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Setting up a stroke team algorithm and conducting simulation-based training in the emergency department - a practical guide

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Abstract:	Time is of the essence when caring for an acute stroke patient. The ultimate goal is to restore blood flow to the ischemic brain. This can be either achieved by thrombolysis with recombinant tissue plasminogen activator (rt-PA), the standard therapy for stroke patients who present within the first hours of symptom onset without contraindications or by an endovascular approach if a proximal brain vessel occlusion is detected. As the efficacy of both therapies declines over time, every minute saved along the way will improve the patient's outcome. This critical situation requires thorough work and precise communication with the patient, the family and colleagues from different professions to acquire all relevant information and reach the right decision while carefully monitoring the patient. This is a high fidelity situation. In non-medical high-fidelity environments such as aviation, crew resource management (CRM) is used to enhance safety and team efficiency. This guide shows how we established a stroke team algorithm, which is well transferable to other hospital settings, and how we perform regular simulation-based trainings. It requires determination and endurance to maintain these time-consuming simulation trainings on a regular basis over the course of time. However, the resulting improvement of team spirit and excellent door-to-needle times will benefit both the patients and the work atmosphere in any hospital.

	A dedicated Stroke Team of 7 persons who are notified 24/7 by a collective call via speed dial and run a binding algorithm that takes approximately 20 minutes was established. To train everybody involved in this algorithm, a simulation-based team training for all new stroke team members was conceived and conducted at monthly intervals. This led to a relevant and sustained reduction of the mean door to needle time to 25 minutes and enhanced the feeling of stroke readiness especially in junior doctors and nurses.
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TITLE:
Setting up a stroke team algorithm and conducting simulation-based training in the emergency department – a practical guide

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SHORT ABSTRACT:
Every minute counts in acute stroke care. This guide shows how to establish a stroke team algorithm and enhance its performance with regular simulation training. The principles of crew resource management facilitate a straight workflow, reduce door to needle times and increase staff satisfaction.

LONG ABSTRACT:
Time is of the essence when caring for an acute stroke patient. The ultimate goal is to restore blood flow to the ischemic brain. This can be either achieved by thrombolysis with recombinant tissue plasminogen activator (rt-PA), the standard therapy for stroke patients who present within the first hours of symptom onset without contraindications, or by an endovascular approach if a proximal brain vessel occlusion is detected. As the efficacy of both therapies declines over time, every minute saved along the way will improve the patient's outcome.

This critical situation requires thorough work and precise communication with the patient, the family and colleagues from different professions to acquire all relevant information and reach the right decision while carefully monitoring the patient. This is a high fidelity situation. In non-medical high-fidelity environments such as aviation, crew resource management (CRM) is used to enhance safety and team efficiency.

This guide shows how a stroke team algorithm, which is transferable to other hospital settings, was established and how regular simulation-based trainings were performed. It requires determination and endurance to maintain these time-consuming simulation trainings on a regular basis over the course of time. However, the resulting improvement of team spirit and excellent door-to-needle times will benefit both the patients and the work atmosphere in any hospital.

A dedicated Stroke Team of 7 persons who are notified 24/7 by a collective call via speed dial and run a binding algorithm that takes approximately 20 minutes was established. To train everybody involved in this algorithm, a simulation-based team training for all new stroke team members was conceived and conducted at monthly intervals. This led to a relevant and sustained reduction of the mean door to needle time to 25 minutes and enhanced the feeling of stroke readiness especially in junior doctors and nurses.

INTRODUCTION:
The efficacy of thrombolysis with rt-PA for acute ischemic stroke is highly time-dependent and decreases over time even in the therapeutic time window of 4.5 hours[1]. The same has been shown for endovascular stroke therapy[2]. The additional mechanical recanalization after thrombolysis has been shown to be highly effective in improving outcomes of patients with severe stroke due to large vessel occlusion (LVO)[3]. This new therapy adds to the complexity and

interdisciplinarity of acute stroke care since endovascular therapies require a neurointerventionalist, an anesthetist or neurointensivist and in many cases even the acute onward referral of the patient to a specialized center.

Therefore, concepts are needed to minimize the time to treatment without putting patient safety at risk. Since acute stroke care is delivered by interdisciplinary teams, a standardized algorithm and simulation-based training of technical and non-technical skills appear to be a straightforward approach. In this context not only “time is brain” but also “team is brain” since precious minutes and safety-relevant information can be lost by inefficient communication among team members. In non-medical high-fidelity situations such as aviation, a concept called Crew Resource Management (CRM) has proven to be highly effective[4].

A large share of fatal errors is not due to a lack of knowledge or technical skills, but to deficits in communication, interaction and decision-making. CRM emphasizes the importance of “non-technical skills” and defines them as cognitive, social and personal resources that complement technical skills. The six key domains comprise clear communication, teamwork, situation awareness, decision-making, leadership and the management of stress[5].

This concept has already been successfully implemented in professional cardiovascular life support[6]. A binding algorithm, a basic education in CRM for all stroke team members and regular simulation-based trainings for all new members of the high-fidelity stroke team offer ways to improve acute stroke care.

A dedicated stroke team of 7 persons who are notified by a collective call via speed dial and have precise tasks within a defined stroke algorithm was established to treat patients within the therapeutic time window. The stroke team consists of 7 mandatory team members that are summoned to each stroke alarm:

1 resident in neurology from the stroke unit (SU)
1 resident in neurology from the emergency department (ED)
1 nurse from the ED
1 laboratory technician
1 resident specializing in neuroradiology
1 radiology technician
1 specialist in neurology (senior neurologist of the stroke unit)

Thus, a simulation-based stroke team training was conceived, which is conducted at monthly intervals for all new stroke team members and as a refresher for permanent staff. The simulation-based training transports the values of CRM and emphasizes the importance of non-technical skills in an interdisciplinary multiprofessional team. To monitor the effects of this stroke team intervention consisting of the algorithm and the regular training, door to needle times, thrombolysis-associated complications and staff satisfaction and perceived safety in the emergency room are recorded continuously.

PROTOCOL:

1. **Prenotification of the emergency department (ED)**

1.1. After the ED nurse hears an alarm, go to the computer screen immediately after hearing the alarm.

1.2. Check the information above the incoming patient via the online platform (e.g., IVENA Ehealth)[7]. Find that the system announces a 66-year-old female patient with the tentative diagnosis of a stroke within the time window (stroke <6 h) with the estimated time of arrival.

1.3. Pre-notify the resident of the SU via phone call.

1.4. As the SU resident hears the mobile phone ringing, have the SU resident take the phone call. Have the SU resident go to the ED at the estimated time of arrival.

2. **Patient arrives in the ED**

2.1. Bring the patient to the emergency department via paramedics. Have paramedics enter the ED with the patient on the stretcher and report to the stroke nurse and SU resident.

2.2. SU resident: Perform a first initial check including the FAST-Test[8] (F: facial droop, A: arm weakness, S: speech difficulties, T: exact time of symptom onset or time last seen well). Ask the patient or the paramedics about the intake of blood thinners. Find out about the characteristics and evolution of the symptoms, in order to exclude very obvious stroke mimics or patients that present beyond the therapeutic time window or have overt contraindications to thrombolysis. If the patient or the paramedics cannot answer these questions, contact relatives if available.

Note: The initial check reveals that the patient is a thrombolysis candidate.

2.3. ED nurse: Trigger the stroke team alert by a speed dial collective call, which simultaneously informs all members of the stroke team via their institutional mobile phones. Enter the insurance data of the patient into the hospital information system and perform the registration procedure. Check whether the patient has been treated at the hospital before and print out the latest discharge letter and laboratory values from the electronic hospital information and hand them to the SU resident.

2.4. Have all Stroke Team members answer their phones to hear an automatic voice message saying “stroke within time window”. Have all Stroke Team members immediately go to their workplaces as defined by the algorithm: ED resident, SU resident and senior neurologist meet at the emergency department, laboratory technician goes to the laboratory, radiology resident and technician meet at the CT scanner.

3. **Rapid blood sampling and clinical examination**

3.1. ED resident: Obtain an intravenous access and perform blood sampling, either through an adaptor to the venous access or with a butterfly cannula, for coagulation parameters INR

(prothrombin time in international normalized ratio), activated prothrombin time (aPTT) and thrombin time (TT) (3 mL, citrate plasma), hematology (1.6 mL, EDTA plasma), and clinical chemistry (7.5 mL, lithium heparinate plasma)[9].

3.2. SU resident: Inform the patient that he is examined for the suspicion of an acute stroke. Take a brief history including the questions on symptom onset, symptom evolution, prior disabilities, current medication intake (especially blood thinners), allergies and preexisting medical conditions. Ask whether the patient has had prior radiologic exams with contrast agents. When the patient cannot answer these questions, ask the relatives when available.

3.2.1. Perform a focused neurological exam on the basis of the NIH stroke scale (NIHSS)[10]. Free online-trainings of the NIHSS are available in several languages[11].

3.3. Senior neurologist: Review the patient's case and decide upon the appropriate imaging modality for the patient depending on the presenting symptoms and the time window. Preferentially consider computed tomography (CT) for patients with unequivocal stroke symptoms and a stroke onset clearly within the therapeutic time window because of speed and easy access. Preferentially consider magnetic resonance imaging (MRI) for patients beyond the therapeutic time window or with unknown onset of stroke symptoms or patients with an atypical clinical presentation.

3.4. Mark the blood samples as "vital" with pink coding caps and bring them to the laboratory. Reserve one centrifuge for stroke team samples. The complete analysis that is performed on an automated hemostasis analyzer, an automated hematology system, and an automated analyzer for clinical chemistry requires 15-20 minutes.

3.5. Bring the patient to the CT scanner. The patient is still lying on the ambulance stretcher and is accompanied by the paramedics, the residents from the ED, the SU, and the senior neurologist from the SU.

3.6. At the CT scanner, meet the resident specializing in neuroradiology and the radiology technician.

4. **Cranial CT scan and acute therapy**

4.1. Transfer the patient to the CT and connect a line with contrast agent (e.g. Ultravist-300) for the CT angiography to the venous access via Luer lock connection.

4.2. ED nurse: Arrive at the CT scanner and bring along a stretcher with a thrombolysis kit (containing 10 mg rt-PA + aqua ad injectabilia, blood pressure medication suitable for intravenous (i.v.) application [e.g. urapidile], i.v. anti-vomiting medication [e.g. granisetron], i.v. sedative [e.g. lorazepam], 10 mL syringes and 0.9% NaCl solution to flush the venous access), monitoring equipment and portable oxygen.

4.3. Radiology technician: Perform a cranial CT (to exclude intracranial hemorrhage) and CT

angiography (to screen for LVO). Stroke-CT includes unenhanced CT with a slice thickness of 5 mm and CT angiography depicting brain supplying cervical and intracranial arteries.

4.4. Neuroradiologist: Directly review the cranial CT. Unenhanced CT must exclude intracranial hemorrhage and intracranial tumor. For mechanical thrombectomy, CT angiography must prove proximal vessel occlusion, and infarct core on unenhanced CT should not be larger than Alberta Stroke Program Early CT score (ASPECTS)[12] of 5.

4.5. Senior neurologist: Voice the decision to treat the patient with i.v. rt-PA.

4.5.1. If the patient can reliably exclude the intake of blood thinners and prior problems with hemostasis, do not await coagulation parameters and administer the rt-PA bolus before the acquisition of the CT angiography.

4.5.2. In case of an aphasic patient or an active oral anticoagulant therapy, await the laboratory values (15-20 min) and perform the CT angiography first.

4.6. ED nurse: Prepare the appropriate dose for the rt-PA bolus and call the colleagues in the ED to prepare the remaining 90% of the dose for infusion via a pump over one hour. Rt-PA is given at a dose of 0.9 mg/kg body weight. Have a table with appropriate doses for all body weights between 40 kg and > 100 kg in discrete steps of 5 kg ready to prevent calculation errors. Patients weighing 100 kg and more should receive a total dose of 90 mg.

4.7. SU resident: Administer the bolus of rt-PA (10% of the total dose) intravenously over one minute directly on the CT table.

4.8. Stroke team: Transfer the patient to the ED stretcher.

Note: The paramedics leave the scene.

4.9. Laboratory technician: Call the SU resident and disclose the coagulation parameters such as international normalized ratio (INR), thrombocytes, thrombin time (TT) and activated prothrombin time (aPTT).

4.10. Neuroradiologist and senior neurologist of the SU: Examine the CT angiography for LVO. If LVO is present, directly notify the neuroradiologist, and the department of anesthesiology of the planned intervention.

4.11. Stroke team: Transfer the patient back to the ED or directly to the angiography suite in case of LVO.

4.12. Administer the remaining 90% of the rt-PA in the ED or in the angiography suite. Monitor blood pressure, heart rate, oxygen saturation and neurological function on the NIHSS every 15 minutes and treat severely elevated blood pressure with i.v. medication (e.g. urapidil)

to a target value below 185/90 mmHg.

4.13. SU resident: Go to a computer and check the remaining laboratory parameters in the hospital information system.

5. **Simulation-based STROKE TEAM Training**

5.1. Stroke team trainers (two): Invite all new staff members that are involved in the care of acute stroke patients to the stroke team training, which is offered once a month.

5.2. Before the Training starts, prepare the remote-controlled manikin. Connect it to a real monitor, fill it with artificial blood (sugar-free red tea for example). Place the manikin on a stretcher with a head deviation to the left and a plegic position of the right arm and leg.

6. **The theoretical course**

6.1. Sit a group of 4-10 staff members and medical students around a table. Introduce everyone, describe their professional background and share their experience in stroke care as well as the expectations towards the training.

6.2. Stroke team trainer 1: Give an oral presentation supported by illustrative slides, which covers the most frequent stroke symptoms and their detection by the FAST[8] score, the basic principles of stroke pathophysiology and the current treatment modalities (i.v. thrombolysis and endovascular thrombectomy) as well as the stroke team algorithm of the hospital.

6.3. Teach how to do a concise NIHSS exam and let the group practice on each other.

Note: At the end of the theoretical part which takes approximately 60 minutes, and in which the participants should understand the importance of the “time factor” and the significance of efficient teamwork, go to the ED.

7. **The hands-on stroke team simulation**

7.1. Stroke Team trainer 2: Allocate the participants their roles in the stroke team algorithm and advise them to treat the manikin as if it were a real patient.

7.2. Tell the participants that a stroke patient is awaited. Leave them enough time to clarify a few questions and get together as a team.

7.3. Bring the manikin into the ED, acting as a paramedic.

7.4. Report that the patient is a 72-year-old female who collapsed during lunch and showed a loss of speech and a right-sided hemiparesis. State that the exact time of symptom onset is unknown, but there is the telephone number of the patient’s daughter. Show the containers of aspirin and a beta blocker collected at the patient’s home.

7.5. Stroke team: Perform the stroke team algorithm on the manikin while stroke team

trainer 1 notes the procedural times and positive and negative elements of the performance.

7.6. Stroke Unit resident: Take the history from the paramedic and the daughter via the telephone and examine the NIHSS. Ask for the time of symptom onset, the intake of additional blood thinners, the preexisting medical conditions, especially recent operations, preceding hemorrhagic events and malignant diseases. Delegate some of the tasks (e.g. taking the history from the daughter by phone) to the team.

Note: The phone call reaches stroke team trainer 1.

7.7. Stroke team trainer 1: Report that the symptoms began abruptly an hour ago, that her mother certainly did not take additional blood thinners ("… neither warfarin nor any of the new ones that her doctor proposed because her husband died from a brain bleeding when taking warfarin and she would not have that."), has recently been short of breath when climbing the stairs but is otherwise healthy except for a mild arterial hypertension.

7.8. ED resident: Establish venous access, take a blood sample and cap it as "vital", ensure that the blood sample is brought to the laboratory and order the imaging in the hospital information system.

7.9. Stroke team trainer 1: Display a systolic blood pressure of 210 mmHg.

7.10. Stroke team: Decide if and how to treat this blood pressure, which is a contraindication to thrombolysis, communicate with the nurse and administer the right dose of a suitable i.v. drug.

7.11. Transfer the patient to the CT scanner.

7.12. Radiology technician: Perform a head CT of the manikin.

7.13. Stroke team trainer 1: Confront the neuroradiologist with a printed CT scan of a stroke patient brain without intracranial hemorrhage, without LVO and without early infarct signs.

7.14. Neuroradiologist: Analyze the scan and convey the findings clearly to the residents of the stroke unit and the ED.

7.15. Stroke team: Decide to treat the patient with thrombolysis and administer the bolus.

7.16. Stroke team trainers: Conduct a feedback session with discussion after the simulation.

7.16.1. Stroke team trainer 1: Name the door-to-needle time that was achieved during the training session which is usually between 20 and 30 minutes and lower than expected by the participants.

7.16.2. Stroke team trainer 2: Conduct two rounds of feedback to each individual team member. Start the first one with the questions “What was done well? What would you personally do the same way in your next stroke team operation?” followed by a second round with the question “What did not work so well? What would you personally do differently next time?” and conclude with a feedback round to the complete team: “What are the essential factors for a successful stroke team operation?”

REPRESENTATIVE RESULTS:

Effect on the door to needle times and thrombolysis rate

The implementation of the stroke team algorithm in 2012 accompanied by regular simulation-based stroke team trainings led to a relevant increase in the patients treated with a door-to-needle time below 30 minutes and below 60 minutes and to an increase in our thrombolysis rate.

[place figure 1 here – stroke team algorithm]

[place figure 2 here – door-to-needle time strata and thrombolysis rates from 2010 to 2015]

Rating of the course concept by the participants

The course was systematically evaluated by handing out questionnaires to all participants from June 2015 to January 2016 (n = 45; 16 physicians, 11 ED nurses and radiology technicians and 18 medical students). Participation in the stroke team training significantly increased the participant’s confidence to be able to safely treat acute stroke patients.

[place figure 3 here]

The learning format of a simulation-based stroke team training in general was rated highly positive by the majority of the participants (median 10 on a scale from 1-10, n=45). Also the relevance to daily practice (median 10) and the contents conveying CRM (median 9) were rated very positive. Especially the younger residents in neurology (work experience < 2 years) stated that the course increased their perception of patient safety and reduced fear of committing treatment errors.

Figure 1 Stroke team algorithm of the Frankfurt University Hospital.

The binding appointment of all staff members to the stroke team has been agreed upon by the directors of the departments of Neurology and Neuroradiology as well as the head of the university hospital central laboratory. The alarm is distributed by a collective call via speed dial.

Figure 2 Door to needle time-strata before and after the introduction of the stroke team.

The introduction of the composite stroke team intervention in October 2012 increased the share of patients treated with a door to needle time shorter than 30 minutes from 21.2% in the years 2010 – 2012 to 77% in the years from 2013 – 2015 and the share of patients treated with a door to needle time shorter than 60 minutes from 65.1 to 96.5%. Thrombolysis rate also increased by approximately 30% (data not shown). Based on data from Tahtali et al.[13]

Figure 3 Perceived ability to offer patient safety in acute stroke care.
Questionnaire assessment of all participants of the simulation-based stroke team training from June 2015 to January 2016 (n = 45; 16 physicians, 11 ED nurses and radiology technicians und 18 medical students) before and after the training session. Answers are given in% of all participants during this time.

DISCUSSION:
A binding stroke team algorithm and regular simulation-based stroke team trainings can lead to a long-term reduction of the door-to-needle time as the key benchmark process time for acute stroke treatment. Excellent examples of a set of measures that improve the acute stroke work flow, which also inspired our algorithm, have been described by the Helsinki group[14,15]. Another very innovative approach to shorten the time interval from symptom onset to thrombolysis are mobile stroke units such as the pioneering STEMO in Berlin, Germany[16,17] or the PHAST project from Cleveland, Ohio in the USA[18]. By contrast, the system presented here starts at the doorstep of the hospital and is easily transferable to other hospitals without specific infrastructural prerequisites. It relies on a fixed algorithm allowing parallel work of all team members with optimal efficacy organized by a binding definition of each member's role on the STROKE TEAM and the teaching of non-technical skills.

The principles of crew resource management (CRM) stem from aviation as a high-fidelity work area similar to emergency medicine[4,5]. Their application is yet in its infancy in the field of neurologic intensive care and stroke medicine, but their applicability to clinical medicine has been positively tested in anesthesiology[19] and surgery[20]. Recognizing errors early, communicating and correcting them have a tremendous effect on patient safety. Therefore it is important to create a sense of shared responsibility and flat hierarchical structures which allow open communication. Especially young staff members are often afraid to point out errors to more experienced colleagues. Elucidating the responsibility of each individual team member for the common treatment goal and practice of non-technical skills enhance every team member's authority to speak up. A recent behavioral study of medical student's attitudes in surgery showed that students, who were encouraged by the surgeon to speak up when recognizing mistakes were more likely to do so than students who were told to save questions for after the operation[21].

EDs are often staffed by young physicians and nurses who experience considerable stress while collecting their first pieces of work experience. Several studies have suggested that the incidence of depression in young residents is greater than in the general population[22] and an interview study with ED nurses has shown that a substantial proportion reported to experience intrusive memories of critical incidents in the emergency department[23]. Resilience factors include concordance about treatment goals and a feeling of personal accomplishment[24]. Both factors are strengthened by the interprofessional Stroke Team algorithm and training which value the contribution of each individual team member and improve team communication.

The critical factor in the process of establishing a stroke team is a thorough analysis of the

current acute stroke workflow and the factors that delay the door-to-treatment times. This should optimally be done jointly by neurologists, stroke nurses and neurointerventionalists and in case of a central interdisciplinary ED should also involve a key representative of the ED. It is helpful to record the newly designed algorithm in writing and have it signed by the directors of the respective departments. Technical simplifications of emergency communication such as telecommunication with the paramedics and a collective call via speed dial can also accelerate process times. The algorithm should be tailored to each hospital's conditions since rules and practices may vary between different countries and hospitals. Maybe not every hospital can provide 7 team members for a stroke algorithm. The algorithm, which is presented here, should be an example which can be modified with regard to the local institutional circumstances. Some tasks that are performed by physicians in our algorithm could be equally performed by other health care professionals depending on their education and training. For example, the i.v. catheterization and blood sampling could also be done by the paramedics on their way to the hospital or by the nurse of the ED.

Regular simulation training is an optimal vehicle to spread the knowledge of the new algorithm and to introduce new team members by means of experiential learning. We learned over time that it is best to keep the simulation simple and present a standard case to first time users of the algorithm to create a mental engram of an ideal acute stroke workup. We use a heart rhythm simulator which has been designed for advanced cardiac life support training without any neurological features. This manikin allows altering the heart rate and rhythm by remote control which simulates the need to monitor the patient while running the algorithm. We position the manikin with head deviation to the left and right sided paresis and compensate the lack of speech by mimicking an aphasic patient. Alternatively, a less costly and technically-sophisticated dummy or a patient actor could be used.

Concerning the feedback session, we found it most efficient to start on a positive note by naming the door-to-needle time that was achieved in the run. It usually lies clearly below 30 minutes which encourages the team of novices in view of their first independent shifts. After that, two rounds of individual feedback followed by a discussion of factors for successful team operations after the participants have just been immersed in high intensity teamwork have worked best in our setting. One key factor to the enduring effects of our new treatment algorithm is the thorough training and empowerment of the youngest stroke physicians in training and novice stroke nurses that has created a positive attitude towards acute stroke care. We think that this experiential learning under the directed attention of two experienced Stroke Team trainers is a very effective way to teach acute stroke care.

To some readers, a stroke team of seven may seem inefficient or just not feasible in terms of personnel demand. We want to emphasize that we report from a teaching hospital where the residents are usually not yet board certified. We make a point of training junior doctors as early as possible, within the first 6 months of their neurology residency, to become a member of the Stroke Team, so that every nurse and physician in the department can run the algorithm. This assures the maintenance of high standards 24/7 during the on-call hours as well. When training other hospitals with smaller stroke units, such as our cooperation partners in the regional

stroke network INVN Rhein-Main, we emphasize that the first 30 minutes which a stroke patient spends in the ED are the crucial time interval to achieve good outcome and the patient should be cared for as intensively as possible. From these hospitals, mostly regional stroke units mostly, we received the feedback that with some reorganization, even smaller departments can master a quite similar algorithm and benefit from the didactic effects of being involved in a team for junior personnel.

Even if the algorithm is not transferrable to an individual hospital in each detail and there may be ways to streamline and refine it, we believe that some key points, such as defining a binding algorithm, pointing out the factor time in acute stroke care and the importance of team work and non-technical skills to the entire staff as well as conducting a regular Stroke Team training can be transferred to any hospital with a little effort and will result in better acute stroke care and improved patient outcomes.

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The authors have no conflicts of interest.

REFERENCES
1. Emberson, J., et al. Stroke Thrombolysis Trialists' Collaborative Group. Effect of treatment delay, age, and stroke severity on the effects of intravenous thrombolysis with alteplase for acute ischaemic stroke: a meta-analysis of individual patient data from randomised trials. *Lancet*. **384** (9958), 1929 – 1935, doi: 10.1016/S0140-6736(14)60584-5 (2014).
2. Goyal, M., et al. HERMES collaborators. Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials. *Lancet*. **387** (10029), 1723 – 31, doi: 10.1016/S0140-6736(16)00163-X (2016).
3. Goyal, M., et al. SWIFT PRIME investigators. Analysis of Workflow and Time to Treatment and the Effects on Outcome in Endovascular Treatment of Acute Ischemic Stroke: Results from the SWIFT PRIME Randomized Controlled Trial. *Radiology*. **279** (3), 888 – 97, doi: 10.1148/radiol.2016160204 (2016).
4. Flin, R., Maran, N. Basic concepts for crew resource management and non-technical skills. *Best Pract Res Clin Anaesthesiol*. **29** (1), 27 – 39, doi: 10.1016/j.bpa.2015.02.002 (2015).
5. Flin, R., O'Connor, P., Crichton, M. Safety at the sharp end. A guide to non-technical skills. Farnham: Ashgate (2008).
6. American Heart Association. Adavanced Cardiovascular Life Support Provider Manual, ISBN 978-1-61669-010-6 (2011).
7. IVENA ehealth (Interdisziplinaerer Versorgungskapazitaeten-Nachweis/Interdisciplinary Announcement of Care Capacities). http://www.ivena.de/page.php?k1=main&k2=index. Accessed 17. July 2016.
8. Kothari, R.U., Pancioli, A., Liu, T., Brott, T., Broderick, J. Cincinnati Prehospital Stroke Scale: reproducibility and validity. *Ann Emerg Med*. **33** (4), 373 – 378 (1999).

9. National Institute of Health, www.ninds.nih.gov/doctors/NIH_Stroke_Scale.pdf Accessed 17 July 2016.
10. National Institute of Health, http://www.nihstrokescale.org/ Accessed 17 July 2016.
11. Jauch EC., et al. American Heart Association Stroke Council; Council on Cardiovascular Nursing; Council on Peripheral Vascular Disease; Council on Clinical Cardiology. Guidelines for the early management of patients with acute ischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. **44**, 870-947 (2013).
12. Pexman JH., et al. Use of the Alberta Stroke Program Early CT Score (ASPECTS) for assessing CT scans in patients with acute stroke. *AJNR Am J Neuroradiol*. **22**, 1534-1542 (2001).
13. Tahtali, D., et al. Crew resource management and simulator training in acute stroke therapy. *Nervenarzt*. Epub ahead of print, DOI: 10.1007/s00115-016-0162-5 (2016).
14. Meretoja, A., et al. Reducing in-hospital delay to 20 minutes in stroke thrombolysis. *Neurology*. **79** (4), 306 – 13, doi: 10.1212/WNL.0b013e31825d6011 (2012).
15. Meretoja, A., et al. Helsinki model cut stroke thrombolysis delays to 25 minutes in Melbourne in only 4 months. *Neurology*. **81** (12), 1071 – 1076. doi: 10.1212/WNL.0b013e3182a4a4d2 (2013).
16. Ebinger, M., et al. STEMO Consortium. Effect of the use of ambulance-based thrombolysis on time to thrombolysis in acute ischemic stroke: a randomized clinical trial. *JAMA*. **311** (16), 1622 – 1631, doi: 10.1001/jama.2014.2850 (2014).
17. Ebinger, M., et al. Prehospital thrombolysis: a manual from Berlin. *J Vis Exp*. **26** (81), e50534. doi: 10.3791/50534 (2013).
18. Itrat, A., et al. Cleveland Pre-Hospital Acute Stroke Treatment Group. Telemedicine in Prehospital Stroke Evaluation and Thrombolysis: Taking Stroke Treatment to the Doorstep. *JAMA Neurol*. **73**(2), 162 – 168, doi: 10.1001/jamaneurol.2015.3849 (2016).
19. Fletcher, G., Flin, R., McGeorge, P., Glavin, R., Maran, N., Patey, R. Anaesthetists' Non-Technical Skills (ANTS): evaluation of a behavioural marker system. *Br J Anaesth*. **90** (5), 580 – 588 (2012).
20. Youngson GG, Flin R. Patient safety in surgery: non-technical aspects of safe surgical performance. *Patient Saf Surg*. **4** (1), 4. doi: 10.1186/1754-9493-4-4 (2010).
21. Barzallo Salazar, M.J., et al. Influence of surgeon behavior on trainee willingness to speak up: a randomized controlled trial. *J Am Coll Surg*. **219** (5), 1001 – 7, doi: 10.1016/j.jamcollsurg.2014.07.933 (2014).
22. Mata, D.A., et al. Prevalence of Depression and Depressive Symptoms Among Resident Physicians: A Systematic Review and Meta-analysis. *JAMA*. **314** (22), 2373 – 2383. doi: 10.1001/jama.2015.15845 (2015).
23. Kleim, B., Bingisser, M.B., Westphal, M., Bingisser, R. Frozen moments: flashback memories of critical incidents in emergency personnel. *Brain Behav*. **5** (7), e00325. doi: 10.1002/brb3.325 (2015).
24. Rushton, C.H., Batcheller, J., Schroeder, K., Donohue, P. Burnout and Resilience Among Nurses Practicing in High-Intensity Settings. *Am J Crit Care*. **24** (5), 412 – 420. doi: 10.4037/ajcc2015291 (2015).

Figure 1

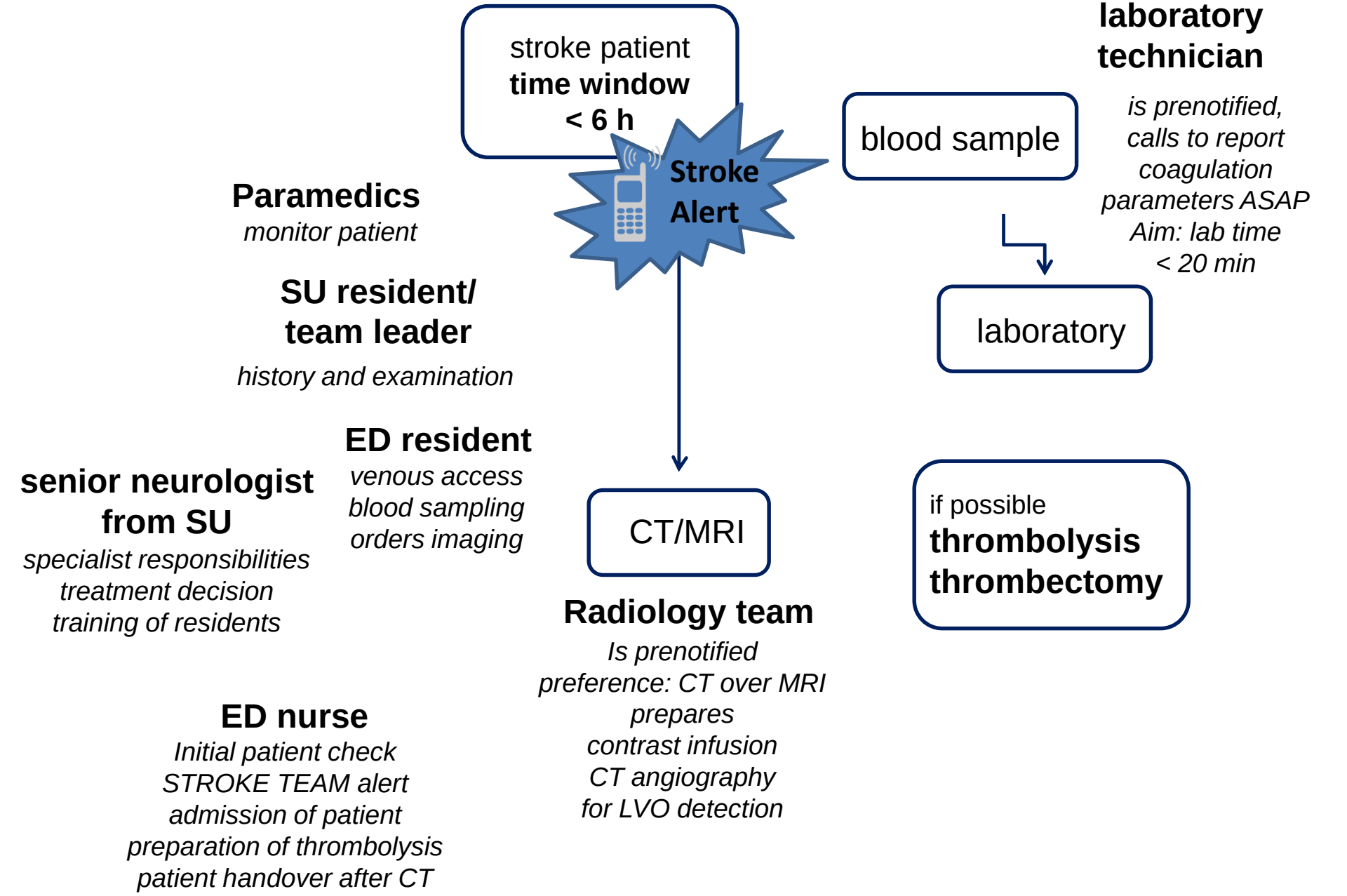

Figure 2

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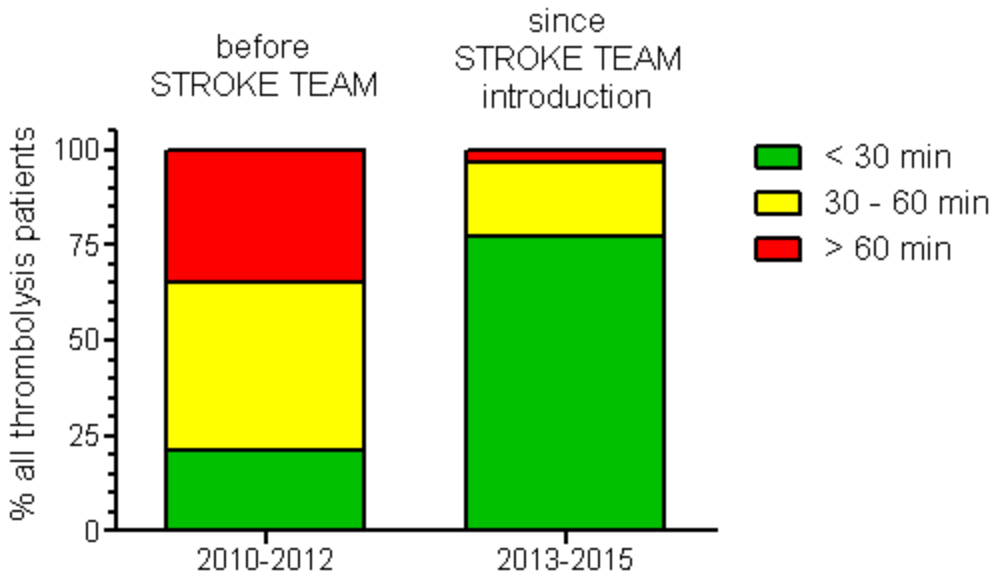
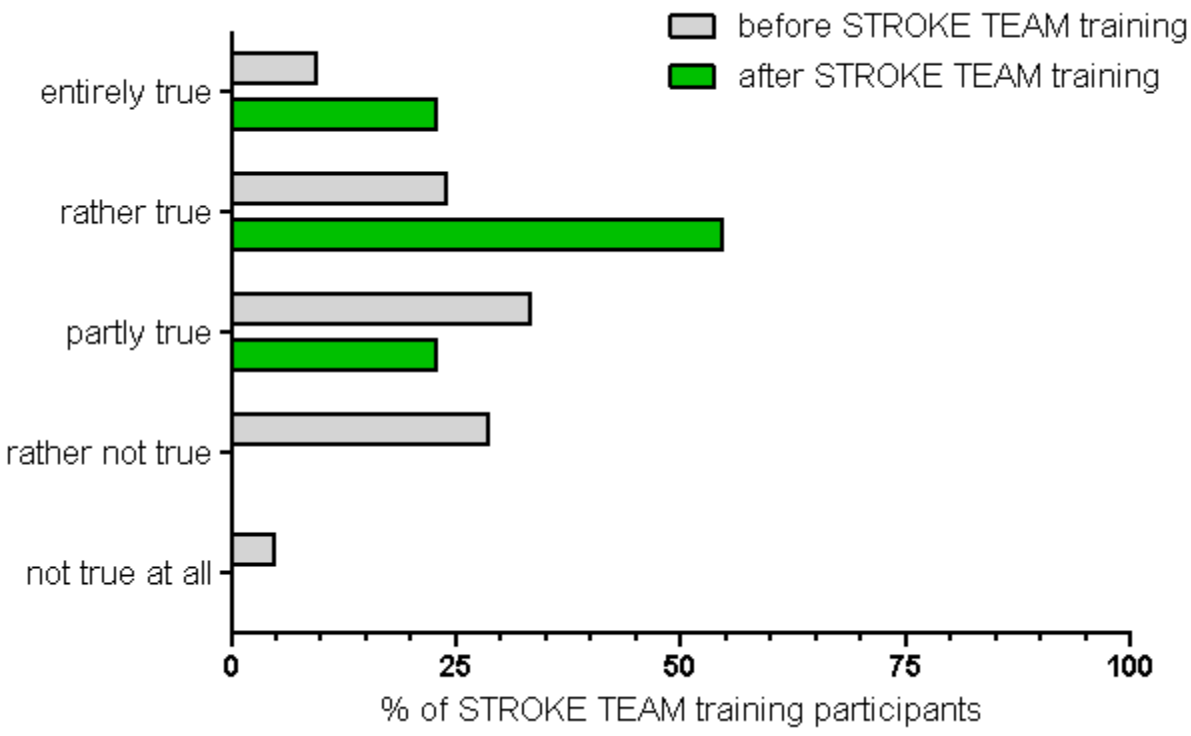


Figure_3



Excel Spreadsheet- Table of Materials/Equipment

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Name	Company	Catalog Numb
Drug		
Alteplase (rtPA)	Boehringer Ingelheim, Ingelheim am Rhei	
Urapidil 50 mg/10 ml	Takeda Pharma, Berlin, Germany	
Granisetron 3 mg/3 ml	Hameln Pharma, Hameln, Germany	
Lorazepam 2 mg/1 ml	Pfizer, Berlin, Germany	
Iopromid 300 mg/ml	Bayer Vital GmbH, Leverkusen, Germany	
Device		
S-Monovette citrate 3 ml	Sarstedt, Nürnbrecht, Germany	
S-Monovette EDTA 1.6 ml	Sarstedt, Nürnbrecht, Germany	
S-Monovette lithium heparinate 7.5 ml	Sarstedt, Nürnbrecht, Germany	
ACL Top 500	Instrumentation Laboratory, Kirchheim, G	
Sysmex XE 2100	Sysmex Corporation, Norderstedt, Germa	
Cobas 6000	Roche Diagnostics, Mannheim, Germany	
Resusci Anne Skillreporter	Laerdal, Stavanger, Norway	
Ingenuity 128	Philips, Hamburg, Germany	
MEDRAD Stellant	Bayer Radiology, Leverkusen Germany	
Universal 320 R	Hettich, Tuttlingen, Germany	
Perfusor fm	Braun, Melsungen, Germany	
Infinity Gamma	Dräger, Hamburg, Germany	
Ivena ehealth	mainis IT-Service GmbH, Offenbach, Gern	
Braun ThermoScan PRO 4000	Welch Allyn, Hechingen, Germany	

ɔer	Comments
in, Germany	Licensed drug, which has proven effectiveness for acute ischemic str
	Licensed drug, antihypertensive
	Licensed drug, antiemetic
	Licensed drug, sedative
	Licensed drug, non-ionic contrast agent for computed tomography
	to collect blood for coagulation assays
	to collect blood for hematology assays
	to collect blood for clinical chemistry assays
Germany	Automated hemostasis analyzer
ıny	Automated hematology analyzser
	Automated clinical chemistry analyzser
	remote-controlled manikin
	CT-scanner
	Contrast agent delivery system
	Centrifuge
	Infusion pump
	Monitor
nany	online prenotification platform
	ear thermometer

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Author(s): D. Tahtali, F. Bohmann, P. Rottek, H. Steinmetz, W. Pfeilschifter

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Dear Dr. Nguyen,

thank you for your help with our manuscript. We now resubmit “Setting up a stroke team algorithm and conducting simulation-based training in the emergency department – a practical guide” taking into account the reviewers suggestions.

Editorial comments:
We addressed your points 1-4 on language and formatting and performed another proofreading.

Concerning point 5, we think it would be best to film steps 1-4 of the protocol (our ED algorithm) with a patient-actor whom we will recruit and suggest to film short episodes of steps 6.1., 6.2. und 7.3., 7.8 und 7.11 of the simulation training. In step 7, the manikin (simulation puppet) should be filmed.

We added the information requested in point 6. Concerning step 4.9 of the protocol: yes, the coagulation parameters are from the bloodwork. We think that this will be clear to the viewers who are interested in the topic of this video.

Advice on difficult points and suggestions for trouble shooting requested in point 7 were already present in the 4th (on the setup of the algorithm) and the 5th (on the conduct of the simulation training) paragraph and shortly elaborated on again.

Reviewer #1:
Medical history prior to arrival: *The identity of the patient is not transmitted before he/she arrives at the hospital and there is no direct contact to the paramedics. On the other hand, transport times are short in our densely populated region with several stroke units. As soon as the patient arrives, we see whether he/she has been treated at our hospital before and if so, information on the medical history and the last laboratory findings are printed out by the ED nurse who does the administrative admission. We added this to the manuscript (step 2.3).*

Possibility to assign tasks differently to different professions or earlier/later in the

whole workflow. *This is an important point to make the algorithm more generalizable, which we mentioned in the discussion. As we had stated before, each hospital should adapt the algorithm to the local circumstances and regulations.*

Allergies against contrast agents: *This is a valid point, we added this to the algorithm (step 3.2).*

Inclusion and information of relatives: *Yes, this is necessary and helpful. Added to the protocol.*

Maximal rt-PA dose: *rt-PA is approved for stroke thrombolysis with a maximal dose of 90 mg and the dose is 0.9 mg/kg. As reviewer #1 points out, patients weighing 100 kg receive 90 mg and the dose is not increase further in patients weighing > 100 kg. Corrected, thank you.*

Should we report on the effect on DNT? Actually, we would like to keep this piece of data for two reasons. First, we think that it shows what extent of improvement hospitals can actually expect to reach with a fixed Stroke Team algorithm. Second, most JoVE manuals also provide on piece of data to illustrate what type of results can be achieved by the method.

Reviewer #2
The authors should show alternatives to reduce the DNT with fewer staff: *Thank you for making this point that helps us to sharpen the basic principle of our concept in the discussion. We agree that the algorithm has to be tailored to each hospitals circumstances. In fact, we think that the setting-up of the algorithm in interdisciplinary team of neurologists, neuroradiologists, anaesthesiologist and stroke nurses already is an important part of the improvement process. There are certainly ways to perform all tasks with less personnel but we think that this unnecessarily delays treatment times. Often, some of the physicians involved in the algorithm are not yet board certified and need to call for supervision leading to unnecessary delays if the senior neurologist is not involved directly. We think that hospitals specializing in stroke should find a way to assemble a strong Stroke Team at short notice, as it is already common and institutionalized in trauma care.*

We thank the reviewers for their time and input and hope that our manuscript is now suitable for publication.

Sincerely,
Waltraud Pfeilschifter