Simulation training for hyperacute stroke unit nurses

Angela Roots, Libby Thomas, Peter Jaye and Jonathan Birns

Abstract

National clinical guidelines have emphasized the need to identify acute stroke as a clinical priority for early assessment and treatment of patients on hyperacute stroke units. Nurses working on hyperacute stroke units require stroke specialist training and development of competencies in dealing with neurological emergencies and working in multidisciplinary teams. Educational theory suggests that experiential learning with colleagues in real-life settings may provide transferable results to the workplace with improved performance. Simulation training has been shown to deliver situational training without compromising patient safety and has been shown to improve both technical and non-technical skills. This article describes the role that simulation training may play for nurses working on hyperacute stroke units explaining the modalities available and the educational potential. The article also outlines the development of a pilot course involving directly relevant clinical scenarios for hyperacute stroke unit patient care and assesses the benefits of simulation training for hyperacute stroke unit nurses, in terms of clinical performance and non-clinical abilities including leadership and communication.

Key Words: Hyperacute ■ Stroke ■ Simulation ■ Training ■ HASU

Until recently, stroke was not considered a medical emergency and hospitalization was considered to be necessary only for nursing, therapy or social care needs (Wade et al, 1985). This nihilistic perception has been changed by evidence demonstrating the effectiveness of acute stroke care (Hacke, 2000; Kalra et al, 2000; Stroke Unit Trialists' Collaboration, 2007) and thrombolysis for selected patients (Wardlaw et al, 2009). Management on a specialized acute stroke unit from the time of admission results in 18% more patients remaining alive and independent at 1 year compared with those managed on a general medical ward, even with specialist stroke team support (Stroke Unit Trialists' Collaboration, 2007). Similarly, treatment with thrombolysis within 3 hours of stroke onset results in 29% more patients remaining alive and independent at 3 months (Wardlaw et al, 2009).

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There has been increasing recognition of the importance of timely medical attention in acute stroke management (Stone, 2002; Fitzpatrick and Birns, 2004) and the use of fast-track systems with stroke-specific assessment tools has been advocated as a method to rapidly evaluate patients presenting with suspected stroke (Harbison et al, 2003; Nor et al, 2005). This leads to the prioritization of patients and the early initiation of appropriate clinical assessments and medical investigations. This facilitates early diagnosis and determination of the aetiology of the stroke (ischaemic or haemorrhagic) in addition to planning treatment strategies aimed at reducing the brain damage caused by the stroke and preventing complications.

In order to offer rapid access to the best possible treatment for stroke patients, it has been advocated that stroke services in the UK, particularly in London, should be reconfigured to provide 'hyperacute' stroke care in designated centres (Healthcare for London, 2008). A hyperacute stroke unit (HASU) provides an immediate response to the stroke by a specialist workforce trained to stabilize the patient and provide primary intervention.

HASU workforce specialist training

Managing stroke patients in a HASU has been shown to improve care and delivery of acute interventions such as thrombolysis for acute ischaemic stroke (Royal College of Physicians, 2011). In view of the 'high-dependency' nature of the hyperacute element of the stroke patient's journey (with a need for continuous physiological monitoring), a HASU requires a high nurse to patient staffing ratio and a need for nurses to work as part of a multi-disciplinary team. HASU nurses require stroke specialist training and development of competencies in dealing with neurological emergencies. Furthermore, in a number of centres, the HASU nurse undertakes acute neurological assessment and co-ordination of the thrombolysis pathway (Birns and Roots, 2010). Stroke-specific educational frameworks have been advocated to provide HASU nurses with the appropriate knowledge, understanding, skills and ability (Department of Health (DH), 2010), and to ensure high-quality, equitable stroke services, from an appropriately skilled team, are available to all patients.

Simulation training

Simulation is defined as 'a technique, not a technology, to replace or amplify real experiences with guided experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion' (Gaba, 2004). Human patient simulation (HPS) involves life-size full body simulators equipped with computer software that allows them to replicate humans

both physically and physiologically. They can talk, sweat, breathe, bleed and have signs that change, such as heart sounds and pulses, and continuous monitoring may demonstrate variations in physiological parameters such as blood pressure and oxygen saturation (Cooper et al, 2004).

In simulation training, some individuals participate in simulated scenarios while others watch the situation unfold by live video feed. Following the scenario, all those involved and watching actively participate in the debrief (Gaba et al, 2001). Debriefing after scenarios to provide feedback is the most important aspect for effective learning (Issenberg et al, 2005). Debrief uses different sources including student and facilitator observation, data from the mannequin and video replay (Fanning and Gaba, 2007). The debrief is facilitated by an instructor to guide participants through a detailed discussion of their experiences (Lederman, 1992; Steinwachs, 1992).

HPS has been in use since the 1960s (Denson and Abrahamson, 1969) but was primarily the remit of anaesthetists until the late 1990s (Issenberg et al, 1999). It then expanded into other medical domains, although centred mainly around critical care (Gaba et al, 2001), but it is now increasingly being used with other healthcare deliverers working in a variety of clinical roles and for inter-professional education (Laschinger et al, 2008; Elliott et al, 2011).

HPS has grown in response to an increased need for alternative methods of delivering situational training (Laschinger et al, 2008) without compromising patient safety. It is also an effective means of addressing patient safety issues as emphasized in the Chief Medical Officer's report of 2008 (Donaldson, 2009). The use of simulation, in combination with specific training about managing resources, was found to show improvement in key behaviours in aviation (Helmreich and Foushee, 1993) and was adopted into medical simulation by clinicians (Gaba and DeAnda, 1988). This led to the simulation debrief focusing on teaching cognitive skills including situational awareness and decision making, and social skills including effective communication, leadership and teamwork.

Simulation training for a HASU

The need for training of teams, rather than individuals, working in healthcare settings is becoming more widely accepted and acknowledged as best practice (Salas et al, 2008). In order to address the varied educational needs of a HASU workforce, HPS, combined with specific debriefing, may be employed concentrating on both the tasks to be performed and cognitive skills required (Bond et al, 2006). In the HASU setting, individual tasks may be broken down into technical skills (e.g. neurological examination and setup and delivery of thrombolysis), complex tasks (e.g. the transfer of patients while treatment is ongoing), and team training skills (e.g. communication skills and leadership). Each task often involves an inter-professional mix of health professionals in varying environments including the emergency department, hospital corridors during transfer and the HASU itself. HPS courses have been previously run specifically for emergency medicine teams (Small et al, 1999; Reznek et al, 2003; Shapiro et al, 2004) but have not included HASU health professionals.

HPS allows the educators to create a close to real environment to allow the health professionals to practise in the roles they normally assume on the HASU without posing any risk to real patients. This is described as 'the power of simulation' (Salas et al, 2008) as it creates a setting that allows individuals to use the same cognitive processes they will use in real life without the potential consequences if patient care does not go entirely to plan. This salient connection is thought to increase transferability of skills into real practice although evidence is currently limited (McGahie et al, 2010). Another key feature of simulated scenarios is that they may be used to improve the exposure of HASU staff to important, but rare, complications such as anaphylaxis or accelerated hypertension. This way, if they are faced with them in real life, they will have previous experience on which to base their actions (Brindley et al, 2007).

Links to educational theory

This type of experiential learning draws on various pedagogical theories including both social and cognitive constructivism. Social constructivism concentrates on the idea of allowing learning to occur in a context akin to the one in which the practitioner really will be working. By allowing groups to construct knowledge for each other and collaborate to create shared meanings and learning, they can create their own shared culture. Cognitive constructivism concentrates on the idea that despite having the information, knowledge needs to be created from that information in order for it to be useful and accessible in the future (Harvard, 1996). Biggs took these constructivist ideas and married them with the notion that teachers should make a deliberate alignment between the learning activities planned and the outcomes of that learning. This was called constructive alignment and is a principle used to devise educational activities that directly address learning outcomes in a way not traditionally achieved through tutorials, lectures and exams (Biggs, 1996).

HPS is an ideal medium in which to break away from traditional teaching modalities and apply the constructive alignment theory to produce a rounded and fit-for-purpose educational experience to address the new issues facing HASUs. It also complements the teaching of non-technical skills as these are rarely taught in more formal educational environments. The use of a teaching method grounded in educational theory is reassuring but some of the challenges that still exist in simulation-based medical education include measuring the effect of simulation and the transference of knowledge from the simulated environment to real life. Kirkpatrick described four levels of evaluating training programmes (Kirkpatrick, 1998):

- Level 1: reaction
- Level 2: learning
- Level 3: behaviour
- Level 4: results.

Creating and delivering an education programme providing results (level 4) is a challenge but one that may be achievable through an HPS programme for HASU teams. Indeed, there is evidence from other clinical specialties that learning may transfer from the simulation setting to real patient care with an improvement in the performance of health professionals (Seymour et al, 2002; Mayo et al, 2004; McGahie, 2008).

Development of training for HASU

Six Band 5 nurses and one foundation doctor working on the HASU at St Thomas' Hospital, London, were invited to attend a pilot stroke simulation study day. They were presented with a number of clinical scenarios, directly relevant to HASU patient care, including post-thrombolysis anaphylaxis, raised intracranial pressure, seizures and accelerated hypertension (illustrated in *Table 1*). Between one and three candidates participated in each scenario and the course was held in a designated simulation suite set up to replicate the accident and emergency (A&E) department or the HASU, depending on the scenario. Candidates interacted with the high-fidelity mannequin (SimMan 3G) whose physiology was controlled remotely as the scenario evolved. This included changes

Table 1. Clinical scenarios for HASU simulation training course

Scenario	Narrative description
1	Woman admitted to A&E with slurred speech and left sided weakness. Was thrombolysed and transferred to the ward. The band 6 nurse has commenced the altepase infusion and handed the patient over to the ward staff. The patient begins to develop an allergic reaction to the altepase
2	Patient admitted with expressive dysphasia and right sided weakness, National Institutes of Health Stroke Scale (NIHSS) 14. CT scan normal. Thrombolysed (total 76 mg) with good effect. NIHSS at 2 hours= 0. The patient appears to have become more confused. Glasgow Coma Score (GCS) deteriorates because of intracranial haemorrhage and oedema
3	Patient admitted 2 days ago with a haemorrhagic stroke. While nurse is taking a telephone handover about another patient, she is called by a healthcare assistant who has noticed that the patient appears to be twitching
4	45-year old man admitted to HASU with dysphasia and seizures. CT brain showed intracerebral haemorrhage. The patient has become increasingly restless and the staff overnight had difficulty controlling his blood pressure. He is to be re-scanned

in cardiovascular, respiratory and neurological function. Simulation centre faculty staff role-played other health professionals and patient relatives in the scenarios.

Course participants not directly involved in a scenario watched a live video-feed in a debrief room and the video footage was used subsequently for debriefing. Each simulated scenario lasted up to 15 minutes and was followed by a group debriefing session lasting approximately 40 minutes. The debrief started with a detailed description of the scenario, making sure that everyone understood all clinical issues, before moving on to an analysis phase. The analysis formed the crux of the debrief and involved the facilitator helping the group break down the non-technical skills, such as teamwork, to see what worked well, what issues arose and what improvements could be made. The facilitator encouraged the group to reflect upon real-life examples and explore ways in which they could improve their future practice, both as individuals, and as a team.

Candidates were given previously validated pre- and post-course questionnaires, containing both quantitative questions based on a Likert scale and open-ended qualitative questions (*Figure 1*) (Thomas and Jaye, 2009; Thomas et al, 2009). They were asked to assess their leadership and communication skills as well as their confidence in managing emergency situations using the 'patient at risk' (PAR) score on a scale of one (little or no skill/confidence) to seven (high level of skill/confidence) (Rees and Mann, 2004). The pilot sample group was too small for any meaningful statistical calculations but certain trends could be seen from the results. *Table 2* demonstrates that six of the seven candidates' post-course questionnaires showed a self-reported improvement in their leadership, communication skills and confidence in managing hyperacute stroke clinical situations, and that there was an increase in mean score in all non-technical domains. One candidate provided a lower post-course self-assessment, expressing that the course had allowed her to reflect on her skills and had given her significant insight into her limitations, of which she was previously unaware, such that she had taken forward a number of learning action points. This progression from unconscious incompetence to conscious incompetence (Howell and Fleishman, 1982) is perhaps the most important progression in Miller's pyramid (Miller, 1990).

Within the qualitative feedback, all candidates expressed that they felt the scenarios were realistic of working life. They also stated that they enjoyed the interactive learning environment and that the course allowed them to practise common clinical scenarios and revisit uncommon acute scenarios. One candidate expressed a greater understanding of the severity of potential complications post-thrombolysis and felt that this would have a great impact on their practice in post-thrombolysis care. Since completing the course, the candidates fed back through informal interviews that they had each independently taken the opportunity to share knowledge gained with colleagues and reported greater confidence in managing acute clinical situations similar to the simulation scenarios.

Limitations and recommendations

While nurses who participated in this pilot course described improvements in their clinical and non-clinical skills, the benefits are limited by the self-reporting and small sample size. As such, the findings lack generalizability. Furthermore, although simulation training affords situational learning without compromising patient safety, it cannot replace real-life experience and it also compartmentalizes clinical scenarios that would often be continuous or concurrent.

In view of the positive findings of the pilot study, a similar course aimed at more highly qualified stroke health professionals, including Band 6 and 7 nurses and stroke consultants, has been planned. A series of these 'basic' and 'advanced' courses is being developed to be undertaken at a number of high-fidelity simulation suites across London with learning objectives mapped to fulfil curriculum requirements of the DH's *Stroke-specific education framework* (DH, 2010). Evaluation of the results from all of these training days may then be combined to provide a summative assessment of the impact of HPS on HASU staff.

Conclusion

As stroke service provision is demanding more specialist nursing input, with an increasingly important role in hyperacute patient management, simulation training has much to offer a HASU nursing workforce. HPS affords HASU nurses the opportunity to practise assessing and managing stroke patients in emergency scenarios in a real-life environment without compromising patient safety. In addition to providing HASU nurses with exposure to common clinical events, it affords them the opportunity to feel competent and confident in dealing with less common scenarios and allows them to learn new non-technical skills. Simulation training cannot replace real-life work-based experience but may be used to augment knowledge and competencies. A small pilot study suggested improvements in both clinical and non-clinical skills of HASU nurses, outlining the potential benefit of HPS transferring experiential learning into the workplace. This has implications for the training of HASU nurses and is an area requiring more research in the future. BJN

Conflict of interest: none

Biggs JB (1996) Enhancing Teaching though Constructive Alignment. *Higher Education* **32:** 347–64
Birns J, Roots A (2010) Innovations in the assessment and management of stroke: the use of telemedicine. *BJNN* **6**(2): 66–9
Bond WF, Deitrick LM, Eberhardt M et al (2006) Cognitive

versus technical debriefing after simulation training. *Acad Emerg Med* **13**(3): 276–83

Brindley PG, Suen GI, Drummond J (2007) Medical Simulation: "See one, do one, teach one...just not on my Mom". *Canadian Journal of Respiratory Therapy* **43**(4): 22–7

Cooper JB, Taqueti VR (2004) A brief history of the development of mannequin simulators for clinical education and training. *Qual Saf Health Care* **13**(1suppl 1): i11–8

Denson JS, Abrahamson S (1969) A computer-controlled patient simulator. *JAMA* **208**(3): 504–8

Department of Health (2010) Stroke-specific education framework. http://tinyurl.com/6ol9hwj (Accessed 16 November 2011)

Donaldson SL (2009) 150 years of the Annual Report of the Chief Medical Officer: On the state of public health 2008. http://tinyurl.com/cn4zc5 (Accessed 16 November 2011)

Elliot S, Murrell K, Harper P, Stephens T, Pellowe C (2011) A comprehensive systematic review of the use of simulation in the continuing education and training of qualified medical, nursing and midwifery staff. *JBI Library of Systematic Reviews* **9**(17): 538–87

Fanning RM, Gaba DM (2007) The role of debriefing in simulation-based learning. *Simul Healthc* **2**(2): 115–25

Fitzpatrick M, Birns J (2004) Thrombolysis for acute ischaemic stroke and the role of the nurse. *Br J Nurs* **13**(20): 1170–4

Gaba DM (2004) The future vision of simulation in health care. *Qual Saf Health Care* **13**(suppl1): i2–i10

Gaba DM, DeAnda A (1988) A comprehensive anesthesia simulation environment: re-creating the operating room for research and training. *Anesthesiology* **69**(3): 387–94

Gaba DM, Howard SK, Fish KJ, Smith BE, Sowb YA (2001) Simulation-based training in anesthesia crisis resource management (ACRM): A decade of experience. *Simulation and Gaming* **32:** 175–93

Hacke W (2000) A late step in the right direction of stroke care. *Lancet* **356**(9233): 869–70

Harbison J, Hossain O, Jenkinson D, Davis J, Louw SJ, Ford GA (2003) Diagnostic accuracy of stroke referrals from primary care, emergency room physicians, and ambulance staff using the face arm speech test. *Stroke* **34**(1): 71–6

Harvard G (1996) The Key Ideas of Vygotsky and their Implications for Teaching and Schooling'. In: R Fox, ed. *Perspectives on constructivism*. University of Exeter, Exeter

Healthcare for London (2008) Stroke strategy for London. http://tinyurl.com/7ucvog8 (Accessed 16 November 2011)

Helmreich RL, Foushee HC (1993) Why crew resource management? Empirical and theoretical bases of human factors in aviation. In: Wiener E, Kanki B, Helmreich RL, eds. *Cockpit Resource Management*. Academic Press, San Diego

Howell WC, Fleishman EA (1982) *Human Performance and Productivity. Vol 2: Information Processing and Decision Making.* Erlbaum, Hillsdale

Issenberg SB, McGaghie WC, Hart IR et al (1999) Simulation technology for health care professional skills training and assessment. *JAMA* **282**(9): 861–6

Issenberg SB, McGaghie WC, Petrusa ER, Lee Gordon D, Scalese RJ (2005) Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. *Med Teach* **27**(1): 10–28

Kalra L, Evans A, Perez I, Knapp M, Donaldson N, Swift CG (2000) Alternative strategies for stroke care: a prospective randomised controlled trial. *Lancet* **356**(9233): 894–9

Kirkpatrick D L (1998) Evaluating Training Programs, 2nd edn. Berrett-Koehler, San Francisco

Laschinger SJ, Medves J, Pulling C et al (2008) Effectiveness of simulation on health profession students' knowledge, skills, confidence and satisfaction. *Int J Evid Based Healthc* **6**(3): 278–302

Lederman LC (1992) Debriefing: Toward a Systematic Assessment of Theory and Practice. *Simulation & Gaming* **23**(2): 145–60

Mayo PH, Hackney JE, Mueck JT, Ribaudo V, Schneider RF (2004) Achieving house staff competence in emergency airway management: results of a teaching program using a computerized patient simulator. *Crit Care Med* **32**(12): 2422–7

McGaghie WC, Issenberg SB, Petrusa ER, Scalese RJ (2010) A critical review of simulation-based medical education research: 2003-2009." *Med Educ* **44**(1): 50–63

McGaghie WC (2008) Research opportunities in

Multi-disciplinary Simulation Training Improving Patient Safety
Pre-course questionnaire

Course Date: ………………
Institution:
Grade: FY1 FY2 Nurse Band………

Please circle your preferred answer
(1= poor/not at all/ no and 7= good/very high / yes)

What is your level of experience with simulation	1	2	3	4	5	6	7
Is patient safety an issue that needs to be improved from what you have seen during clinical practice?	1	2	3	4	5	6	7
How good are your clinical communication skills?	1	2	3	4	5	6	7
How good are you leadership skills?	1	2	3	4	5	6	7
How confident do you feel managing emergency situations?	1	2	3	4	5	6	7
Have you ever seen or used an early warning score such as PAR?	1	2	3	4	5	6	7
If yes, how useful was it?	1	2	3	4	5	6	7

Multi-disciplinary Simulation Training Improving Patient Safety
Post-course questionnaire

Course Date: ………………
Institution:
Grade: FY1 FY2 Nurse Band………
Have you been in high-fidelity simulation scenarios before? YES NO
If yes, how many times?...................................
How did this experience compare to previous simulation sessions? **Better** **Same** **Worse**

Please Circle (1= poor and 7= very good)

How good are your communication skills?	1	2	3	4	5	6	7
How good are your leadership skills?	1	2	3	4	5	6	7
How confident do you feel managing emergency situations?	1	2	3	4	5	6	7
Is the early warning score system? useful	1	2	3	4	5	6	7

Please rate each component of the course 1=terrible 7=terrific

Did you enjoy the course?	1	2	3	4	5	6	7
How relevant was this course to your clinical practice?	1	2	3	4	5	6	7
Learning outcomes and introduction to simulation	1	2	3	4	5	6	7
Familiarisation with Mr/Mrs Simulator	1	2	3	4	5	6	7
Simulator scenarios	1	2	3	4	5	6	7
Catering	1	2	3	4	5	6	7
Venue	1	2	3	4	5	6	7
Faculty	1	2	3	4	5	6	7
Communication session	1	2	3	4	5	6	7

Was the course too long or too short?
Was there anything you particularly liked?
Was there anything you particularly didn't like?
What did we do well?
What could we do differently?
What is one thing you are going to take away from this course?
Additional comments?

Figure 1. Pre- and post- course questionnaires

Table 2. Pre- and post- simulation training scores for non-technical skills

Non-technical skill set	Pre-course score range	Pre-course mean score	Post-course score range	Post-course mean score
Communication	4-6	5	4-7	6
Leadership	3-6	4	3-7	5
Managing emergency situations	3-7	4	3-7	5
Use of PAR score	4-7	6	7	7

KEY POINTS

- Nurses working on hyperacute stroke units require specialist training
- Simulation training allows educators to create a close to real environment for nurses to practise their roles without posing any risk to acutely unwell patients
- Simulation training may incorporate the use of high-fidelity mannequins with adaptable physiological responses and/or role play
- Simulation training provides transferable experiential learning and may improve clinical and non-clinical skills

simulation-based medical education using deliberate practice. *Acad Emerg Med* **15**(11): 995–1001 Epub

Miller GE (1990) The assessment of clinical skills/competence/performance. *Acad Med* **65**(9suppl): S63–7

Nor AM, Davis J, Sen B et al (2005) The Recognition of Stroke in the Emergency Room (ROSIER) scale: development and validation of a stroke recognition instrument. *Lancet Neurol* **4**(11): 727–34

Rees JE, Mann C (2004) Use of the patient at risk scores in the emergency department: a preliminary study. *Emerg Med J* **21**(6): 698–9

Reznek, M, Smith-Coggins R, Howard S (2003) Emergency medicine crisis resource management (EMCRM): pilot study of a simulation-based crisis management course for emergency medicine. *Acad Emerg Med* **10(4):** 386–9

Royal College of Physicians (2011) National Sentinel Stroke Audit. Public report of 2010 Clinical Audit. http://tinyurl.com/7ph5yzn (Accessed 16 November 2011)

Salas E, DiazGranados D, Weaver SJ, King H (2008) Does team training work? Principles for health care. *Acad Emerg Med* **15**(11): 1002–9 Epub

Seymour NE, Gallagher AG, Roman SA et al (2002) Virtual reality training improves operating room performance: results of a randomized, double-blinded study. *Ann Surg* **236**(4): 458–63

Shapiro MJ, Morey JC, Small SD et al (2004) Simulation based teamwork training for emergency department staff: does it improve clinical team performance when added to an existing didactic teamwork curriculum? *Qual Saf Health Care* **13**(6): 417–21

Small SD, Wuerz RC, Simon R, Shapiro N, Conn A, Setnik G (1999) Demonstration of high-fidelity simulation team training for emergency medicine. *Acad Emerg Med* **6**(4): 312–23

Steinwachs B (1992) How to facilitate a debriefing simulation. *Simulation & Gaming* **23**(2): 186–95

Stone S (2002) Stroke units. *BMJ* **325**(7359): 291–2

Stroke Unit Trialists' Collaboration (2007) Organised inpatient (stroke unit) care for stroke. *Cochrane Database Syst Rev.* **17**(4): CD000197

Thomas LT, Jaye P (2009) A New Method of Delivering Effective Multi-Disciplinary Teaching to Ward Staff Addressing Clinical Issues, Patient Safety and Human Factors. United Kingdom National Association of Medical Simulation Conference Abstracts, Manchester.

Thomas LT, Jaye P, Dev S (2009) Improving Patient Safety in Emergency Situations. College of Emergency Medicine Conference Abstracts, Brighton.

Wade DT, Langton Hewer R (1985) Hospital admission for acute stroke: who, for how long, and to what effect? *J Epidemiol Community Health* **39**(4): 347–52

Wardlaw JM, Murray V, Berge E, Del Zoppo GJ (2009) Thrombolysis for acute ischaemic stroke. *Cochrane Database Syst Rev*. **7**(4):CD000213