Three years of Angels: delivering a vision of consistent improvements in stroke care, internationally

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Abstract

The ANGELS Initiative, in collaboration with the European Stroke Organisation (ESO) and supported by Boehringer Ingelheim, was launched in 2016 in Europe, with the original aim of establishing 1,500 European stroke-ready hospitals and improving the standard of acute stroke care and patients' outcomes in Europe by May 2019. In the subsequent three years since launch, the ANGELS programme has expanded its sphere of influence significantly, and internationally; it now engages with stroke physicians, nurses, and emergency medical services (EMS) in more than 2,700 hospitals in 95countries. The ANGELS Initiative satellite symposium: "The ANGELS Initiative: three years and counting" was presented at the European Stroke Organisation Conference ESOC) on the 22nd May 2019 in Milan. This symposium reviewed the contribution the ANGELS Initiative has made over the last three years with respect to increasing the availability and the quality of acute stroke care. The content of the symposium presentations, made by leading stroke professionals, provides insights into how a new stroke-ready hospital is established, and how a regional stroke network can be achieved. The crucial roles of the specialised stroke nurse and emergency stroke services (EMS) are acknowledged, and the educational and training initiatives that have been made available for these professionals through ANGELS are reviewed. In addition, an assessment of the measurable impact the ANGELS initiative has had on the delivery and effectiveness of acute stroke care in Vietnam is reported.

KEYWORDS: ANGELS INITIATIVE, STROKE NETWORKS, STROKE-READY HOSPITAL, STROKE NURSES, ACUTE STROKE.

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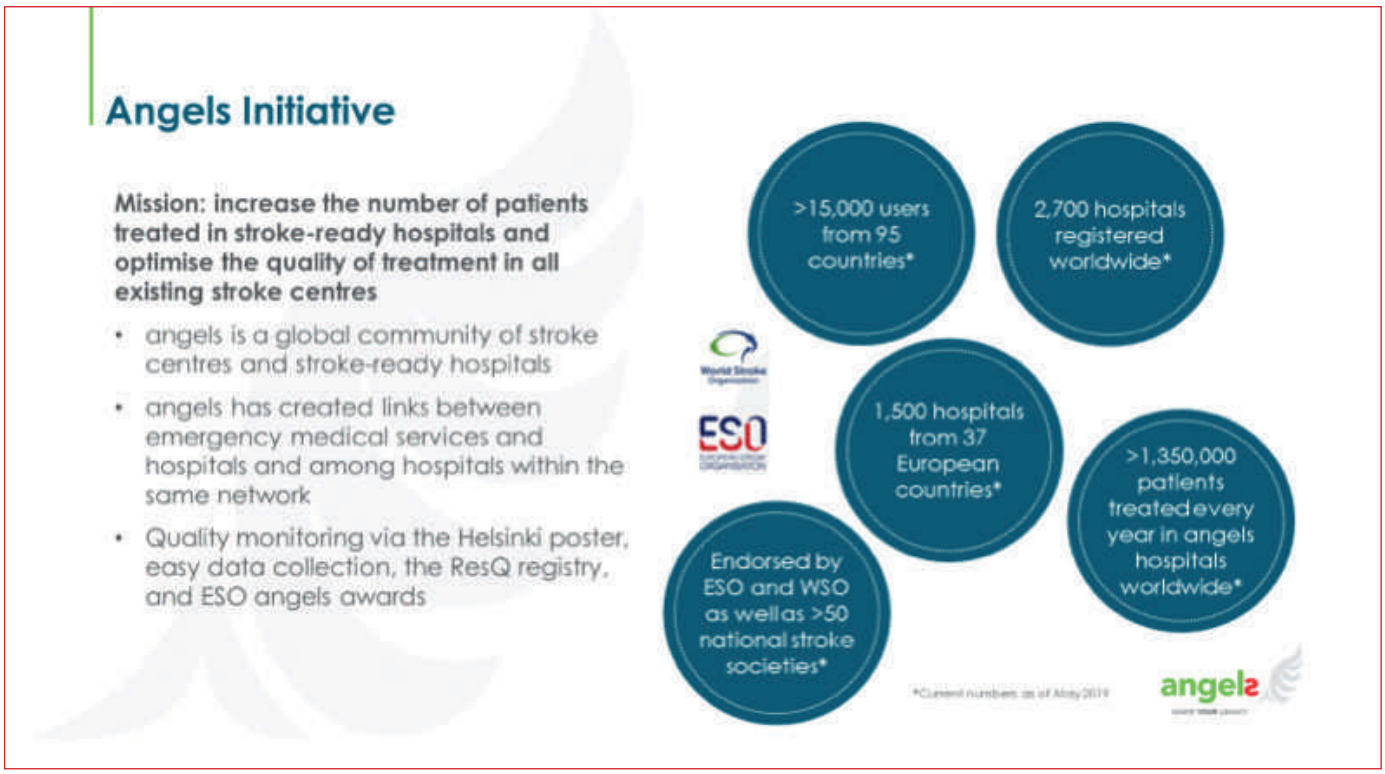
The ANGELS Initiative: three years and counting. Georgios Tsivgoulis MD, PhD, MSc, FESO, FEAN

Dr Tsivgoulis summarised the considerable worldwide burden of acute stroke. One in six people will have a stroke during their lifetime. Over 17 million strokes occur each year worldwide and in six million cases, these strokes are fatal. Accordingly, stroke is a leading cause of death, in both developed and developing countries, and is the major cause of disability on a worldwide basis. Stroke therefore represents a huge financial and resource burden for governments and healthcare systems.

The ANGELS Initiative: This unique non-profitable healthcare initiative was launched by Boehringer Ingelheim, in partnership with the World Stroke Organisation (WSO) and the European Stroke Organisation (ESO), in 2016, to improve care and outcomes for acute stroke patients, initially in Europe, but now on a worldwide basis. The principal aim of the ANGELS initiative is to develop a community of "stroke ready" hospitals, and to encourage and improve acute stroke networks between hospitals in order to share information, set up stroke units, and improve treatment procedures and outcomes. The ANGELS programme provides unique resources, training opportunities, and support for physicians, nurses, and hospitals to establish and optimise acute stroke networks worldwide.

Dr Tsivgoulis noted that the ANGELS initiative is now endorsed by over 50 national stroke societies and reviewed the current ANGELS recruitment position. Currently, there are over 15,000 healthcare professional participants involved in 95 countries. Over 1,500 hospitals in Europe, and over 2,700 hospitals worldwide are now participating in the initiative to create a global community of stroke centres that now treats over 1,350,000 acute stroke patients annually. These statistics are summarised in the following slide.



Notable key impacts of the ANGELS programme are the functional links and improved communication processes created between emergency medical services (EMS) and their stroke units, and consistency in hospital data collection and quality monitoring, leading to participation in the RES-Q stroke registry and ESO ANGELS awards.

The ANGELS overall approach to establishing stroke ready hospital status is "top down" and multidisciplinary; the main steps are shown in the following illustration.

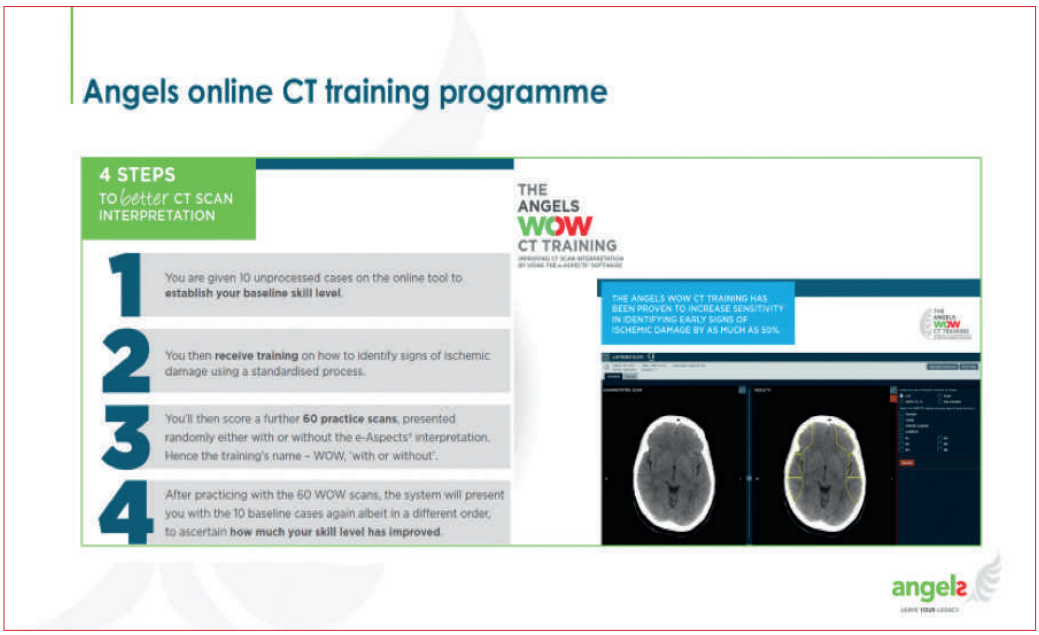
The ANGELS consultancy process is now a standardised agile process with eight well-defined steps. Following enrolment, an individual hospital's performance and processes are compared with current best stroke practice and acute stroke treatment guidelines. Training and simulation exercises are then tailored to those areas of work-flow practice that can be improved in each hospital. In addition, further simulation exercises, training workshops, and progress monitoring are conducted as necessary. These steps are detailed in the following illustration.

Dr Tsivgoulis explained that the implementation of standardised best practice acute stroke care and continuous quality monitoring via the ANGELS programme leads to reduced mortality, disability, and complications in participating hospitals. In parallel, patients' length of hospital stay, and hospital treatment costs are reduced; furthermore, patients' functional independence and ability to perform the essential activities of daily living are improved.

Training and standardisation of acute stroke care: One of the main goals of the ANGELS initiative is the standardisation of in-hospital stroke treatment. The ANGELS programme provides hospital units with a stroke treatment bag, and treatment of the patient in the CT scanner suite is encouraged to reduce door-to-treatment (DTT) time. Key components of the ANGELS in-hospital educational and training activities are illustrated right.

Dr Tsivgoulis provided evidence for the effectiveness of simulation exercises provided by the ANGELS programme. In a sample of 200 participating hospitals who adopted training simulation exercises, a reduction of 37% in DTT time was achieved (25 minutes saved). By contrast, participating hospitals who did not conduct simulation training only managed to improve DTT by 14% (10 minutes saved). Hence, the potential benefits of extrapolating these results obtained with simulation to global real-world acute stroke treatment practices are enormous.

Other ANGELS training initiatives: The ANGELS online with or without (WOW) e-ASPECTS CT training programme is aimed at familiarising stroke physicians with the early signs of acute cerebral ischaemia and improving their CT scan interpretation skills using e-ASPECTS software. The four main steps of this training programme are presented in the following illustration (left).



Currently, there are 12 European countries that have dedicated operational teams of ANGELS consultants facilitating training, and in order to extend training opportunities for younger less experienced stroke physicians in other countries,

the "Train the Trainer" programme has been established. This programme invites physicians, nurses, and ambulance crews from hospitals not covered by ANGELS consultants, to a training venue with high level acute stroke treatment expertise, where they can receive best practice training in stroke management and evaluate quality management tools. On their return to their own hospital these participants can then relay any newly acquired training, skills, and insights to their local working colleagues.

The ANGELS programme provides important training opportunities for nurses, who represent a crucial hospital resource in acute stroke management. The importance of nurses is underlined by the success of the nurse-led development of "Fever, Sugar, Swallow" (FeSS) protocols. Incorporating three simple protocols in nursing care to manage fever, hyperglycaemia, and swallowing (dysphagia) can lead to profound improvements in outcomes in acute stroke patients.[1] When implemented, FESS protocols led to a 15.7% reduction in mortality in acute stroke patients, and an associated number-needed-to-treat (NNT) of 6. Accordingly, the ANGELS programme provides learning and educational videos for nurses, with FeSS check lists and self-assessment modules.

Quality monitoring, stroke registries and the ESO ANGELS awards: The ANGELS programme encourages all participating centres to adopt continuous quality monitoring and to chart their door-to-treatment (DTT) times using ANGELS supplied posters so progress can be monitored objectively. Additionally, performance data, using quality measures captured in this way can contribute to the ESO-endorsed RES-Q and the Safe Implementation of Treatment in Stroke (SITS) stoke registries. Dr Tsivgoulis stressed the importance of continually monitoring the quality of stroke care in order to maintain and improve performance. Quality measures recommended by ESO in addition to DTT and door-to-reperfusion times include: the rate (%) of recanalization; the rate (%) of acute imaging in suspected stroke patients; the rate (%) of dysphagia screening; information on secondary prevention measures (the percentage of patients discharged from hospital on antiplatelet and anticoagulation therapies), and finally, the rate (%) of suspected stroke patients treated in acute stroke units.

Dr Tsivgoulis explained the basis of the ESO ANGELS awards. Once participating hospital centres begin to capture and document quality monitoring data, these data can be used to apply for and receive awards and accreditation. The ESO Angels Awards are designed to acknowledge and honour hospital stroke care teams, and individuals, committed to quality improvement in stroke practice, and are used to establish a culture of continued monitoring in their hospital and across the network of ANGELS-participating hospitals. These awards are categorised as gold, platinum and diamond, with diamond the highest accreditation. Those teams awarded diamond status are formally recognised at the annual ESOC meetings. In 2017, 17 diamond awards were presented; however, in 2019, 62 diamond awards have been recognised, and this reflects the growing number of hospitals that have joined the ANGELS programme and significantly improved their standard of acute stroke care in this short timescale.

The ANGELS initiative - success stories: There has been a wealth of reports of more streamlined workflows, increased treatment rates, and successful outcomes following hospital participation in the ANGELS programme. Significant documented improvements in acute stroke care and patient outcomes have been reported worldwide. Dr Tsivgoulis provided a brief overview. Highlights included Russia where a prominent simulation centre has been established, the number of stroke units has increased, and the fibrinolysis treatment rate has increased significantly. Similar improvements have been achieved in Latvia, and in Romania, treatment rates have been tripled, and the number of acute stroke patients treated in hospital has quadrupled as the stroke network begins to take shape. In Greece, those hospital centres that enrolled into the ANGELS programme reduced their DTT time by an average of 15 minutes compared with overall national statistics, and thrombolysis rates in these centres are now around 5-10% compared with an overall national rate of 0.5%. Of note, Icelandic nurses showed remarkable speed in their implementation of FeSS post-acute phase clinical protocols leading to clear patient benefits. In Italy, within a year of their ANGELS participation, one small hospital (Ospedale Maria Vittoria in Turin-Piemonte), almost halved their DTT from 80 to 47 minutes. Dr Tsivgoulis stressed that reports such as these provide evidence from an increasing number of countries that participation in the ANGELS programme has led to more acute stroke patients receiving timely and effective acute reperfusion therapy. In short, many lives and years of disability have already been saved.

The ESO ANGELS Spirit of Excellence Award has recently been introduced to recognise committed, inspirational, and innovative leaders in the acute stroke community who embody "excellence in acute stroke care". These are the individuals who are at the forefront of driving continuous improvements in acute stroke care in routine everyday practice in stroke hospital units in their home country.

In summary, Dr Tsivgoulis summarised the impact of the ANGELS programme and the key milestones achieved during the three years since it was launched. There is now broad acceptance and endorsement by international and national stroke organisations. There is now a vast and growing participation in the acute stroke care best practice and continuous quality monitoring initiatives promoted by the ANGELS programme, in Europe and increasingly the rest of the world. Over 2,700 hospitals are participating in ANGELS-led activities worldwide. Exceptional and effective educational and training opportunities for stroke physicians, stroke nurses and emergency medical services are now available in hospitals where previously such opportunities were very limited or non-existent. ANGELS has helped to build an international community of stroke professionals with a common mindset and dedication to improve stroke care. The ANGELS programme is a unique non-profit healthcare initiative that is establishing strong collaborations between the pharma industry, scientific societies, healthcare professionals, and patient organisations in order to improve treatment and outcomes for stroke patients.

Setting up a new stroke-ready hospital. Salvatore Ascione, MD, Ospedale del Mare, Naples, Italy.

Dr Ascione provided some global data on the burden of neurological disorders. In 2015, neurological disorders were ranked as the leading cause (10.2%) of disability adjusted life years (DALYs), and the second leading cause of global deaths (16.8%)[2] Within neurological disorders, stroke is the single biggest cause of death (67.3%), and the single biggest cause of disability as measured by DALYs.[2] Although neurologists often focus on a single patient, it is the overall burden of a disease to society that health economists focus on in considering the systems of care required to treat the disease nationally or on a wider basis.

The stroke network in Campania: In the Campania region of Italy, with a population approaching 5.9 million, the annual hospitalisation figure due to acute strokes and cerebral haemorrhage is currently 10,768.

Acute stroke beds expected in Campania

Campania region: 5,869,965 inhabitants

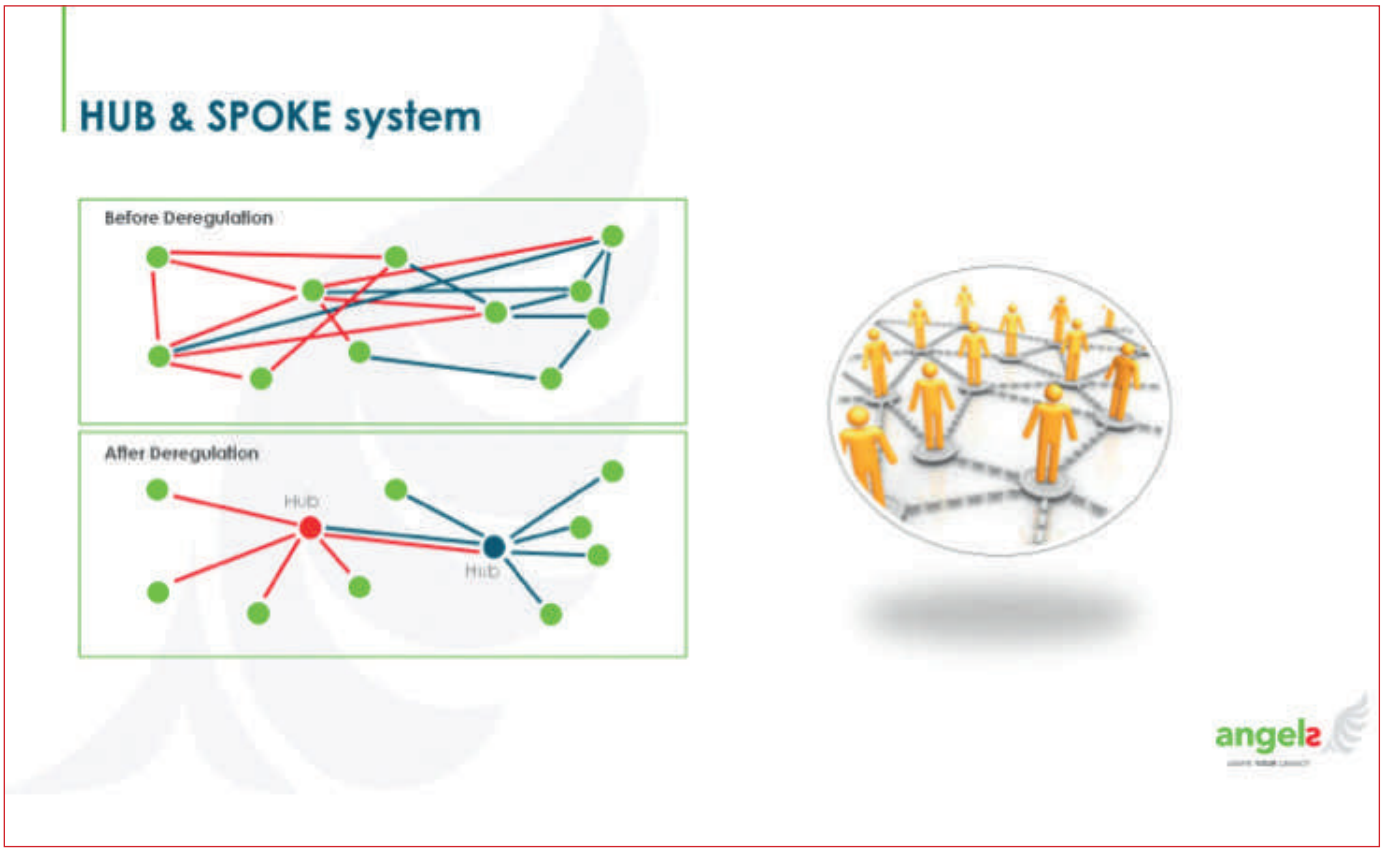
Acute recovery ordinarily >1 day, urgent	Annual hospitalisation
Cerebral haemorrhage	1,379
Vascular occlusion with cerebral infarction	5,837
Vascular stenosis without infarction	1,163
TIA	2,389
Total	**10,768**

Number of acute stroke beds: 104

angels

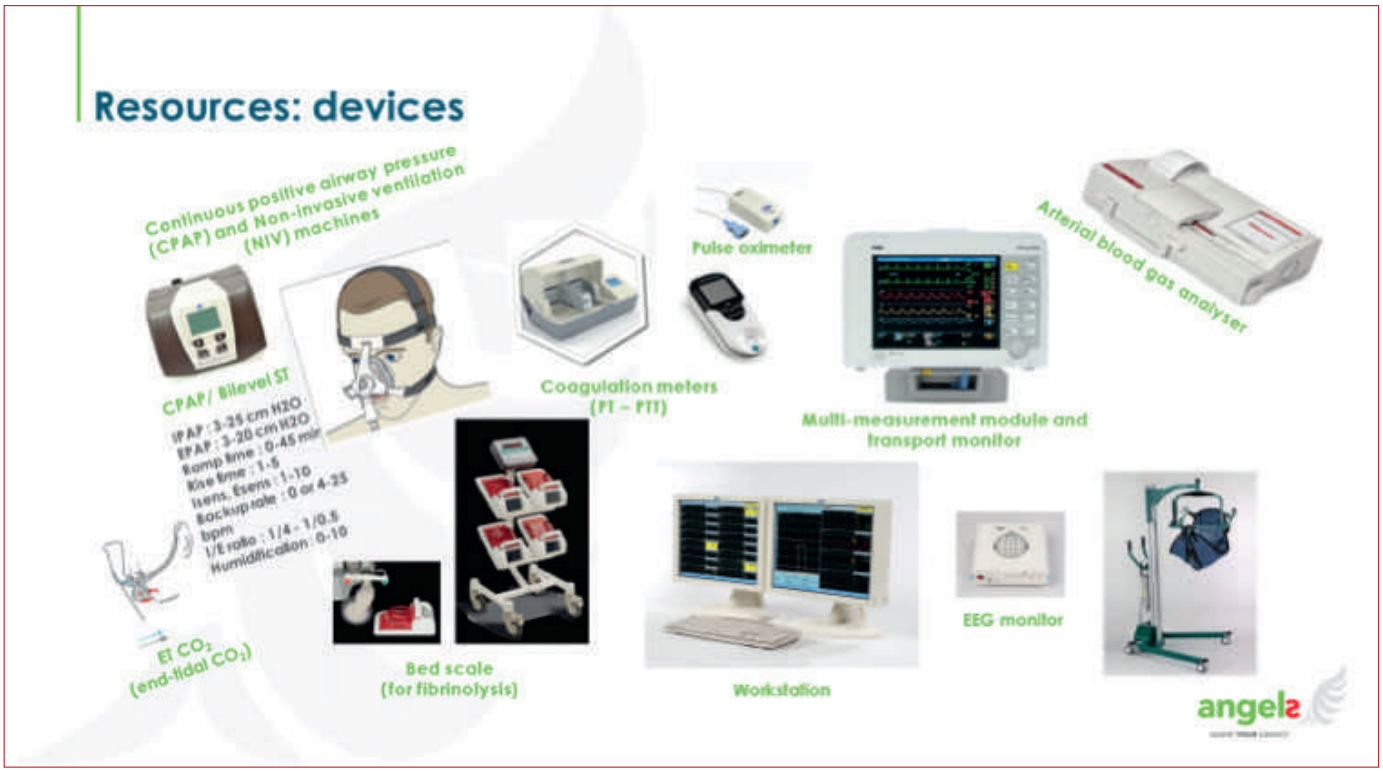
The number of acute stroke beds required to deal with this volume of patients in Campania is estimated to be 104. Campania currently has eight centres with i.v. thrombolysis capability, and two centres with additional endovascular treatment capability. Working on the assumption that a stroke unit is required for every 200,000 inhabitants, the distribution of stroke units in Italy varies by region. Campania has approximately one third of the acute strike beds it needs, and like many other Italian regions is under-resourced. Regions in the North (Valle d'Aosta, Umbria, Abruzzo); however, have more acute stroke beds and exceed the number to meet demand. ▶

◀ Dr Ascione acknowledged that the "hub and spoke" model is the most efficient network system for regulating and managing the flow of acute stroke patients; however, in his region, of the seven centres that could be categorised as a hub, only 3 were active. Of the 13 centres that could act as spokes, six have no strike unit at present. Dr Ascione felt that the development of a stroke network in his region could be described as a disordered spider web. The main task ahead is to reorganise the hub and spoke organisational structure to build an ordered and regulated constellation shaped network. This transition vision is illustrated in the following diagram.



Dr Ascione stressed that government-led healthcare policy does not reflect the proven medical science that provides the basis for best practice acute stroke treatment. Audits show that patients with ischaemic stroke are offered thrombolysis too rarely, or if they are offered it, too slowly. Quick treatment requires efficient processes and a team approach. Pre-hospital systems to identify patients and bring them to appropriate hospitals, emergency department streamlining, better access to rapid simple imaging, and the use of telemedicine must be harnessed to reduce times to treatment.[3] Government and healthcare systems must use proven medical science as a platform for the development of policy and systems of acute stroke care.

Steps forward in stroke management at Ospedale del Mare, Naples: Dr Ascione used the analogy of a mirage in the desert to illustrate the initial starting position of his hospital, and the huge and daunting task of establishing an efficient acute stroke unit. The required resources were identified and are illustrated in the following diagram.



The personnel resources identified and recruited for the stroke unit are shown in the listing below.

Training rather than resources was soon identified as the key to making progress. Dr Ascione explained the basis of the diagnostic and therapeutic assistance protocol (DTAP). This protocol precisely describes the details of every phase in the

management of an acute stroke patient: from pre-hospital identification and transportation to an appropriate hospital, observations, assessments and patient history, to treatment decision and selection of the best practice treatment for the same patient in the emergency department and/or angiographic suite. The DTAP is designed by physicians, and in Dr Ascione's hospital, the head neurologist consulted with physicians in other departments, and the resulting ◄ DTAP is approved by the Health Management Board of the hospital. The DTAP provides the detailed steps to work up an overall stroke care and treatment algorithm. Because quality intervention is time-dependent, the key to improved stroke care and better treatment outcomes for patients is to ensure each step of the defined workflow process is completed consistently in a timely, documented, and uninterrupted manner. This takes training, teamwork, and practice.

Simulation training with ANGELS input and assistance, at Ospedale del Mare, has helped to foster the high level of organisation and co-ordination required to deliver stroke intervention much more quickly. This has made possible DTT times of less than 60 minutes, and time to CT scan imaging of less than 45 minutes i.e. the requisite performance to meet ANGELS accredited acute stroke ready hospital status. The first thrombolysis procedure at Ospedale del Mare was performed in November 2018; 12 patients had been thrombolysed by the end of December 2018, and to date, 22 patients have been thrombolysed. A continuous quality monitoring system now seeks to improve workflow timings wherever possible and minimise delays at the hospital. Plans to initiate mechanical thrombectomy procedures at the hospital are now being finalised.

Organisation of a regional stroke network. Andrea Zini MD, Maggiore Hospital, Italy.

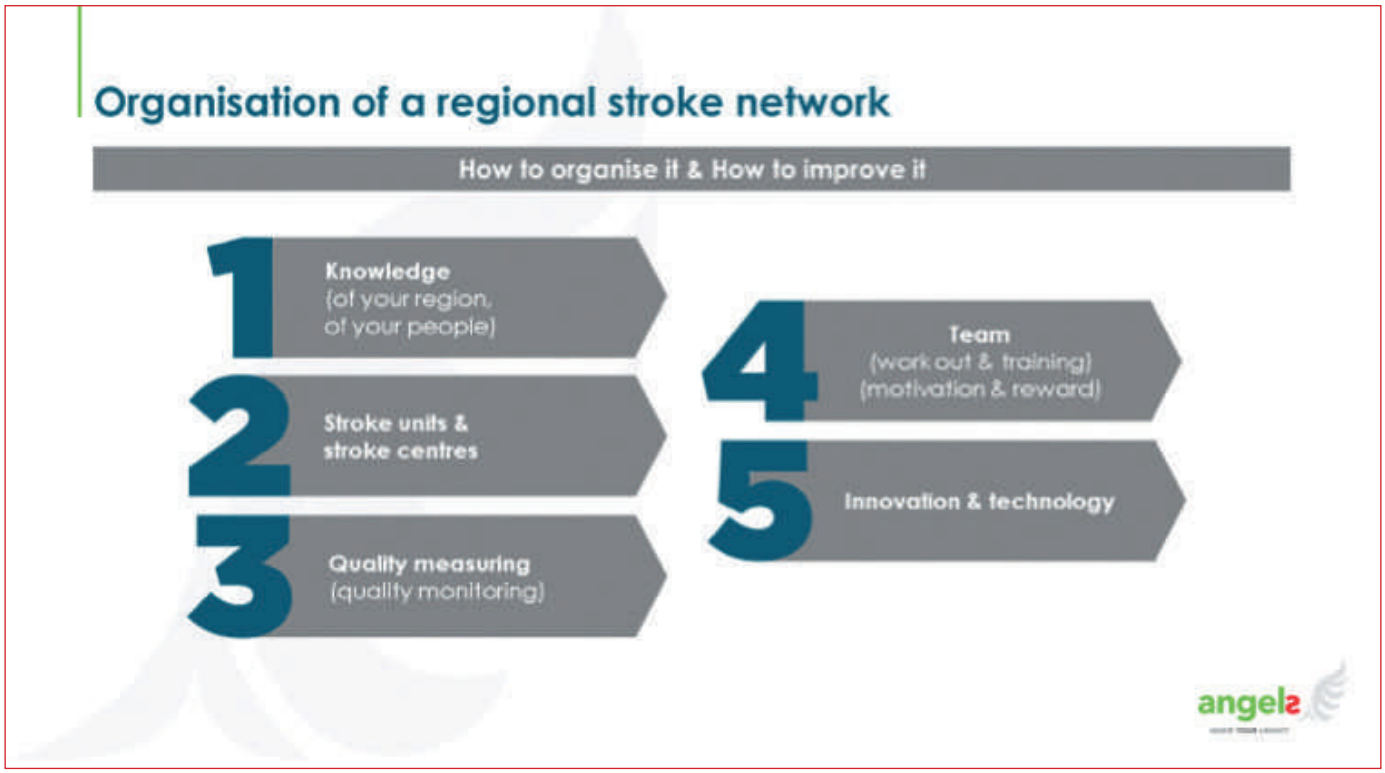
Background: The hub and spoke model of networked stroke hospital organisation is logical and promises to maximize the efficiency of available acute stroke care resources and, crucially, to reduce the time to treatment intervention for the stroke patient. However, in many European countries, in recent years, the hospitals that provide stroke care have been working largely in isolation, and not as part of an integrated regional stroke network. With the arrival of mechanical thrombectomy in 2015, the need for hospitals to work together co-operatively, and as a regional network, became obvious if more eligible acute stroke patients were to be referred and considered for endovascular intervention.

ANGELS consultants have been instrumental in helping to strengthen regional networks. ANGELS have been working with local Emergency Medical Services (EMS) companies to establish protocols for standardising prehospital management

for stroke patients. Regional ANGELS workshops have been a platform helping to establish a regional stroke community, with the aim of providing integrated acute stroke care on a regional basis. ANGELS consultants, with the help of the RES-Q registry, are facilitating the introduction of specific regional quality parameters, and a system of on-line benchmarking in order to ensure continual improvement in acute stroke care. Many of these initiatives have been endorsed by local regional governments as agreed future strategy for the management of acute stroke patients. As a result, more stroke patients are being transferred to specialist centres for specialist treatment interventions.

Organisation of a regional stroke network in Italy

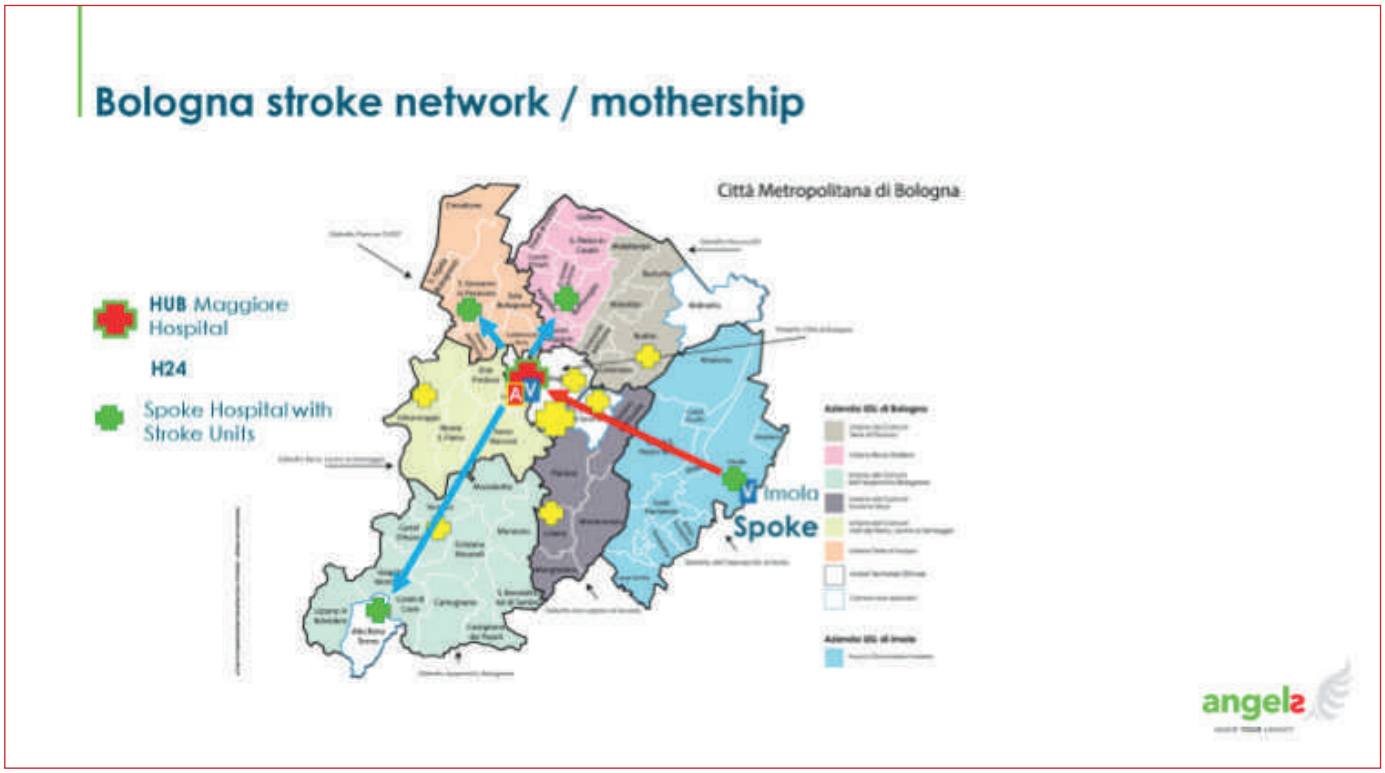
Dr Zini introduced the five main considerations involved in the development and organisation of a regional stroke network. These are displayed in the following illustration.



Dr Zini's region is Emilia-Romagna with 4.4 million inhabitants. It is important to understand the people of the region you are trying to provide stroke care for. Dr Zini explained that a public stroke awareness campaign was run in 2014 to increase awareness and knowledge of stroke; however, increasing public knowledge of stroke is not enough. The over-riding imperative is to increase stroke preparedness and encourage the public to take immediate action, and call EMS when they witness a person having a stroke. It is important to change behaviour and for the public to act. Consequently, when a second campaign was developed and run in 2018, a much stronger call to action was promoted. This was based on the message of: I see; I recognise; I call.

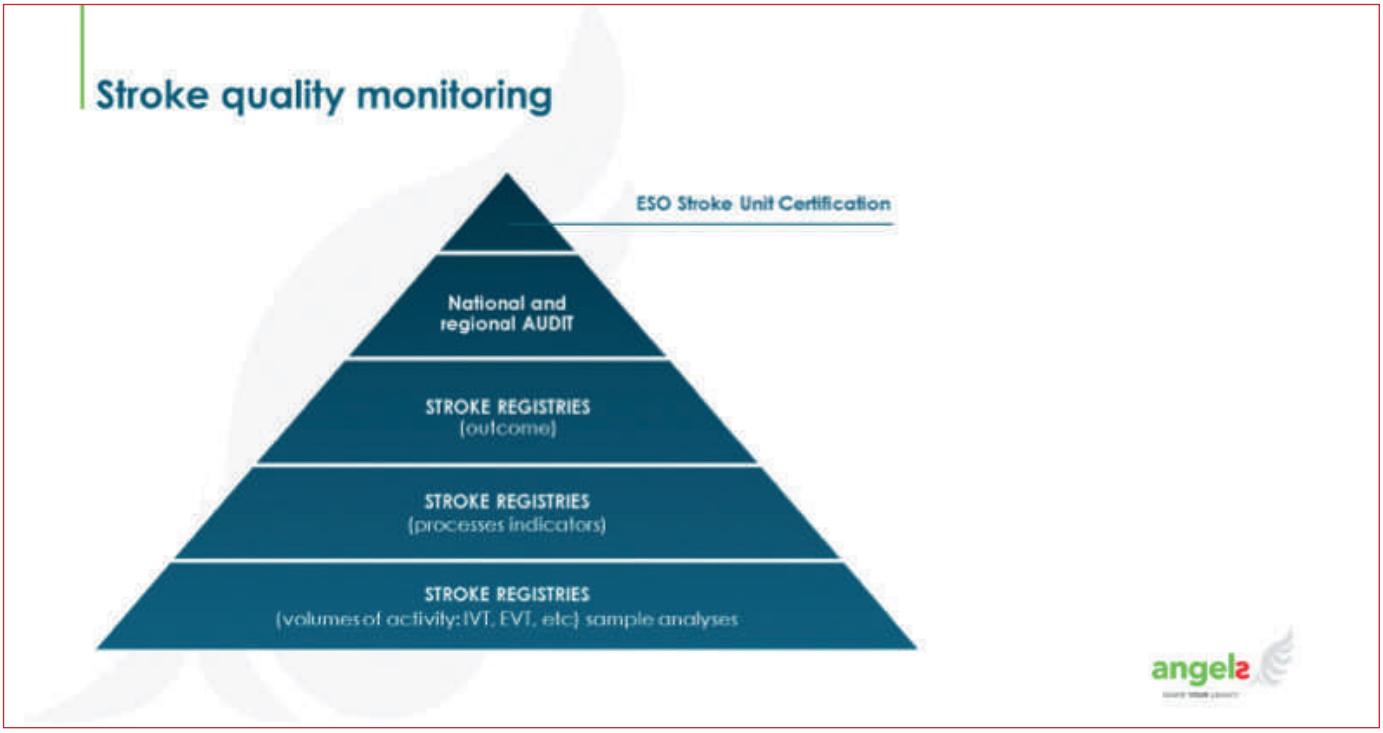
Dr Zini explained the composition of stroke centres and stroke hospital units in Emilia-Romagna. Although there is a process of accreditation involved in opening a stroke centre or a stroke unit, currently there is no process of certification that recognises the continuing quality of the ongoing performance of stroke units or centres. Dr Zini hoped that Italy would adopt the ESO stroke unit certification process. In the Modena region, a Mothership model of acute hospital stroke care has been established with "spoke" hospitals with stroke units referring patients to the single Baggiovara hospital "hub" centre that has both thrombolysis and endovascular treatment capabilities. In the larger Bologna region, a similar mothership stroke network exits. This is shown in the following illustration.

Quality measures and monitoring: Dr Zini presented the process of quality monitoring as a pyramid with ESO Stroke Unit Certification at the apex. At the base of the pyramid are the documented volumes of i.v. thrombolysis and



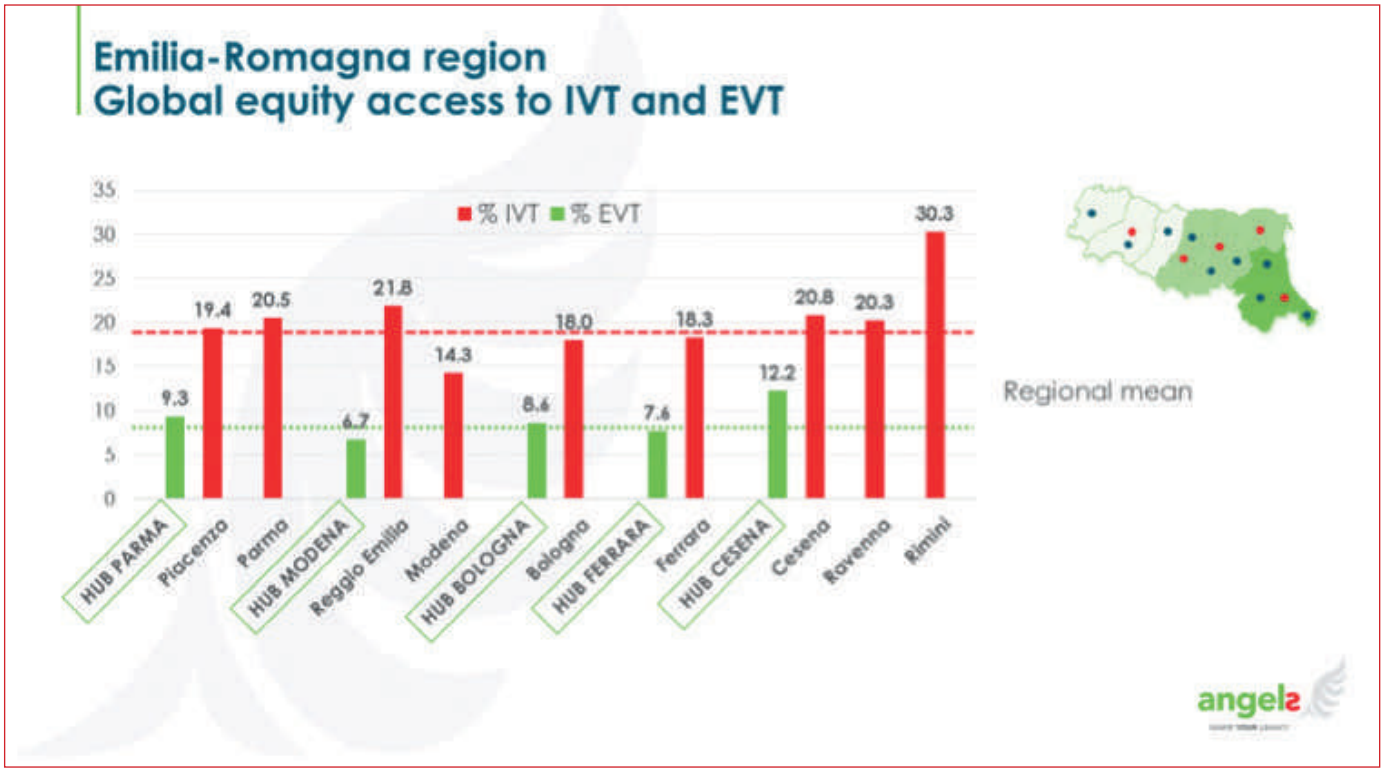
endovascular treatments (EVT) recorded in stroke registries by individual hospitals, the process and timing indicators used, and the patient outcomes achieved. These data can then be consolidated to provide regional and national audits defining stroke care performance by region and country.

In Italy it is now mandatory to document all acute stoke patient data in the Safe Implementation of Thrombolysis in Stroke–International Stroke Thrombolysis Registers (SITS-ISTR) and the Italian Endovascular Registry. Dr Zini emphasized the importance of completeness of data entry with inclusion of patients' 3-month outcome assessments.



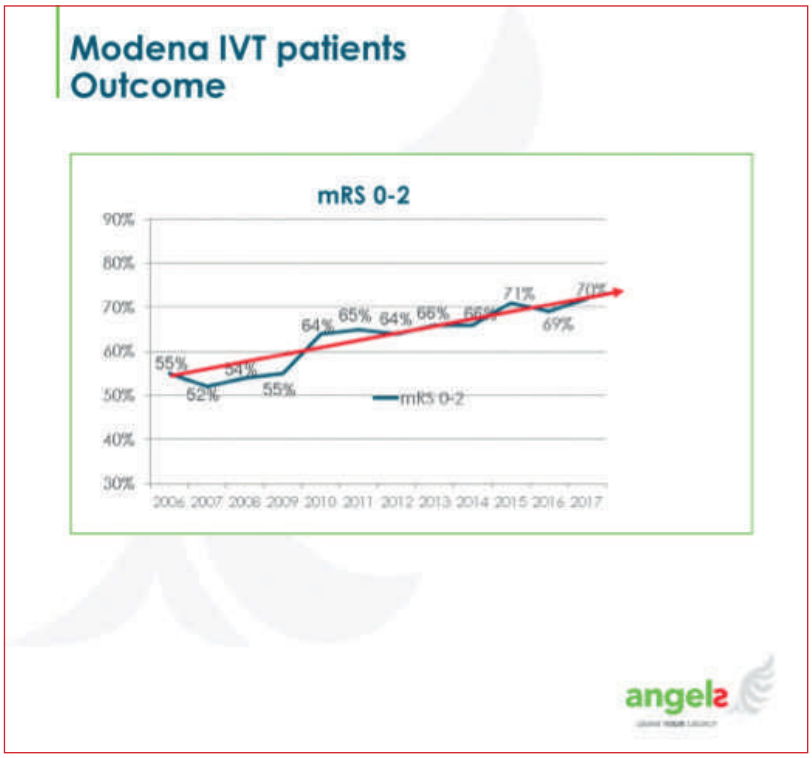
Other initiatives supporting stroke network development. Due to access difficulties in the mountainous region of Emilia-Romagna, a telestroke project was started in 2011, using audio and visual technology, allowing stroke neurologists to start evaluating patients en route to the hospital. ▶

◀ Dr Zini explained it was important to analyse the equity of access to i.v. thrombolysis (IVT) across the region. IVT and endovascular treatment (EVT) rates across the Emilia-Romagna region are shown in the following graph.



The regional means for these IVT and EVT treatment rates meet the 2018 Action Plan for Stroke in Europe targets by achieving IVT rates above 15% and EVT rates above 5%.[4]

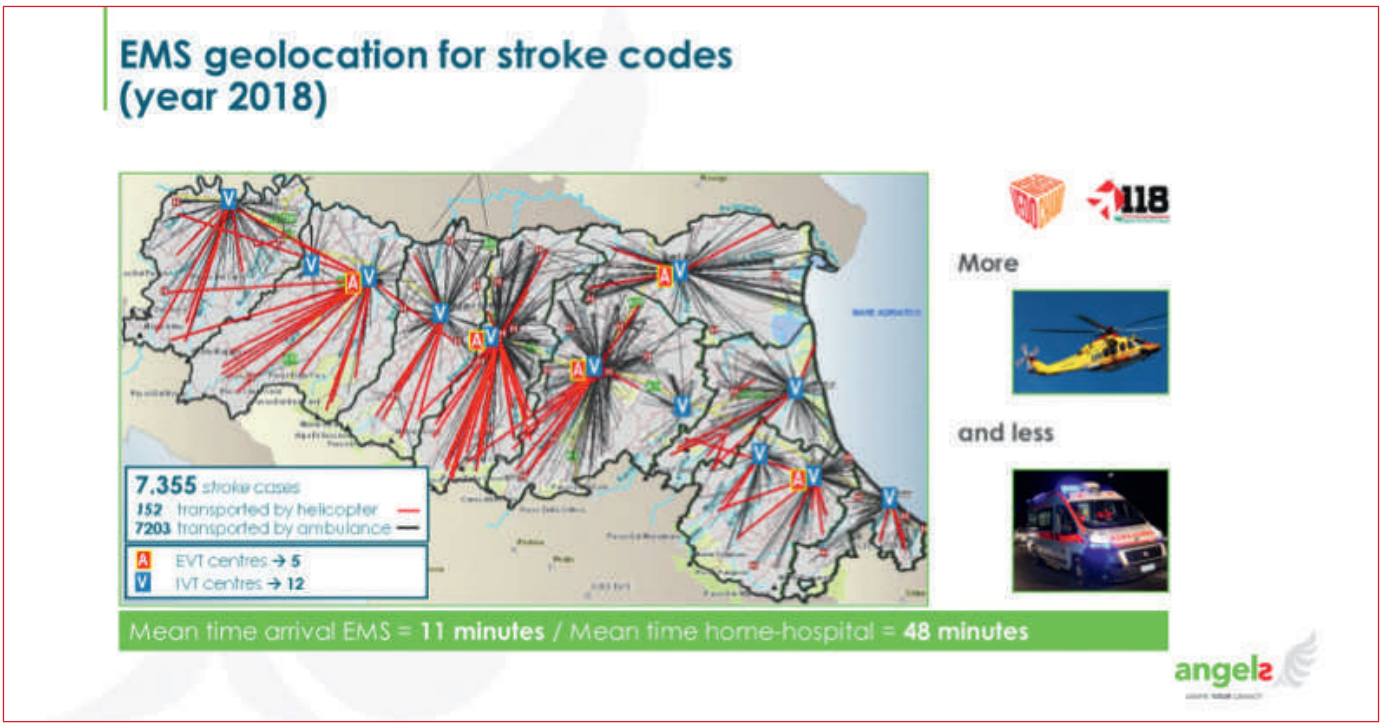
ANGELS support for the region: Dr Zini explained that ANGELS provided significant support, particularly with respect to providing tools for measuring and improving patient preparation and procedural timings. In Modena, for example, during the 2017-2018 period, monthly median DTT times were consistently below 60 minutes and often below 45 minutes. This has led to a steady improvement in patient outcomes as assessed by the percentage of patients with Modified Rankin Scores (mRS) of 0-2 at three months. Inspection of the chart below shows an encouraging upward trajectory: the percentage of IVT patients with mRS 0-2 assessments, at three months, has increased from 55% in 2006 to 70% in 2017.



Dr Zini stressed the importance of monitoring door to reperfusion (DTR) time because this is an end-to-end measure and all the steps in the IVT workflow process can be critically examined for potential improvements. ANGELS training videos also provide a template for hospital stroke teams with pointers for improving performance and reducing timings. These include videos covering pre-hospital management, the pre-notification call, an IVT case study, and a wake-up stroke case study with IVT selected by neuroimaging followed by mechanical thrombectomy.

Motivation of hospital teams, recognition of achievement, and rewarding effort are important for maintaining team morale, cohesion, and the impetus for progress and continual improvement in acute stroke care. In addition to participation in the ESO-ANGELS awards, every month in Modena, an inter-hospital competition takes place across local hospitals. The best performing emergency medical service team and best performing inter-hospital team are recognised and congratulated. This allows individual to evaluate and compare their own performance with that of their peers in other hospitals.

Innovations and technology: Dr Zini recognised the contribution of innovation and technology in driving advances in acute stroke care, particularly with neuroimaging. The availability of fully automated CT perfusion (CTP) software gives rapid processing of CTP images, and allows sharing of neuroimages across hospitals, with faster diagnosis and treatment intervention decisions. Geolocation of EMS is likely to be a significant factor in improving EMS arrival to patient time and subsequent hospital transfer times. The helicopter and ambulance transfers during 2018in the Emilia-Romagna region as summarised in the following illustration. More use of helicopter transfers to improve prehospital timings, for patients located in the mountain areas of the Emilia-Romagna region is expected.



Finally, Dr Zini discussed the increasing use of Smartphone Apps particularly as an aid during the prenotification video call from EMS to stroke neurologists. In particular, an app developed by Dr Zini is proving very helpful in capturing and storing patient history, vital signs and stroke severity assessment data to forward from EMS to the interventional neurologist and hospital work colleagues.

Empowering Stroke Nurses. Estela Sanjuan, RN, PhD.

Background: A major goal of the ANGELS programme is to train and empower more nurses to specialise in providing acute stroke care. Nurses play a crucial role in the stroke team, but often receive limited support and are not fully recognised for the work they do. ANGELS have now launched a comprehensive on-line stroke nurse certification

course, and this has been officially endorsed by several national stroke and nursing societies. So far, over 800 nurses have enrolled, and this course is designed to improve nurses' knowledge of stroke and to increase their standing in the stroke community.

ANGELS have invested significantly in targeted training for nurses, to address, for example, an inadequate level of dysphagia screening in acute stroke patients in many countries. In Czech Republic and Poland several hundred nurses have already undergone specific training to address this issue. This has led to a dramatic increase in dysphagia screening in stroke patients during the first 24 hours of hospitalization in these countries. Spain is currently at the forefront of developing and expanding the role of the acute stroke nurse, and notably, it is the only country in Europe that has an official neurology nursing society (SEDENE) with a major focus on stroke.

Empowering stroke nurses in Spain: Dr Sanjuan explained that, collectively, nurses represent the biggest sector of healthcare professionals with 19.3 million registered worldwide; they significantly outnumber physicians by a ratio of 3:1 in the US, and by 2.5 in Europe. Despite this majority, nurses are underrepresented in policy decisions. Dr Sanjuan stressed that nurses should see themselves as leaders and be prepared to lead change, in order to advance health. Many nurses have limited opportunities to develop leadership, and high nursing staff turnover is often driven by a sense of being undervalued. Many nurses feel their contributions are underestimated. Dr Sanjuan felt nurses need to move to a power position where they can take part in policy and decision making.

Availability of nurses is an important influence on in-hospital patient mortality and morbidity. Wards with more registered nurses have lower mortality rates.[5] Fewer nurses results in more mortality, increased readmission rates, and increasing costs for national healthcare systems. Consequently, nurse staffing cuts to save money might adversely affect patient outcomes. There is strong evidence from high impact publications that nurse interventions save lives and improve outcomes in stroke patients.[1,6] Currently, a nurse's job involves more documentation and interaction with technology and less time at patients' bedsides. Dr Sanjuan estimated that a third of most nurses' time is spent recording data; however, very little of these data are used to create and publish clinical evidence. More nurse-led studies need to be published so that valuable information and experience can be more widely disseminated.

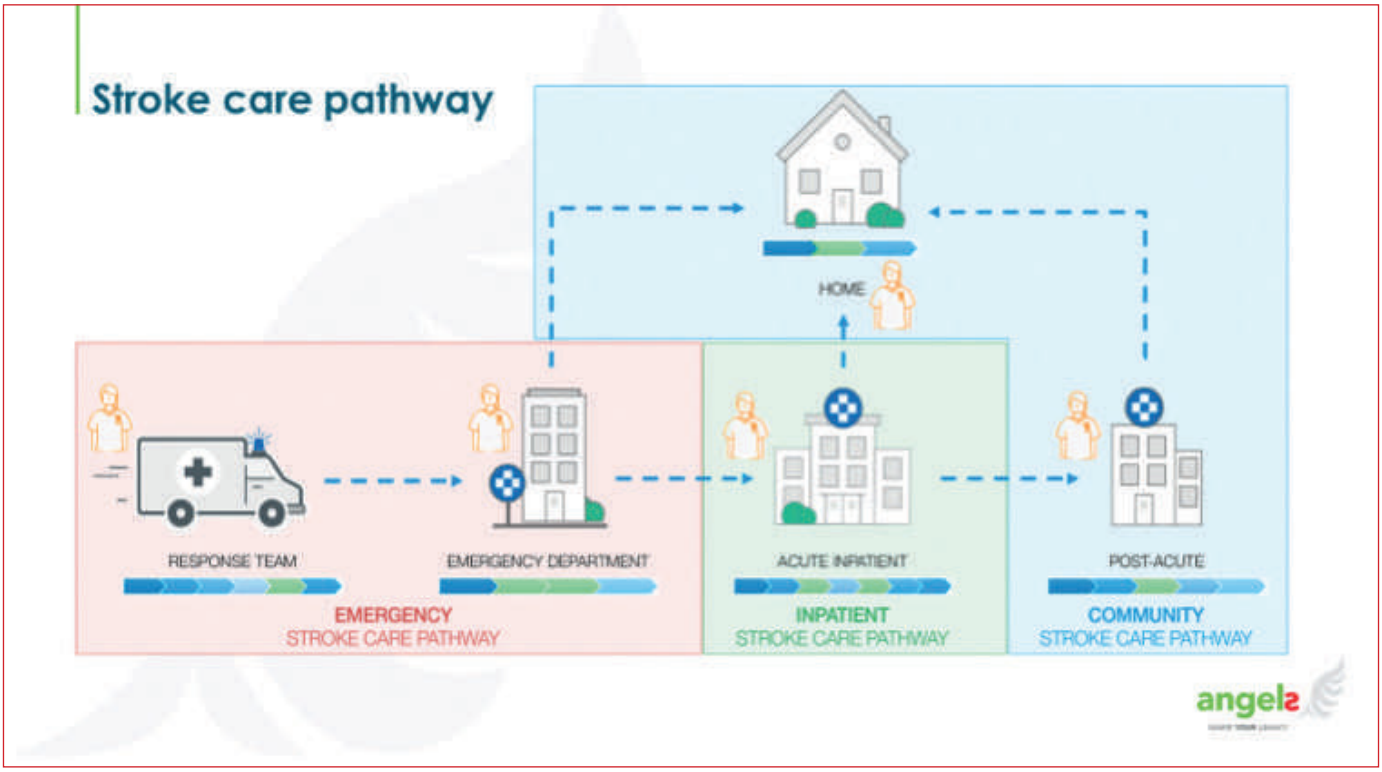
Dr Sanjuan presented an overview of stroke care and the principal changes that have occurred over the last few decades. Once a passively treated condition, stroke is now treated in a rigorously proactive manner, with the advent of Code Stroke activation systems to alert and mobilise all the hospital's acute stroke team members and stroke support services. Thrombolysis and mechanical thrombectomy procedures for eligible patients are becoming more widely available, and more intensive rehabilitation is provided. These advances, together with the expert stroke nurse care, have reduced deaths and patient dependency. However, even though emergency, acute inpatient, and community care pathways have become more streamlined and focused, and fewer people die of stroke than ever before, stroke remains one of the biggest challenges to contemporary medical practice.

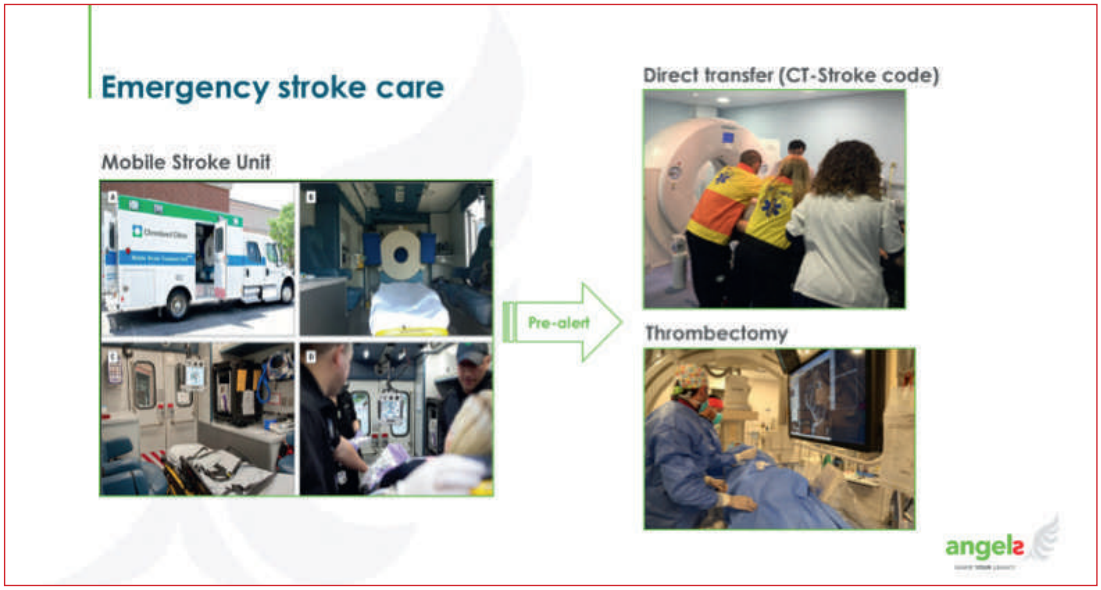
Specialist training in acute stroke care for nurses in Europe has produced significant measurable benefits; these are listed in the following illustration.

In particular, nurse stroke training has helped shape practical and effective, evidence-based, stroke care practices in hospitals,[1] and the boost in the nurses' skill set has helped to create a positive synergy with their interaction with other expert stroke care professionals. ▶

◀ Dr Sanjuan emphasised that nurses are involved in every step of the overall stroke care pathway illustrated in the diagram below.

Dr Sanjuan gave an overview of a well-executed patient journey through the stroke care pathway. Following emergency call-out and initial assessment, EMS will pre-alert the hospital stroke team during hospital transfer. At arrival, the patient will be transferred to the emergency room (ER), or directly to the CT suite to evaluate eligibility for fibrinolysis and/or endovascular treatment. If a mobile stroke unit is available, the CT can be performed before the arrival and thrombolytic treatment can be started on the ambulance.





Post-procedure, the patient will be admitted to the stoke unit to receive expert stroke nurse care with particular emphasis on intensive monitoring of vital signs, intensive neurological monitoring in order to detect any development of

post-procedure complications or worsening of the patient's status, and intensive efforts to facilitate early mobilization and recovery for the patient.

Dr Sanjuan maintained that nurses can make a significant difference in outcomes for stroke patients. She highlighted the 15.7% in reduction in death and dependency in stroke patients associated with nurse-led interventions, conducted during the first three days of hospitalisation, based on the Fever, Sugar, Swallowing (FeSS) protocols developed and published by Middleton et al.[1,6] Dr Sanjuan urged all nurses involved with acute stroke care to apply to join the Quality in Acute Care (QASC) Project in Europe.

Nurses play an important role in the discharge of stroke patients from hospital and in providing support for patients' rehabilitation and recovery through a discharge care plan, and the provision of risk factor modification advice. Dr Sanjuan noted new technologies can be utilised in the provision of stroke patient support, at discharge, and thereafter. At her stroke centre, the stroke team designed a patient website (www.aulaictus.com), a mobile app (Farmalarm)[7], and tablet devices are available for patients' use and reference.

Empowerment of nurses in Spain: Support for nurses who want to develop their stroke care capability, in Spain, is available from the Spanish Society of Neurological Nursing (SEDENE), which has a major focus on stroke care, and the ANGELS initiative, who both offer grants to finance a 1-week stay at a national reference stroke centre. This experience shares knowledge and builds specific stroke nursing skills for nurse participants; it also provides an entry point for collaborating in multicentre clinical studies and contributing valuable patient data. The ANGELS e-Learning Stroke Nurse Certification course (www.angels-initiative.com) has now been translated into Spanish and is reviewed and endorsed by SEDENE.

The Nursing Now Campaign: The Nursing Now campaign is a global 3-year campaign that aims to raise the status and profile of nursing. Run in collaboration with the World Health Organization and International Council of Nurses, Nursing Now seeks to empower nurses to take their place at the heart of tackling 21st Century health challenges. Dr Sanjuan explained that Nursing Now will concentrate on the key activities illustrated on the following global map.

In summary, Dr Sanjuan was insistent that nurses must initiate change. There are approaching 20 million nurses worldwide providing 24-hour care, from birth to death, in all medical and healthcare disciplines. Nurses must ensure

their voice is heard and their contributions to patient welfare is recognised and valued. Crucially, nurses must move to a power position with more nurse leaders, where they can take part in healthcare policy making and decision making. Nurses are well placed to conduct more research, to create and evaluate evidence, and to disseminate their findings to the wider medical community and to patient populations. Nurse education and training, when implemented, has a significant effect on patient outcomes; consequently, all nurses should be able to extend their competence by training to maximise the positive impact of the care they provide for their patients. Finally, the actions that nurses take today will affect the future of nursing and healthcare as a whole. Change, with nurses taking ownership of their profession, has to start now, and it will have great impact in the future.

Emergency Medical Services: The Advanced Stroke Life Support® Program. Ivette Motola MD, MPH.

Background: The European Stroke Organisation (ESO) has prepared a European stroke action plan for 2018-2030 in cooperation with Stroke Action for Europe (SAFE). This plan includes a target to treat 90% of all stroke patients in Europe in a stroke unit as a first level of care by 2030. The plan can only work by ensuring very close cooperation with emergency stroke services (EMS) and ensuring that all acute stroke patients are only delivered, by ambulances, to a stroke-ready hospital. Public education is important because they need to know how to access EMS and patients with a suspected stroke who drive, or who are driven, in order to seek treatment independently of EMS, have a significant chance of ending up in a hospital outside the region's stroke-ready network. Regional networks are becoming more complex and an important question to address is: can a better outcome for a patient be achieved by bypassing transfer to the nearest stroke-ready hospital and directly transferring that patient to a more comprehensive stroke centre instead?

Professor Ivette Motola and colleagues in Neurology, Emergency Medicine, EMS and nursing at the University of Miami Miller School of Medicine have developed an Advanced Stroke Life Support programme which has been widely used to train emergency medical services personnel, nurses, and stroke physicians in the USA and across the world. This training programme is now available to EMS stroke healthcare professionals in Europe who are enrolled in the ANGELS initiative as an e-learning course.

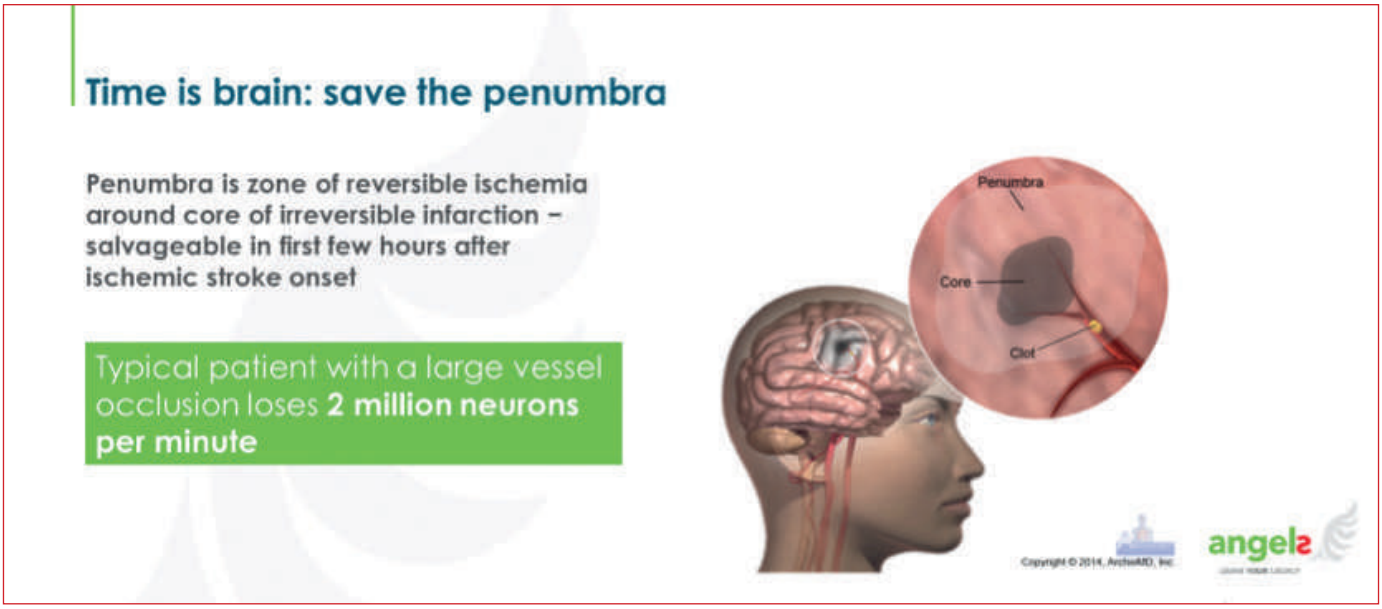
The Advanced Stroke Life Support (ASLS®) Program: Professor Motola explained that she has been the director of The Advanced Stroke Life Support (ASLS®) Program for the last 12 years. She presented some summary statistics describing the burden of stroke. Stroke affects 600,000 people annually in Europe (800,000 in the USA), and worldwide every two seconds, a person will have a stroke. The burden, incidence, and prevalence of stroke are all high, and growing as populations age. The annual estimated cost of stroke in Europe is €45 billion; however, these costs are expected to rise. Professor Motola estimated that, by 2035, there will be a 34% increase in the number of stroke events, a 25% increase in the number of people surviving and living with stroke, a 45% increase in deaths due to stroke, and a 35% increase in disability-adjusted life years (DALYs).

Professor Motola maintained that improvements are required at every stage in the chain of stroke care. In particular, public education is vitally important; if the public do not recognize stroke in the same way as they do with e.g. chest pain and myocardial infarction, urgency in their response to a stroke will be lost. The ASLS® Program has a key focus on EMS and EMS training for prehospital providers so EMS can detect and begin management of stroke, and triage acute stroke patients to the nearest appropriate hospital. Each region has to determine the best to set up their stroke systems of care, based on available hospitals and EMS services. The second focus of ASLS® is in-hospital training especially in the emergency department (ED) where so much has to happen so quickly. Usually this involves a CAT scan to determine if the patient is experiencing an ischaemic or haemorrhagic stroke, followed by the most applicable treatment: i.v. thrombolysis with tPA and/or endovascular treatment.

History and Development of the ASLS® Program: This programme was developed in the US by a consortium of stroke neurologists, emergency physicians, nurses, and educators in 1998 shortly after the National Institute of Neurology and Stroke (NINDS) trial was published.[8] This training is appropriate for all healthcare providers involved in the management of acute stroke patients, although most participants are nurses or EMS personnel; it meets or exceeds the requirements for stroke centre certification

education. In the US, the programme is accredited by the American Nurses Credentialing Center (ANCC) and the Commission on Accreditation for Prehospital Continuing Education (CAPCE). The content of the course is updated and revised regularly. Professor Motola gave an overview of the face-to-face course with a strong emphasis on simulation-based practice sessions.

A principal objective of the programme is to instill urgency and the need to act quickly. Neurological assessments are covered and include the Face Arm and Speech Test (FAST), and the Miami Emergency Neurologic Deficit Exam (MEND), in addition to others. There are two versions of the curriculum for Stroke management i.e. Prehospital and hospital care. Professor Motola explained that given the importance of the prehospital notification call this is covered in considerable detail. A key slide used in the ASLS® progamme explains what the penumbra is and underlines the key message that all acute stroke care should be focused on saving the penumbra - those cells in the brain that are injured but not yet dead. This slide is presented below.



ASLS® makes use of animated sequences to cover such topics as transient ischaemic attacks (TIAs) to show the impact of an embolic event in an artery of the brain, compromising distal blood flow and leading to ischaemia. TIAs are taken seriously as many TIA patients will subsequently go on to have a more serious stroke shortly afterwards. Professor Motola presented a video sequence used in EMS training based on a person with a left hemisphere stroke; it illustrated a FAST examination and the questioning used to exclude tPA contraindication.

ASLS® training is now disseminated through a network of almost 130 training centres by 1,200 certified instructors. Although the programme was developed in the USA, training is now conducted worldwide, with courses recently delivered in Mexico, UK, Hong Kong, Saudi Arabia and India. During 2017 and 2018, ASLS® training has been delivered to approximately 15,000 EMS in-hospital healthcare providers. This training has been very well received by participants: their average assessment score, based on evaluation of all components, is 4.93 out of 5.0. The course effectiveness is well established and documented. A recent presentation[9] at the International Stroke Conference (ISC) 2018, based on almost 10,000 mainly nurse and prehospital US participants, who completed the course between 2014 and 2017, illustrated how ASLS® training significantly improved knowledge of stroke diagnosis and management. Notably, pre to post-course knowledge assessment scores in these participants increased from 64% to 89% ($p<0.001$).

ASLS®e-Learning course: In 2009, in conjunction with the National Health Service (NHS) and the British Stroke Association, several ASLS®courses led by paramedics were conducted in the UK. The original intent was to begin a UK-wide implementation of the face-to-face training course; however, due to budget constraints, the project was halted. Nevertheless, there continued to be a very strong demand for ASLS® training from UK paramedics, and this led to an ASLS partnership with Solutions Training & Advisory Ltd and the development of an e-Learning course focused on EMS training for stroke. This course, through partnership with ANGELS, is now available to bring stroke education and training to on-line participants throughout Europe and beyond.

Professor Motola summarised the main components of the e-Learning course; it includes: epidemiology and pathophysiology of stroke; the rationale for urgent care for stroke patients; CT scans as an aid to diagnosis, and the "7 Ds" in the chain of survival and recovery for stroke: i.e. Detection, Dispatch, Delivery, Door, Data, Decision, and Drug.

Next steps: The UK ASLS® e-Learning course content will now be translated into 13 languages and will be added to the Angels Academy to disseminate this critically important training more widely. This training is specifically designed to improve the detection, management, and triage of acute stroke with the ultimate goal of enabling more stroke patients to receive lifesaving and disability-reducing treatment and interventions such as i.v. thrombolysis and mechanical thrombectomy.

ANGELS outside Europe: a success story from Vietnam. Dr Nguyen Huy Thang, Ho Chi Minh City.

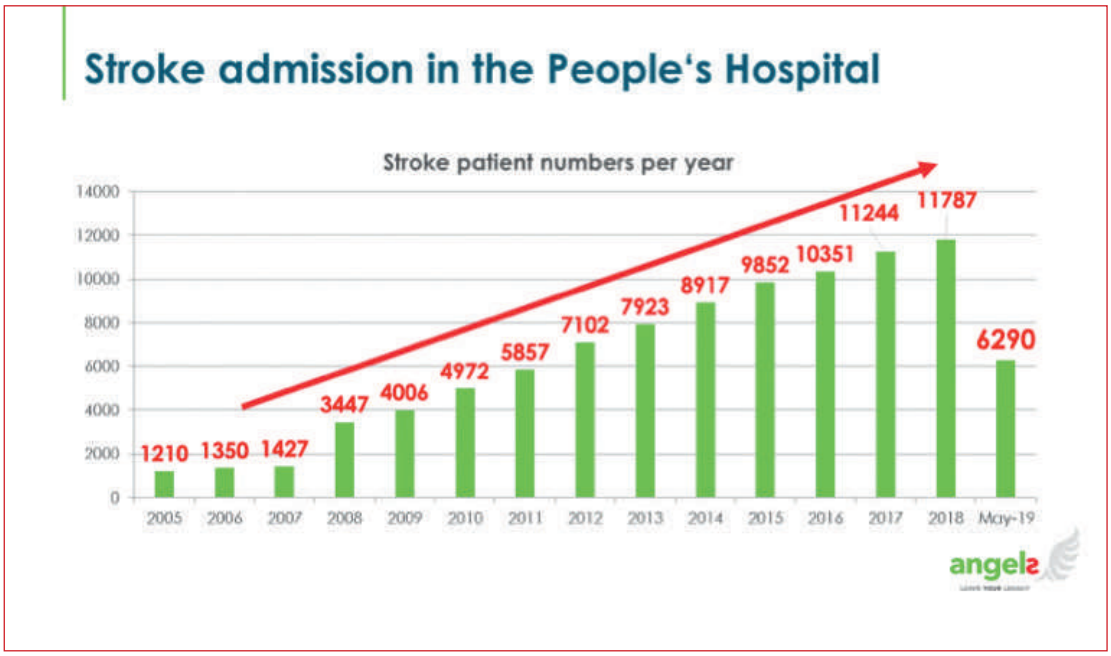
Background: The ANGELS initiative is not just active in Europe; significant inroads to increase the availability and quality of acute stroke care are being made in countries outside Europe. There have been some outstanding recent achievements. For example, hospitals in Mexico are achieving door-to-treatment times of less than 30 minutes. In Columbia, there are now 34 hospital sites that are contributing data from stroke patients to the RES-Q stoke registry, and hospitals initiating and improving their stroke care are being recognised with WSO-ANGELS awards. Progress continues in the Middle East and Africa. In Algeria there were no stroke units at all only two years ago. Recently, however, the Algerian government has endorsed 17 hospitals to take part in the ANGELS initiative and set up stroke treatment services. ANGELS are now active in 2,700 hospitals and 95 countries. Vietnam is a remarkable success story, and an inspiring example of building and improving stroke services from a low base with limited resources.

Vietnam: a success story

The stroke burden in Vietnam: Dr Thang outlined the stroke burden and available expenditure for medical services in Vietnam. With a population of 96 million, around 6% of Vietnam's 2016 economy of 202.6 US dollars (USD) was allocated to healthcare. This translates to 126 USD per person per year. In 1990, the most common cause of death was lower respiratory infections (11.3%) with stroke in second place (6.6%). In 2010, stroke became the leading cause of death (11.2%) in Vietnam and it still is. Deaths due to stroke have continued to increase, and the most recent Ministry of Health statistics list stroke as the most common cause of death in men (18%) and women (23%).

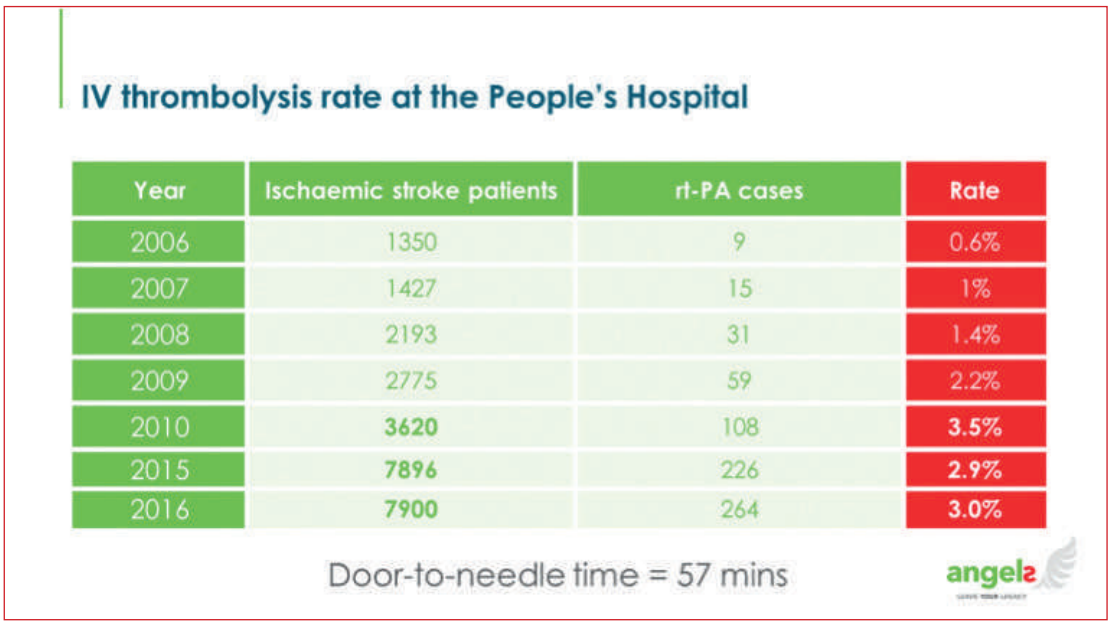
Progress in stroke care in Vietnam: Prior to 2006, stroke patients were hospitalised in general neurology wards. Separation began in 2006 with separate stroke and general neurology wards, and the formation of the first stroke unit in Dr Thang's People's 115 hospital. This centre now has 140 stroke beds and a team of 16 neurologists and 52 nurses and five physical therapists. The number of stroke patients admitted to the People's Hospital has increased ◄ year on year. In 2006 1,350 stroke patients were admitted, but by 2018, admissions had increased to almost 12,000. These statistics are illustrated in the histogram below.

Dr Thang stated that traffic congestion was a big problem in Ho Chi Minh city. This has a significant impact on patient hospitalisation, particularly since over 90% of stroke patients arrive by public transport without paramedic support.



Dr Thang reviewed the thrombolysis rates that were achieved from start-up of the stroke centre in 2006 to 2016. These statistics are shown in the following histogram.

ANGELS was launched in Vietnam in March 2017. As a result of ANGELS activities including stroke team and nurse training, and stroke recognition public awareness campaigns,



IV thrombolysis rate at the People's Hospital

Year	Ischaemic stroke patients	rt-PA cases	Rate
2006	1350	9	0.6%
2007	1427	15	1%
2008	2193	31	1.4%
2009	2775	59	2.2%
2010	**3620**	108	**3.5%**
2015	**7896**	226	**2.9%**
2016	**7900**	264	**3.0%**

Door-to-needle time = 57 mins

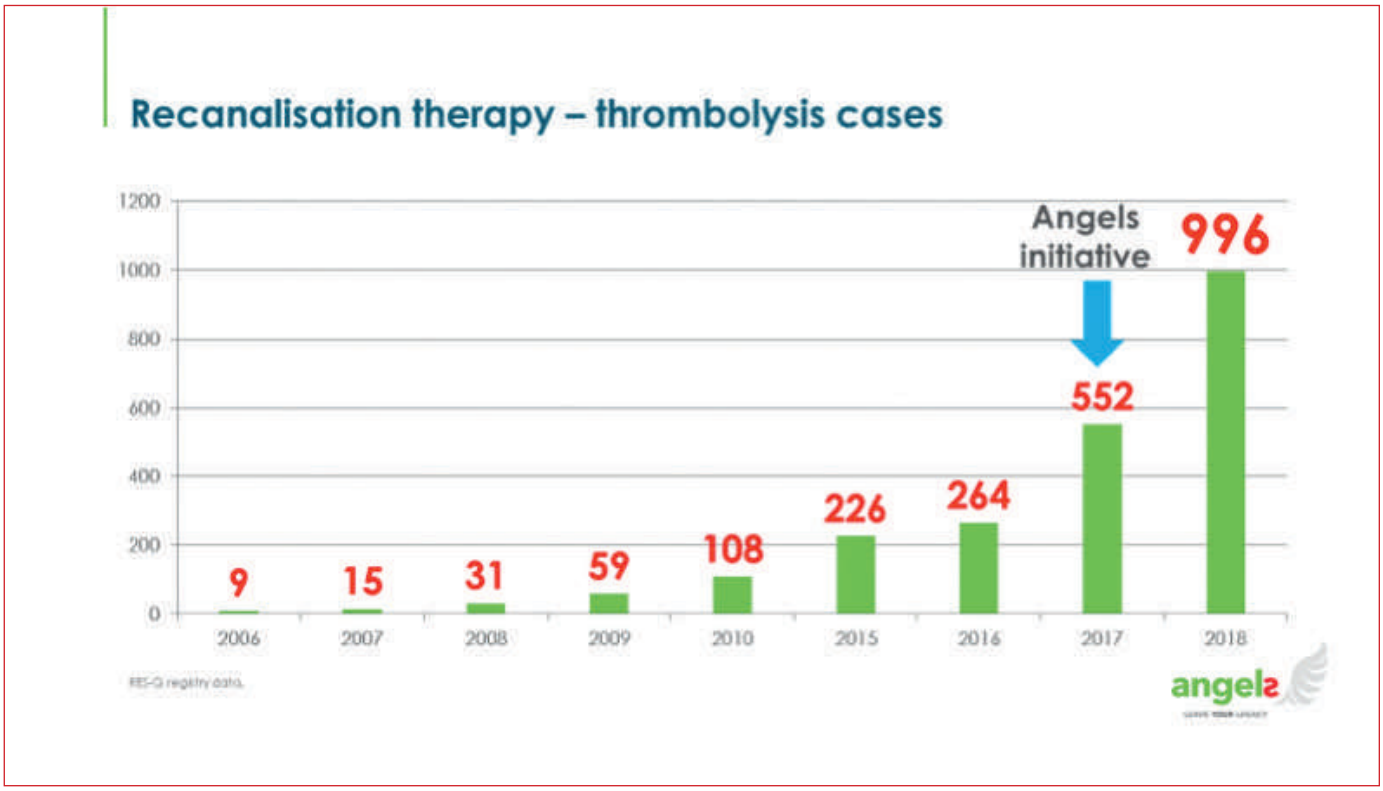
angels

key changes in stroke care were adopted. These included: introduction of localised protocols and check lists; introduction of i.v. thrombolysis in the CT hospital suite using the ANGELS stroke bag; more point-of-care testing to reduce DTT time; introduction of quality monitoring records regularly reviewed at stroke team meetings, and contributing patient data to the RES-Q stroke registry. EMS training, especially rapid stroke recognition using FAST (facial weakness, arm weakness, speech problems and time) assessments was provided as a priority. Stroke maps for EMS indicating the most appropriate hospital to transfer the patient to were introduced.

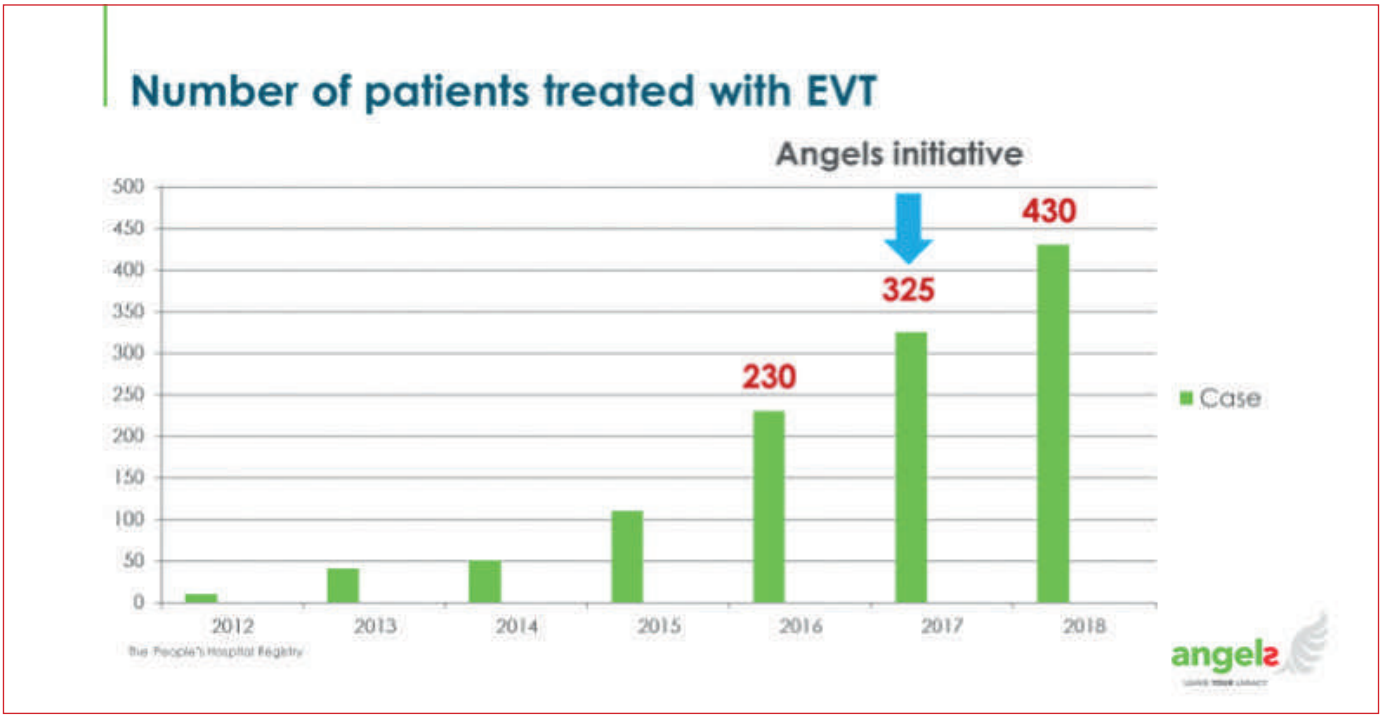
Protocols for emergency nurses have been standardised. Nurses need to recognise the arrival of a stroke patient and ensure they are rapidly transferred to the CT suite. A target of less than 25 minutes for door to CT scan time has been set. Check lists for stroke physicians have also been made available, and the ANGELS stroke bag has been provided to stroke centres around the country so that patients can be treated in the CT suite without a further transfer within the hospital.

Registry of stroke care (RES-Q) experience: Dr Thang gave a summary of stroke patients hospitalised in The People's Hospital during 2018. Of the 8,478 patients received, the vast majority received care in the stroke unit; only 0.44% patients with severe intracranial haemorrhage complications were treated in ICU. Most patients presented with ischaemic stroke (80.59%), intracerebral haemorrhage was evident in 18.53%, and 0.88% of patients had a subarachnoid haemorrhage. More patients were male (53%) than female (47%). Over 90% of patients underwent National Institute of Health Stroke Scale (NIHSS) assessments and the median score was 7. Time from onset of symptoms to hospital arrival was over six hours in 75.3% of patients, with 5.3% hospitalised within 4.5-6 hours, and 19.4% hospitalised within a 4.5-hour window. Dr Thang added that a significant proportion of his stroke patients come from outlying rural areas with an associate delay in transferring these patients.

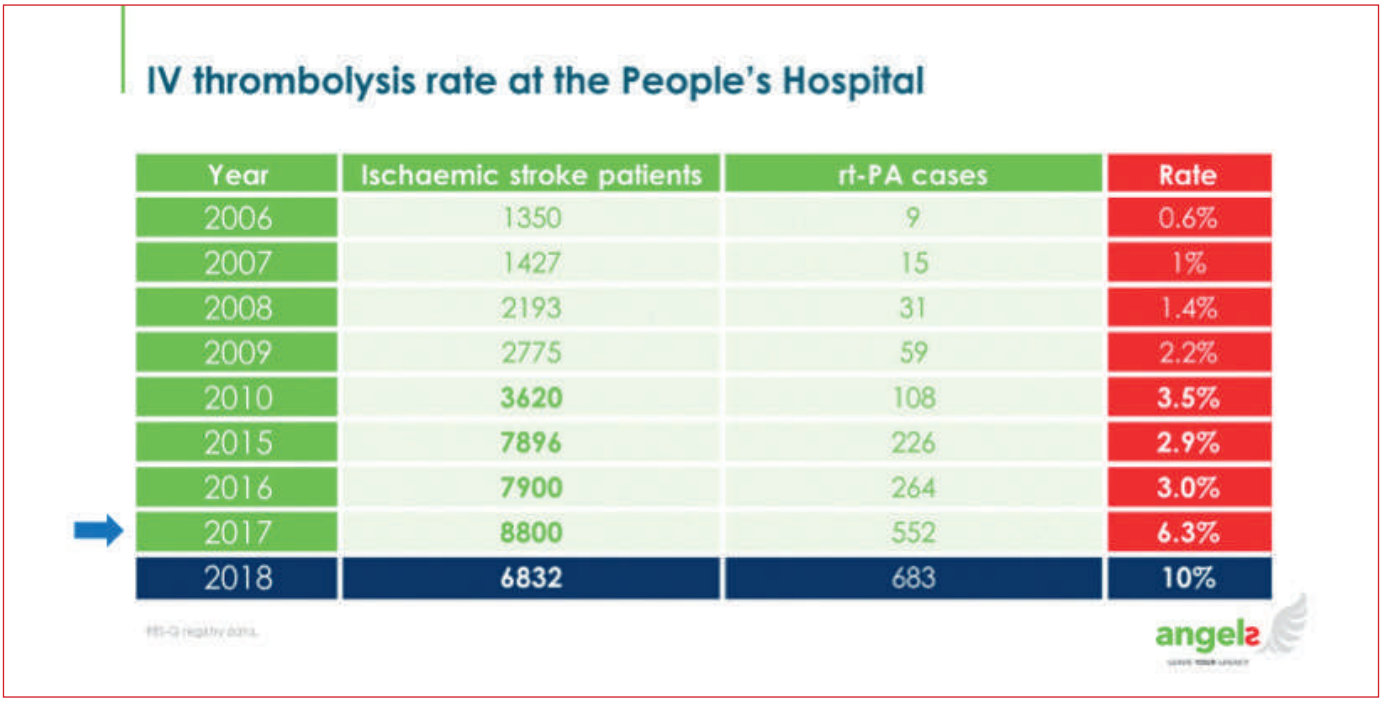
A CT or MRI scan was performed in 99% of patients; of these, 95% patients received their CT scan within an hour of hospitalisation. An 11% recanalisation rate following treatment interventions was recorded; of these, 6.13% of patients were recanalized with i.v. thrombolysis, 3.83% with a combination of i.v. thrombolysis and mechanical thrombectomy, and 1.08 with thrombectomy alone. The impact of the ANGELS initiative (with standardised protocols and improved DTN times) on the number of recanalisations achieved with i.v. thrombolysis, from 264 in 2016, to 996 in 2018, is illustrated in the following histogram.



A similar impact of the ANGELS initiative on the number of mechanical thrombectomy interventions is also evident.



The biggest impact of the ANGELS initiative can be seen in the increased i.v. thrombolysis rates recorded at The People's Hospital. Collaboration with ANGELS led to a doubling of the thrombolysis rate from3% in 2016, to 6.3% in 2017, and is now in the order of around 11%.



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2016	7900	264	3.0%
2017	8800	552	6.3%
2018	6832	683	10%

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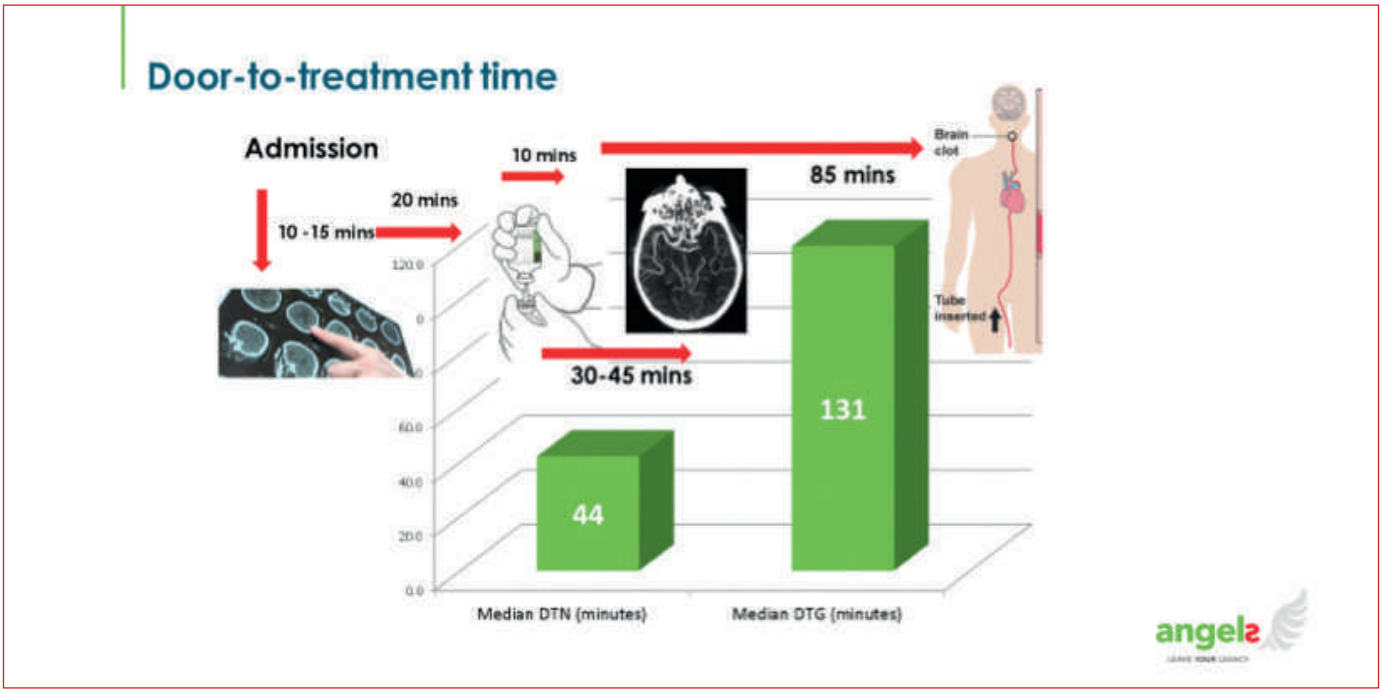
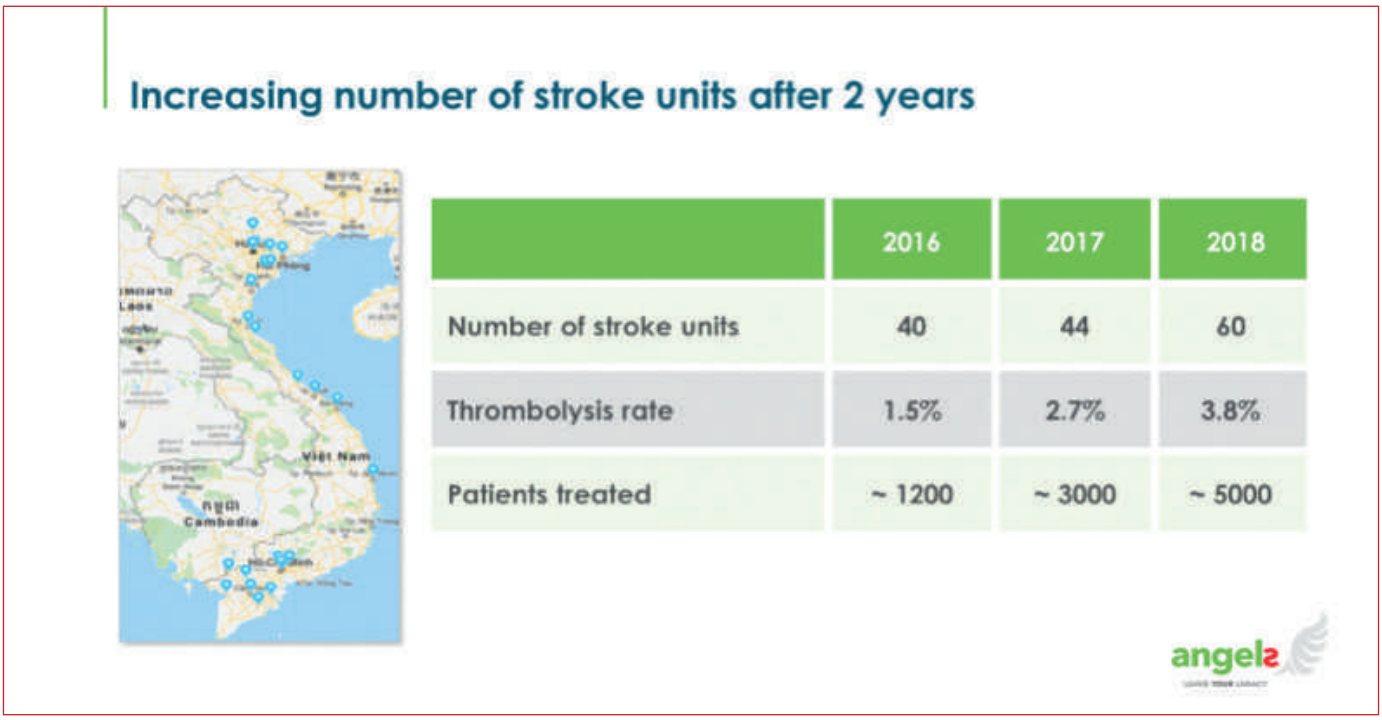
DTN time has improved since ANGELS collaboration began; previously it was 57 minutes, but the hospital now has a median DTN of 44 minutes. Median Door to Groin (DTG) time is currently 131 minutes. Dr Thang explained that provision of i.v. thrombolysis is government funded in Vietnam, but the cost of mechanical thrombectomy is only

50% funded, and arrangements for the patient payment (50%) have to be factored into the overall work-flow timings. These are illustrated in the figure below.



The median hospital stay for stroke patients at The People's hospital is four days, and at discharge, over half of patients (53%) can walk unassisted. Most patients are discharged to their home (94%) with most of these patients on anticoagulation therapy (67%). Of the patients discharged with known atrial fibrillation (AF), antithrombotic therapy is provided for 94%. Since the onset of ANGELS collaborations in Vietnam, the number of stroke units across the country, the overall thrombolysis rate, and the number of acute stroke patients has increased. These increases are illustrated in the following tabular summary.



	2016	2017	2018
Number of stroke units	40	44	60
Thrombolysis rate	1.5%	2.7%	3.8%
Patients treated	~ 1200	~ 3000	~ 5000

Dr Thang concluded that stroke care in Vietnam has significantly improved as a result of collaboration with ANGELS. Patient data continue to be included in the RES-Q registry and the quantity of available data is expected to increase as more stroke centres are established in Vietnam. The availability of RES-Q data will give a more informed ongoing picture of the quality of acute stroke care and its impact on the mortality and morbidity associated with stroke in Vietnam.

Conclusions

The ANGELS initiative over the last three years has made, and continues to make, a highly significant positive impact at every stage in the acute stroke care pathway, on a worldwide basis. As a result of ANGELS activities, over 2,700 hospitals have now achieved stroke-ready status, and faster hospital transfers and intra-hospital work-flow processes have been widely initiated. These improvements have been achieved via ANGELS-led effective EMS, stroke physician, and nurse training initiatives. Additionally, increased use of standardised treatment protocols, based on international best practice, and the introduction of quality monitoring has led to increased patient treatment and outcome data becoming available for inclusion in stroke registries. These data provide the basis for objective performance monitoring within individual hospitals, between hospitals, and across regions and countries. Improved performance at all levels in the stroke care pathway is recognised and encouraged by the ESO- and WHO-ANGELS awards. As a result of ANGELS interventions, inter-hospital communication is improving and helping to foster stronger regional and country-wide hospital stroke networks. Consequently, more patients are being diagnosed with stroke, more are being selected for thrombolysis and endovascular treatment, more patients are being successfully recanalised, more lives are being saved, and the burden of stroke morbidity is reducing as more hospitals achieve stroke-ready capabilities.

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