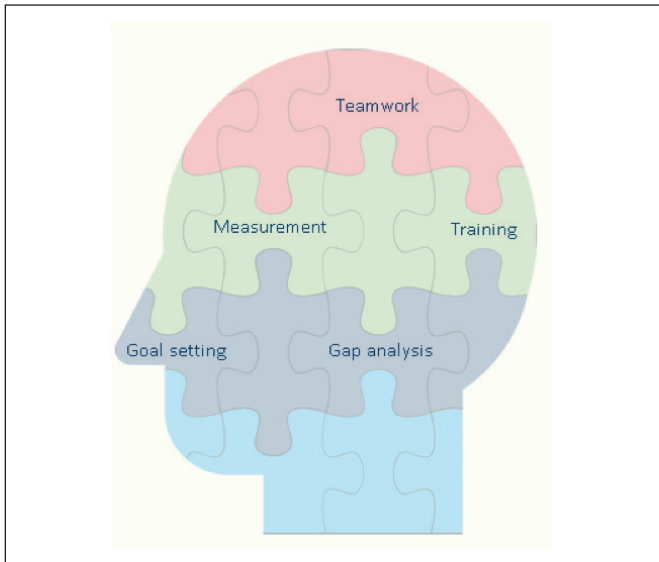


in stroke care services to that of completing a jigsaw. Success depends on fitting the correct components together. Of the components illustrated in the Quality Improvement puzzle shown below, Professor Mikulik considered leadership and teamwork are the most important.

With encouragement and help from the ESO-EAST organisation and ANGELS, the experience and successful framework for building a stroke network and integrated stroke services in the Czech Republic are believed to be transferable to other countries. The methods and achievements of the ESO-EAST programme can be upscaled to enhance and accelerate stroke treatment in Eastern Europe.⁴ The European

Stroke Organisation (ESO) has prepared a European Stroke Action Plan (ESAP) for the years 2018 to 2030⁵, in cooperation with the Stroke Alliance for Europe (SAFE). The ESAP provides a basic road map and sets targets for the implementation of evidence-based preventive actions and stroke services to 2030.

Quality Improvement – an individual mindset. Professor Mikulik stressed that quality improvement should be



embraced by all healthcare professionals involved with providing acute stroke services. Individuals must realize teamwork and continuous measurement of performance are essential for improved stroke care and outcomes; that gap analysis will identify training requirements, and goal setting must specify clear accountabilities for those tasked with meeting the goals.

An essential task for the future is for organizations such as ESO-EAST, ESAP, and ANGELS to work collectively to create a quality improvement mindset in healthcare professionals and stroke teams involved in providing acute stroke care. If this can be achieved, Professor Mikulik stressed the benefits for stroke patients will be substantial.

Chairman's concluding remarks

Professor Hacke acknowledged the significant progress made in improving acute stroke care in the countries featured in the five presentations streamed at this ESO-WSO Virtual Congress. In each of these countries, the ANGELS Initiative contin-

ues to be a powerful common denominator that has brought consistency, standardization, quality monitoring and recognition to stroke services in hospitals across the world. Professor Hacke commented that the ANGELS Initiative has made an unprecedented contribution to the implementation of modern stroke treatment. He made a plea for more publication of the data and patient outcomes achieved, as implementation of the ANGELS platform increases across the world.

Question and Answer session

1. **Professor Hacke to Professor Caso:** What do you think are the three most important elements in the ANGELS programme?

Professor Caso: First of all it's the community and team building aspects; secondly, it's the emphasis on quality measurement, as we need to have an objective and continuous assessment of what we are doing. The third element is continuous education. Developments in stroke care are happening fast; it's therefore important we keep up with developments, and are guided by emerging evidence, so we can incorporate new useful procedures to improve our daily work practices.

2. **Professor Hacke to Dr Esagunde:** Given the ever-increasing volumes of traffic and congested roads in the Philippines, how are you going to manage door-to-needle times?

Dr Esagunde: We are working closely with our EMS teams to establish faster transfers to hospitals, and would like to expand into emergency helicopter use and develop CT scanning facilities on board ambulances; however, due to the COVID-19 pandemic priority, we have been unable to have in-depth discussions with our MoH to progress our ideas.

3. **Professor Hacke to Professor Aref:** I believe your country and your region is ideal for implementing telemedicine. Can you expand on this?

Professor Aref: We have developed a video which we have named The Virtual Hospital. Although this is being used as a teaching aid in our University hospitals, it was developed specifically as a training aid for establishing telestroke networks with more isolated areas of our country. Our plan is to make all our University Hospitals into comprehensive stroke centres; some of the MoH hospitals will be

developed as comprehensive stroke centres, but most will remain primary centres. The remaining distant hospitals will provide stroke services using telestroke support to link them to expert stroke consultants at comprehensive centres. Once this network is fully established, we hope to be able to provide acute stroke care across the whole of Egypt.

4. **Professor Hacke to Professor Martins:** Can you tell us about the stroke hospital certification procedure in South America?

Professor Martins: We have only recently launched the stroke centre certification programme in Latin America. This is based on the WSO roadmap, recommendations, and classifications for advance stroke centres. No costs are incurred by the hospitals. All mandatory elements of stroke care have to be prioritized and implemented in at least 85% of acute stroke patients. We use RES-Q, SITS, and a national registry to capture patients' data and metrics. The organizations that have been involved include the WSO, the Ibero-American Stroke Organization (IASO), local neurological societies and MoH representatives. Following very recent MoH approval, we are using certified stroke units for the implementation of thrombectomy procedures in Brazil.

5. **Professor Hacke to Professor Mikulik:** Can you tell us about the simulation training you have used to help introduce thrombectomy interventions in Czech Republic hospitals?

Dr Mikulik: We used a programme of simulation exercises to train stroke teams and improve their organization and logistics. We have trained approximately one third of the Czech hospitals, and this has led to a significantly faster door-to-needle time following this training. Additionally, we have assisted in setting up simulation centres in other countries, notably in Russia, in Ukraine, and we have collaborated closely with Professor Aref and colleagues in Egypt in setting up simulation centres there.

6. **Professor Hacke to Professor Martins:** Can you describe the regulatory approval process for mechanical thrombectomy in Brazilian public Health?

Professor Martins: We studied the safety and efficacy of thrombectomy in a randomized trial in the public health system of Brazil. The positive results from this study were published earlier this year in the New England Journal of

Medicine.⁶ Recently, a meeting was held with the MoH in Brazil to present the trial data, our implementation plan for thrombectomy, and the budget. This information was well received, and MoH approval for thrombectomy in Brazil was granted on 06 November 2020.

7. **Professor Hacke to Professor Caso:** Can you say what impact your "Don't Stay at Home" public education campaign is having during the second wave of the COVID-19 pandemic?

Professor Caso: Any type of public education campaign needs reinforcement and constant reminders. We have to persuade patients and their families that the stroke hospital is a safe place, and anyone showing the signs and symptoms of a stroke needs urgent hospital treatment. The profession stroke and scientific societies must help to support this campaign by repeating the key message at every available opportunity. Without this constant reinforcement, stroke patients - especially those with minor symptoms or transient ischaemic attacks (TIAs) - will not present at our hospitals. Professor Hacke added that, in Germany, a 17.5% drop in the number of hospitalized stroke patients has been recorded compared with pre-COVID hospitalizations for stroke. Professor Hacke considered that the mortality associated with these stroke patients, who were not hospitalized, could exceed the mortality due to COVID-19 in Germany.

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