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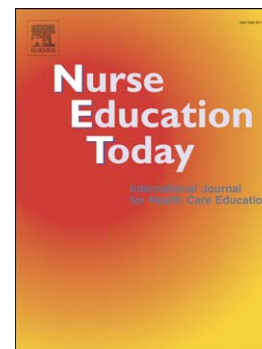
The impact of education and training interventions for nurses and other health care staff involved in the delivery of stroke care: An integrative review

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THE IMPACT OF EDUCATION AND TRAINING INTERVENTIONS FOR NURSES AND OTHER HEALTH CARE  
STAFF INVOLVED IN THE DELIVERY OF STROKE CARE: AN INTEGRATIVE REVIEW

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Dr Chris Price (Clinical Senior Lecturer in Medicine, Newcastle University): substantial contributions to the design and methodology. Contributed to the writing, revision and approval of the final paper.

Professor Caroline Watkins (Professor of Stroke and Older People's Care, University of Central Lancashire): substantial contributions to the design and methodology, advised on the data extraction and data analysis. Contributed to the writing, revision and approval of the final paper.

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### **Abstract**

### **Objectives**

The aim of this review was to explore the impact of stroke education and training of nurses and other health care staff involved in the delivery of stroke care.

## Design

We performed an integrative review, following PRISMA guidance where possible.

## Data sources

We searched MEDLINE, ERIC, PubMed, AMED, EMBASE, HMIC, CINAHL, Google Scholar, IBSS, Web of Knowledge, and the British Nursing Index) from 1980 to 2016.

## Review methods

Any intervention studies were included if they focused on the education or training of nurses and other health care staff in relation to stroke care. Articles that appeared to meet the inclusion criteria were read in full. Data were extracted from the articles, and the study quality assessed by two researchers. We assessed risk of bias of included studies using a pre-specified tool based on Cochrane guidance.

## Results

Our initial search identified 2850 studies of which 21 met the inclusion criteria. Six studies were randomised controlled trials, and one was an interrupted time series. Fourteen studies were quasi-experimental: eight were pretest-posttest; five were non-equivalent groups; one study had a single assessment. Thirteen studies used quality of care outcomes and eight used a patient outcome measure. None of the studies was identified as having a low risk of bias. Only nine studies used a multi-disciplinary approach to education and training and nurses were often taught alone. Interactive education and training delivered to multi-disciplinary stroke teams, and the use of protocols or guidelines tended to be associated with a positive impact on patient and quality of care outcomes.

**Conclusions**

Practice educators should consider the delivery of interactive education and training delivered to multi-disciplinary groups, and the use of protocols or guidelines, which tend to be associated with a positive impact on both patient and quality of care outcomes. Future research should incorporate a robust design.

## BACKGROUND

Stroke is a leading cause of mortality and disability worldwide<sup>1</sup> and is recognised as a time-dependent medical emergency in which early presentation to specialist care reduces death and dependency<sup>2</sup>. Stroke survivors are known to have complex needs<sup>3,4</sup> with a commensurate requirement for knowledgeable and skilled rehabilitative and long-term support from appropriately trained staff. It has been demonstrated that the provision of care in a stroke unit improves outcomes for people who have experienced stroke<sup>5</sup>. The reasons for this are unclear, but are likely to be at least partly attributable to the presence of a multi-disciplinary team with specialised knowledge, skills and experience in stroke. The development and delivery of stroke-specific education is therefore of vital importance to the provision of high quality stroke care and to improve outcomes for people who have experienced stroke; to ensure this care from staff with the appropriate education and skills at all points on the stroke pathway (e.g. pre-hospital, emergency, rehabilitation, long-term care, and primary care).

In England, a report by the National Audit Office (NAO) highlighted that the limited number of health professionals with stroke-specific education and training could be a barrier to providing high-quality acute care and rehabilitation<sup>2</sup>. The National Stroke Strategy in England also highlighted the need for nationally recognised, quality assured and transferable education and training for stroke staff in order to ensure that the stroke workforce had appropriate knowledge and skills<sup>6</sup>. Consequently, a Stroke-Specific Education Framework (SSEF) was developed<sup>7</sup>. The SSEF consists of 16 elements of care, based on the quality markers in the National Stroke Strategy and related to the stroke strategies of all four UK countries, which cover the whole of the stroke care pathway. Each element contains key competencies, reflecting the knowledge and skills required by staff working in that area of stroke care delivery, that should be covered in any education and training package.

A previous review of education and training with nurses in stroke found a paucity of evidence, which was limited to stroke rehabilitation settings<sup>8</sup>, and included only one study which directly examined the impact of education and training for nurses on outcomes of people who had experienced stroke<sup>9</sup>. This before and after study found that whilst there were some improvements in clinical practice, there was no significant difference between the two groups for Barthel index, Hospital Anxiety and Depression scale, occurrence of secondary complications, length of stay or inpatient and carer satisfaction<sup>9</sup>.

As detailed in the National Stroke Strategy, stroke care extends prior to and after rehabilitation, which is only one of the key areas of the stroke pathway<sup>6</sup>. Moreover, a wide range of staff contribute to stroke care across the whole of the stroke pathway. If we are to fully understand the value of stroke education and training we need a comprehensive and systematic approach to synthesising relevant research evidence.

The aim of this review was to summarise the existing scientific literature exploring the impact of stroke education and training of nurses and other health care staff involved in the delivery of stroke care, using integrative review methodology. An integrative review utilises a systematic methodology for searching and appraisal to ensure that it is comprehensive and inclusive. However, unlike other systematic review approaches, integrative review enables the synthesis of research studies utilising diverse methodologies<sup>10</sup>.

Research questions:

1. What types of stroke education and training interventions have been developed for nurses and other health care staff?
2. How has the impact of stroke education and training been assessed?



3. Is there evidence for the effectiveness of stroke education and training on quality of care or patient outcomes?

#### DESIGN

Primary research studies, using any methodology, assessing the impact of stroke education and training were included if they described education and training in relation to stroke, of health care personnel (including: emergency medical dispatchers, paramedics, ambulance technicians, nurses, health care assistants, doctors, physiotherapists, occupational therapists, speech and language therapists, pharmacists, social workers, trainees and multi-disciplinary groups). Studies that focused solely on the education and training of people who have experienced stroke or informal supporters (carers) were not included.

Studies were included if they reported an evaluation of the impact of the education or training on a measure of patient care, in terms of either a patient or quality of care outcome measure. Patient outcomes were defined as those that related to health status or health behaviour. Other measures of health status included mortality or a marker of morbidity such as discharge destination. Quality of care outcomes were defined by the research team as those that related to quality or timeliness of patient care delivery. Where a primary outcome was explicitly stated by the study authors, this was taken as the main outcome of the study. Where no primary outcome was stated and multiple outcomes were reported, the research team designated the main outcome through consensus. If present, a patient outcome was considered to be the main outcome; otherwise a quality of care outcome was selected.

Studies were included from any country, if they were published in full and in English.

### Data sources

A search strategy was developed (see Supporting Information), including the MeSH terms stroke, education, and health personnel. The search strategy was adapted to search a range of databases (MEDLINE, ERIC, PubMed, AMED, EMBASE, HMIC, CINAHL, Google Scholar, IBSS, Web of Knowledge, and the British Nursing Index) from 1980 to July 2016.

### Review methods

Citations were initially screened on title and then abstract. This process was undertaken independently by two trained researchers (SJ and CM). Any articles that met the inclusion criteria were read in full by two trained researchers (SJ, CM, JG, JL). Disagreements over the inclusion of any articles were discussed by the project steering group. Backward and forward citation searches were performed to test the quality of the search strategy.

### Assessment of risk of bias in included studies

The inclusion of studies with varying methodologies required the development of a framework to assess study quality which could encompass a range of study designs. The Cochrane 'risk of bias' tool was used as the starting point to develop this method<sup>11</sup>. Selection, performance, detection, attrition and reporting biases were included in order to assess study quality.

### Data extraction and management

We designed a data extraction form that summarised the following characteristics:

- i. Study detail (author, year of publication, country of origin, study type);
- ii. Staff participants (setting, professions, sample size);
- iii. Type of education or training (content, format, method of delivery, by whom delivered, duration, frequency, barriers to implementation);
- iv. Patient characteristics (stroke/TIA, sample size, age, sex);

- v. Outcomes (primary/main outcome measures categorised as patient outcomes or quality of care outcomes), main results, inferential and descriptive statistics;
- vi. Risk of bias (selection, performance, detection, attrition, reporting).

Method of delivery was categorised into didactic (e.g. lectures, videos, CDs, workbooks, protocols, on-line), or interactive (e.g. action plans, practical sessions, reflective practice, workshops, feedback). Data extraction forms were piloted using three of the included studies. The accuracy of data extraction was checked by a second independent extractor for all included studies.

We did not contact the study authors for missing data or for clarification.

Included studies were mapped against the SSEF Elements of care<sup>7</sup> to assess the breadth of stroke education and training delivery. The 16 elements are listed in Table 1 below.

### Analysis

There was a great deal of heterogeneity between the study designs, the type and format of the education or training provided, and the outcomes reported, and therefore we were unable to perform a meta-analysis of the included randomised controlled trials. Consequently, we have described included studies narratively.

## RESULTS

The search strategy initially identified 2850 articles. Following screening of the title, abstract or complete article, 21 studies met the inclusion criteria (see Figure 1).

Figure 1: Flow diagram.

### Risk of bias

The proportion of studies demonstrating each type of bias can be seen in Figure 2 (Supporting Information). None of the studies was identified as having a low risk of bias across all five domains. Evidence for selection bias was unclear in a majority of studies, and two studies<sup>12-13</sup> were at high risk of selection bias. Performance bias was evident in all studies, although this is not unreasonable given the nature of education and training in health care. Detection bias was unclear for many studies, but where bias could be assessed, in most cases there was a low risk; only one study<sup>13</sup> had a high risk of detection bias. Evidence for attrition bias was unclear for the majority of studies. Two studies were at high risk for attrition bias<sup>14-15</sup> while seven had a low risk<sup>12,16-21</sup>. The risk of reporting bias was unclear in one study, while the other 20 studies were evenly split between low and high risk.

### Narrative review

#### *Description of eligible studies*

Of the 21 included studies, six used a randomised trial design: two<sup>12,21</sup> were randomised controlled trials (RCTs), and four<sup>16,18,22-23</sup> were cluster RCTs. One study was an interrupted time series<sup>24</sup>. The remaining studies used quasi-experimental designs: eight were pretest-posttest<sup>9,13,25-30</sup>, five were non-equivalent groups<sup>15,17,19,20,31</sup> and one was a post-test study<sup>14</sup>. Details of study characteristics are summarised in Table 2. Only 12 studies reported the numbers of staff who received education and training (total 1,190, median 99, range 12 to 345). Over half the studies involved the education or training of nurses (57%). All but one study<sup>25</sup> reported the number of patients included in outcome measurements, which totalled 9,913 across 20 studies (median 495, range 37 to 1696).

Of the 21 studies, 16 provided sufficient further detail to be able to categorise the method of education or training delivery (Table 3).

*What types of stroke educational interventions have been developed for health care staff?*

Twelve studies<sup>9,12-17,22,25,28,31</sup> entailed education or training programmes for a single health profession or occupational group. In most of these studies, nurses were the recipients of the education or training (Table 4). Twelve studies<sup>9,12,15,17-20,23,27,31</sup> delivered education or training using a range of approaches including face-to-face lectures, videos, workshops, protocols and reflective practice. Four studies used a single method of delivery<sup>14,15,24,29</sup>, only one of which delivered an on-line course<sup>24</sup>. The remaining studies did not state the method of delivery<sup>13,21,25,26,30</sup>. In those studies that reported the duration and/or frequency of education or training<sup>9,12,13,15,16,18,22-24,26-28,31</sup>, duration ranged from one hour to two working days, with most education or training sessions being delivered on one or two occasions.

In terms of the 16 Stroke-Specific Education Framework Elements of care, 12 studies focused on a single Element, of which seven were in specialist rehabilitation. Four studies focused on two Elements, four covered three Elements and one focused on five Elements. The included studies focused on urgent response (n=9), acute stroke assessment (n=6) and treatment (n=3), and specialist rehabilitation (n=11). There were fewer studies (two each) on seamless transfer of care, long-term care, and post-stroke review. No studies were identified on managing risk (in terms of primary prevention), information, user involvement, Treatment (TIA), end of life, participation in community, and return to work.

*How has the impact of stroke education and training been assessed?*

Eighteen of the 21 studies specified a main outcome measure. The majority of studies (n=11) used a quality of care outcome. The remaining six studies specified a patient measure as their main

outcome. The three remaining studies did not specify a primary outcome and had a main outcome designated by the research team for the purposes of this analysis. The main outcome measures were very diverse, with only three outcomes being assessed in more than one study: Identification of stroke<sup>13,24,28,30</sup>; thrombolysis rates<sup>19,20</sup>; patient position/posture<sup>9,15</sup> (see Table 5 in Supporting Information).

*Is there evidence for the effectiveness of stroke education and training on outcome?*

Eleven (52%) of the included studies reported a positive impact of education and training on patient or quality of care outcomes. Of the studies measuring patient outcomes none used the same outcome measure. Two of the studies that showed a positive impact on physical health utilised a cluster RCT design and provided interactive, mixed methods of delivery, but there were no further commonalities between the two studies<sup>18,23</sup>. Two further studies found a positive association between education and training and psychosocial<sup>17</sup> and health behaviour<sup>12</sup> outcomes, but again there were few commonalities between these studies. It is therefore difficult to assess adequately the extent to which education and training could lead to improved patient outcomes. Seven studies had a positive impact on quality of care outcomes. Of these studies, three related to the identification of stroke in pre-hospital settings<sup>13,24,30</sup>, two measured the impact of thrombolysis rates<sup>19,20</sup>; whilst the remaining two papers looked at time to arrival at the Emergency Department<sup>26</sup> and correct positioning<sup>15</sup>. Again, there were few commonalities between studies in terms of study design (RCT<sup>13</sup>, Quasi experimental<sup>15,19,20</sup>, interrupted time-series<sup>24</sup>, pre-post intervention study<sup>26,30</sup>); staff groups (mixed<sup>19,20,26,30</sup>, nurses<sup>15</sup>, EMS dispatchers<sup>24</sup>, paramedics<sup>13</sup>); delivery mode (face-to-face practicals, protocols and feedback<sup>19,20</sup>, manual and workbook<sup>15</sup>, on-line<sup>24</sup>, not stated<sup>13,26,30</sup>) and duration (one 4-hour session<sup>13</sup>, one 2-hour session<sup>15,24,26</sup>, not stated<sup>19,20,30</sup>).

## DISCUSSION

This is the first review that has systematically synthesised the published literature on the impact of stroke education and training of nurses and other health care staff involved in the delivery of stroke care. Two of the studies reported positive patient outcomes in relation to the modified Rankin scale<sup>18</sup> and the Functional Independence Measure<sup>23</sup>. Both of these studies were considered high quality, utilising a cluster RCT design with lower risks of bias. One further study<sup>24</sup> reported a positive impact on a quality of care outcome (dispatcher recognition of stroke) in an interrupted time series study, and also had a lower risk of bias. Eight further studies, which reported positive patient or quality of care outcomes, were of less robust study design or at higher risk of bias, or both. The remaining 10 studies did not demonstrate positive findings for their main outcome.

The impact of education and training on patient outcomes in stroke is unclear. Although four studies reported a positive impact of education and training on patient outcomes<sup>12,17,18,23</sup> the strength of evidence was varied and none used the same outcome measure. There is a clearer picture when measuring the impact of education and training on quality of care outcomes. The results of these five studies suggest that the provision of education and training to improve recognition of stroke may lead to an increase in the identification of stroke by paramedics and call handlers<sup>13,24,30</sup> and raising awareness of stroke and protocols for its treatment in the Emergency Department may increase thrombolysis rates<sup>19,20</sup>. However, there is limited evidence from two further studies that education and training may improve onset to arrival times and positioning or posture<sup>15,26</sup>.

The risk of bias varied across the included studies. The risk of attrition and selection bias was often unclear and could have been minimised by robust study design and reporting.

There were further limitations of the studies included. Methodologically, the 21 included studies all shared a common key limitation, in that none conducted comparisons of two or more methods of

educational delivery in order to determine the most effective delivery method(s). Studies often had small sample sizes with high attrition rates and unrepresentative samples. Almost half of the included studies did not report the number of health care personnel that received education and training, and very few reported rates of uptake and/or completion of education and training. Studies varied in the quality of the information reported regarding the content, delivery and duration of the education and training programmes provided. However, the two most recent studies<sup>16,24</sup> were both of higher quality. In numerous studies the educational programme was just one part of a multi-faceted intervention, of which education and training was only one component, making it difficult to evaluate the actual effectiveness of the education and training delivered.

Due to limited resources, only studies in the English language were included and authors of included studies were not contacted for clarification or further information. It is possible that some studies were excluded where they related to staff education and training in general settings (e.g. general medical or rehabilitation wards), where a proportion of the patients had had a stroke, but where study outcomes for people who had experienced stroke were not reported separately.

It is well established that stroke survivors whose care is provided by a multi-disciplinary team who specialise in stroke care are more likely to be alive, independent, and living at home one year after stroke<sup>5</sup>. It could be argued that an education and training programme that reflects the complex multi-disciplinary ethos of stroke care might be more effective in improving outcomes, than initiatives which focus on the delivery of profession-specific education and training for single staff groups. However, as reported in this review, only nine studies used a multi-disciplinary approach to education and training, and nurses in particular were often taught alone.

Continuing education and training in healthcare can be classified as a complex intervention<sup>32</sup>. As with any complex intervention, clearly defined implementation strategies may facilitate the



systematic uptake of educational interventions, and fidelity practices may increase the degree to which the constituent components of an education and training intervention are delivered as planned<sup>33</sup>. It is necessary to conduct robust implementation research in order to translate findings across disciplines and settings. However, only eight studies considered the barriers to the implementation of education and training interventions, and there was a dearth of reporting of detailed implementation strategies. It is recommended that future educational interventions are underpinned with explicit theory that details implementation processes.

The included studies used a variety of delivery methods, with the majority using interactive teaching methods rather than taking a purely didactic approach. Although few studies discussed the theoretical underpinning of their educational approach, the prevalence of the use of interactive methods is consistent with andragogic teaching philosophies<sup>34</sup>. Such approaches are appropriate for programmes of adult learning with health care staff.

Recent advances in the use of information technology as a tool for facilitating student learning (e-learning), particularly for those accessing courses from the practice setting<sup>35</sup>, have the potential to transform continuing professional development in health care. Only one study reported the use of e-learning, although this is unsurprising in relation to the older studies included in this review.

In terms of the Stroke-Specific Education Framework Elements of care, the available evidence is dominated by studies of urgent response, acute stroke assessment and treatment, and specialist rehabilitation. There are few studies of seamless transfer of care, long-term care, and review, and no studies of managing risk, information, user involvement, treatment of TIA, end of life care, participation in community, and return to work. This dominance of the evidence base by studies in the pre-hospital, acute and rehabilitation stages of the stroke pathway, and lack of evidence in other aspects of stroke care, mirrors the distribution of research into stroke interventions themselves (not just educational interventions).

The effectiveness of different approaches for delivery will be related to the content, learner group, setting and mode of evaluation. Therefore it is not possible to recommend a concise summary of interventions, as this would be an over simplification. However, structured summaries of stroke-related knowledge and skills, according to professional role, are available from the SSEF website <http://www.stroke-education.org.uk/>.

### Conclusions

Education and training can improve outcomes for people who have experienced stroke. Practice educators should consider the delivery of interactive education and training delivered to multi-disciplinary groups, and the use of protocols or guidelines which tend to be associated with a positive impact on both patient and quality of care outcomes. Although there were some studies that reported positive results, there was wide heterogeneity of design, interventions and outcomes. Future research should incorporate a robust design including publication of carefully selected patient and quality of care outcome measures, which reflect the educational intervention and facilitate future meta-analysis.

### Competing interests

There are no competing interests to declare.

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Figure 1. Flow diagram of included studies

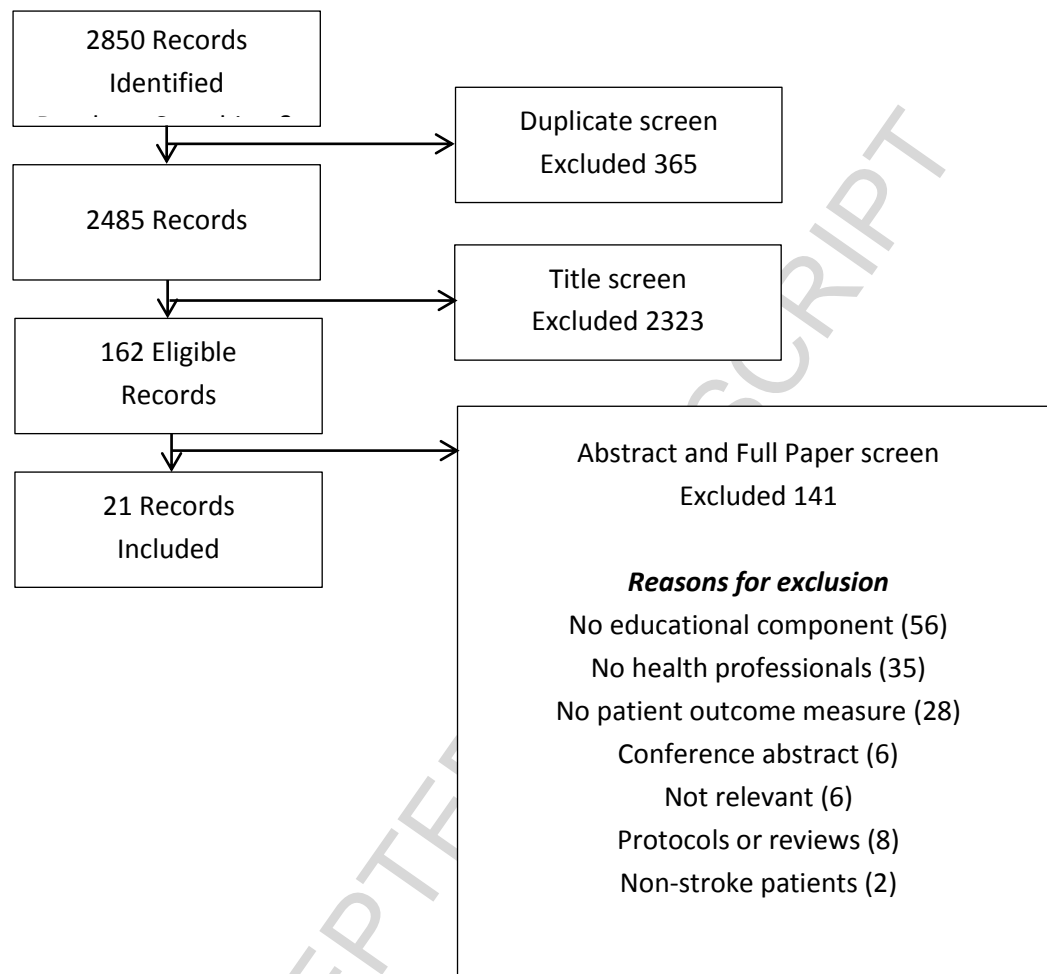




Figure 2. Risk of bias

|                               | <b>Selection bias</b> | <b>Performance bias</b> | <b>Detection bias</b> | <b>Attrition bias</b> | <b>Reporting bias</b> |
|-------------------------------|-----------------------|-------------------------|-----------------------|-----------------------|-----------------------|
| <b>Amato 2006</b>             | Unclear               | High                    | Unclear               | Unclear               | High                  |
| <b>Behrens 2002</b>           | Unclear               | High                    | Unclear               | Unclear               | High                  |
| <b>Booth 2005</b>             | Unclear               | High                    | Unclear               | Low                   | High                  |
| <b>DeLuca 2008</b>            | Unclear               | High                    | Unclear               | Unclear               | High                  |
| <b>Forster 1999</b>           | Unclear               | High                    | Unclear               | Unclear               | Unclear               |
| <b>Forster 2013</b>           | Unclear               | High                    | Low                   | Unclear               | Low                   |
| <b>Frendl 2009</b>            | Unclear               | High                    | Unclear               | Unclear               | Low                   |
| <b>Herr-Wilbert 2010</b>      | Unclear               | High                    | Unclear               | High                  | High                  |
| <b>Hohmann 2009</b>           | Low                   | High                    | Low                   | Unclear               | Low                   |
| <b>Jones 1998</b>             | Low                   | High                    | Unclear               | High                  | High                  |
| <b>Jones 2005</b>             | Low                   | High                    | Unclear               | Unclear               | High                  |
| <b>Kavanagh 2006</b>          | Unclear               | High                    | Unclear               | Unclear               | High                  |
| <b>Middleton 2011</b>         | Unclear               | High                    | Low                   | Unclear               | Low                   |
| <b>Morgenstern 2002</b>       | Unclear               | High                    | Low                   | Unclear               | Low                   |
| <b>Morgenstern 2003</b>       | Unclear               | High                    | Low                   | Unclear               | Low                   |
| <b>Nikopoulou-Smyrni 2007</b> | Unclear               | High                    | Low                   | Unclear               | Low                   |
| <b>Nir 2006</b>               | High                  | High                    | Low                   | Unclear               | High                  |
| <b>Smith 1999</b>             | High                  | High                    | High                  | Unclear               | Low                   |
| <b>Strasser 2008</b>          | Low                   | High                    | Unclear               | Unclear               | Low                   |
| <b>Watkins 2013</b>           | Unclear               | High                    | Unclear               | Unclear               | Low                   |
| <b>Wojner-Alexandrov 2005</b> | Unclear               | High                    | Unclear               | Unclear               | High                  |

Table 1: SSEF Elements of Care

|  |
|--|
| 1) Awareness Raising                             |
| 2) Managing risk                                 |
| 3) Information                                   |
| 4) User involvement                              |
| 5) Assessment – Transient Ischaemic Attack (TIA) |
| 6) Treatment – TIA                               |
| 7) Urgent response                               |
| 8) Assessment – Stroke                           |
| 9) Treatment – Stroke                            |
| 10) Specialist rehabilitation                    |
| 11) End of life care                             |
| 12) Seamless transfer of care                    |
| 13) Long term care                               |
| 14) Review                                       |
| 15) Participation in the community               |
| 16) Return to work                               |

Table 2: Summary of Included Studies

| Author, Year;<br>Country               | Study Type  | Setting                | Staff Participants  | Completion of<br>training | Patient<br>Participants | Mean<br>Patient Age | % Patients<br>Female; Male | Main<br>Outcome<br>Measure |
|--|---|------------------------|---|---------------------------|-------------------------|---------------------|----------------------------|----------------------------|
| <b>Amato 2006;</b><br><b>USA</b>       | Pre Post<br>intervention<br>observational<br>(2 separate<br>convenience<br>samples) | Rehabilitation         | Nurses, N not<br>stated   | NS                        | NS                      | NS                  | NS                         | Patient                    |
| <b>Behrens 2002;</b><br><b>Germany</b> | Pre Post-test<br>intervention<br>study  | Pre-hospital/<br>Acute | 345, dispatchers,<br>paramedics,<br>doctors and<br>neurologists | NS                        | 143                     | NS                  | 45%;55%                    | Quality of care            |
| <b>Booth 2005;</b><br><b>UK</b>        | Quasi-<br>experimental  | Rehab                  | 26 nurses   | NS                        | 37                      | NS                  | NS                         | Quality of care            |

| Author, Year;<br>Country            | Study Type                                | Setting                | Staff Participants  | Completion of<br>training | Patient<br>Participants | Mean<br>Patient Age | % Patients<br>Female; Male | Main<br>Outcome<br>Measure |
|-------------------------------------|---|------------------------|---|---------------------------|-------------------------|---------------------|----------------------------|----------------------------|
|                                     | non-equivalent<br>control group<br>design |                        |   |                           |                         |                     |                            |                            |
| <b>DeLuca 2008;</b><br><b>Italy</b> | Pre Post<br>observational<br>cohort study | Pre-hospital/<br>Acute | 324, physicians,<br>nurses,<br>emergency health<br>operators, drivers<br>& ambulance<br>technicians | NS                        | 1295                    | NS                  | NS                         | Quality of care            |

| Author, Year;<br>Country | Study Type  | Setting | Staff Participants                              | Completion of<br>training | Patient<br>Participants | Mean<br>Patient Age   | % Patients<br>Female; Male          | Main<br>Outcome<br>Measure |
|--------------------------|---|---------|---|---------------------------|-------------------------|-----------------------|-------------------------------------|----------------------------|
| Forster 1999;<br>UK      | Pre Post<br>intervention<br>observational<br>(2 separate<br>convenience<br>samples) | Rehab   | 13 qualified &<br>non-qualified<br>rehab nurses | NS                        | Pre = 26<br>Post = 24   | Pre = 78 Post =<br>77 | Pre = 54%;46%<br>Post = 71%;<br>29% | Quality of care            |

| Author, Year;<br>Country   | Study Type                                 | Setting      | Staff Participants   | Completion of<br>training | Patient<br>Participants | Mean<br>Patient Age | % Patients<br>Female; Male | Main<br>Outcome<br>Measure |
|----------------------------|--|--------------|--|---------------------------|-------------------------|---------------------|----------------------------|----------------------------|
| <b>Forster 2013;</b><br>UK | Cluster RCT                                | Acute/Rehab  | 54 (approx.) snr.<br>physiotherapists,<br>snr. occupational<br>therapists, snr.<br>nurses, staff<br>nurses, consultant<br>physicians, snr.<br>speech &<br>language<br>therapists | NS                        | 928                     | 71                  | 44%;56%                    | Patient                    |
| <b>Frendl 2009;</b><br>USA | Pre Post<br>retrospective<br>observational | Pre-hospital | Paramedics or<br>EMT, N not stated   | NS                        | 154                     | 67                  | 56%;44%                    | Quality of care            |

| Author, Year;<br>Country                      | Study Type                       | Setting                   | Staff Participants                              | Completion of<br>training | Patient<br>Participants                | Mean<br>Patient Age                   | % Patients<br>Female; Male                          | Main<br>Outcome<br>Measure |
|---|----------------------------------|---------------------------|---|---------------------------|--|---------------------------------------|---|----------------------------|
| <b>Herr-Wilbert<br/>2010;<br/>Switzerland</b> | Cohort                           | Rehab                     | 16 nurses                                       | NS                        | 44                                     | 75                                    | 43%;57%   | Patient                    |
| <b>Hohmann<br/>2009; Germany</b>              | Non-<br>randomised<br>controlled | Acute/rehab/co<br>mmunity | 23 community –<br>based<br>pharmacists          | NS                        | Control = 165,<br>Intervention =<br>90 | Control = 68,<br>Intervention =<br>68 | Control =<br>35%;65%,<br>Intervention =<br>34%;66%  | Patient                    |
| <b>Jones 1998; UK</b>                         | Quasi-<br>experimental           | Rehab/ general<br>wards   | 59 nurses and<br>HCAs                           | 59 (100%)                 | 38                                     | 73                                    | 74%;26%   | Quality of care            |
| <b>Jones 2005; UK</b>                         | Cluster RCT                      | Rehab                     | All trained nurses<br>and HCAs, N not<br>stated | NS                        | 120                                    | Control = 71,<br>Intervention =<br>75 | Control =<br>50%;50%,<br>Intervention =<br>63%; 37% | Patient                    |

| Author, Year;<br>Country             | Study Type  | Setting                | Staff Participants      | Completion of<br>training | Patient<br>Participants | Mean<br>Patient Age                            | % Patients<br>Female; Male | Main<br>Outcome<br>Measure |
|--------------------------------------|---|------------------------|-------------------------|---------------------------|-------------------------|--|----------------------------|----------------------------|
| <b>Kavanagh<br/>2006; USA</b>        | Pre Post<br>intervention<br>observational<br>(2 separate<br>convenience<br>samples) | Acute                  | Mixed, N not<br>stated  | NS                        | 41                      | 64   | 55%;45%                    | Patient                    |
| <b>Middleton<br/>2011; Australia</b> | Cluster RCT   | Acute                  | Nurses, N not<br>stated | NS                        | 1696                    | <65<br>Control = 28%,<br>Intervention =<br>31% | 40%;60%                    | Quality of care            |
| <b>Morgenstern<br/>2002; USA</b>     | Quasi-<br>experimental<br>comparison  | Pre-Hospital/<br>Acute | Mixed, N not<br>stated  | NS                        | 1189 (Phase 1 &<br>2)   | 72   | 20%;80%                    | Quality of care            |



| Author, Year;<br>Country         | Study Type  | Setting                | Staff Participants     | Completion of<br>training | Patient<br>Participants | Mean<br>Patient Age | % Patients<br>Female; Male | Main<br>Outcome<br>Measure |
|----------------------------------|---|------------------------|------------------------|---------------------------|-------------------------|---------------------|----------------------------|----------------------------|
|                                  | group design<br>with 2<br>communities   |                        |                        |                           |                         |                     |                            |                            |
| <b>Morgenstern<br/>2003; USA</b> | Quasi-<br>experimental<br>comparison<br>group design<br>with 2<br>communities | Pre-Hospital/<br>Acute | Mixed, N not<br>stated | NS                        | 238 (Phase 3)           | 72                  | 57%;43%                    | Quality of care            |

| Author, Year;<br>Country          | Study Type               | Setting      | Staff Participants   | Completion of<br>training | Patient<br>Participants | Mean<br>Patient Age | % Patients<br>Female; Male | Main<br>Outcome<br>Measure |
|-----------------------------------|--------------------------|--------------|--|---------------------------|-------------------------|---------------------|----------------------------|----------------------------|
| Nikopoulou-<br>Smyrni 2007;<br>UK | RCT                      | Acute        | 12 doctors,<br>nurses,<br>physiotherapists<br>and occupational<br>therapists | 12 (100%)                 | 49                      | NS                  | NS                         | Quality of care            |
| Nir 2006; Israel                  | Pre Post<br>Intervention | Rehab        | Senior nursing<br>students, N not<br>stated                                  | NS                        | 155                     | 73                  | 48%;52%                    | Quality of care            |
| Smith 1999;<br>USA                | RCT                      | Pre-hospital | 22 paramedics  | 22 (100%)                 | 121                     | NS                  | NS                         | Quality of care            |

| Author, Year;<br>Country     | Study Type                 | Setting      | Staff Participants  | Completion of<br>training | Patient<br>Participants | Mean<br>Patient Age | % Patients<br>Female; Male | Main<br>Outcome<br>Measure |
|------------------------------|----------------------------|--------------|---|---------------------------|-------------------------|---------------------|----------------------------|----------------------------|
| <b>Strasser 2008;</b><br>USA | Cluster RCT                | Rehab        | 227 rehabilitation<br>Unit staff:<br>medicine, nursing,<br>occupational<br>therapy, speech<br>and language<br>pathology,<br>physical therapy,<br>social work. | NS                        | 1374                    | 67                  | 27%;73%                    | Patient                    |
| <b>Watkins 2013;</b><br>UK   | Interrupted<br>time series | Pre-hospital | 69 emergency<br>medical<br>dispatchers  | 69 (100%)                 | 464                     | 75                  | 52%;48%                    | Quality of care            |

| Author, Year;<br>Country                    | Study Type                                | Setting                | Staff Participants     | Completion of<br>training | Patient<br>Participants | Mean<br>Patient Age | % Patients<br>Female; Male | Main<br>Outcome<br>Measure |
|---|---|------------------------|------------------------|---------------------------|-------------------------|---------------------|----------------------------|----------------------------|
| <b>Wojner-<br/>Alexandrov<br/>2005; USA</b> | Pre Post<br>intervention<br>observational | Pre-hospital/<br>acute | Mixed, N not<br>stated | NS                        | 1522                    | 69                  | 56%;44%                    | Quality of care            |

N: number; NS: not stated; RCT: randomised controlled trial; snr: senior

Table 3: Summary of education and training interventions

| Author, Year        | Who Received<br>Education and<br>Training                                   | Content of Education<br>and Training   | Format of Delivery                                  | Method of<br>Delivery     | Who Delivered<br>Education and<br>Training                   | Frequency and<br>Duration            | Barriers To<br>Implementation<br>Considered |
|---------------------|---|--|---|---------------------------|--|--------------------------------------|---|
| <b>Amato 2006</b>   | Nurses  | Restraint reduction<br>and falls   | Face-to-face  | NS                        | Clinical nurse<br>specialist                                 | Ongoing, duration<br>not specified   | Y   |
| <b>Behrens 2002</b> | Mixed (Including<br>Paramedics/<br>technicians,<br>Dispatchers,<br>Doctors) | Stroke symptoms,<br>taking medical<br>histories, pre-alerting,<br>stroke as a medical<br>emergency | Face-to-face  | NS                        | Member of the<br>stroke project<br>team                      | One, 2 hour session<br>(repeated)    | NS  |
| <b>Booth 2005</b>   | Nurses  | Handling and<br>positioning patients   | Face-to-face<br>lectures, videos,<br>demonstrations | Didactic &<br>Interactive | Senior<br>physiotherapists<br>and Occupational<br>therapists | Two, 3.5 hour<br>sessions (repeated) | NS  |

| Author, Year        | Who Received Education and Training                                      | Content of Education and Training  | Format of Delivery   | Method of Delivery     | Who Delivered Education and Training                 | Frequency and Duration                               | Barriers To Implementation Considered |
|---------------------|--|--|--|------------------------|--|--|---------------------------------------|
| <b>De Luca 2008</b> | Mixed (Including Paramedics/ technicians, Dispatchers, Nurses, Doctors). | Emergency stroke care pathways   | Face-to-face lectures, videos, reflective practice, on-the-job support     | Didactic & Interactive | Emergency care pathway co-ordinators                 | Multiple sessions, duration not specified            | Y                                     |
| <b>Forster 1999</b> | Nurses   | Pathology, skeletal knowledge, normal movement, positioning upper limb/lower limb, gait, aids and appliances | Face-to-face lectures, videos, demonstrations, workshops/ group discussion | Didactic & Interactive | Physiotherapy lecturer and 3 senior physiotherapists | Multiple sessions, duration not specified (repeated) | Y                                     |

| Author, Year        | Who Received Education and Training  | Content of Education and Training   | Format of Delivery   | Method of Delivery     | Who Delivered Education and Training                              | Frequency and Duration | Barriers To Implementation Considered |
|---------------------|--|---|--|------------------------|---|------------------------|---------------------------------------|
| <b>Forster 2013</b> | Mixed (Including Nurses, Doctors, Physiotherapists, Occupational therapists, Speech and language therapists) | 14 core carer competencies  | Face-to-face, lecture, training CD, manual/ workbook, workshops/ group discussions | Didactic & Interactive | Members of the MDT who were part of the study implementation team | Two, 1 day sessions    | NS                                    |
| <b>Frendl 2009</b>  | Paramedics/ technicians  | Stroke recognition and the use of the Cincinnati Pre-hospital Stroke Scale (CPSS) | Face-to-face, videos, workshops/ group discussion                                  | Didactic & Interactive | NS  | One, 1 hour session    | NS                                    |

| Author, Year             | Who Received Education and Training | Content of Education and Training   | Format of Delivery                       | Method of Delivery | Who Delivered Education and Training | Frequency and Duration                    | Barriers To Implementation Considered |
|--------------------------|-------------------------------------|---|--|--------------------|--------------------------------------|---|---------------------------------------|
| <b>Herr-Wilbert 2010</b> | Nurses                              | Anatomy, physiology and pathology of the urinary tract, urinary incontinence (UI) and treatments, identifying risks and signs of UI | Manual/ workbook                         | NS                 | NS                                   | NS  | Y                                     |
| <b>Hohmann 2009</b>      | Pharmacists                         | Stroke, risk factors, symptoms, pharmaceutical care, secondary prevention   | Face-to-face, workshop/ group discussion | NS                 | NS                                   | Multiple sessions, duration not specified | NS                                    |
| <b>Jones 1998</b>        | Nurses, HCAs                        | Aetiology of stroke, factors influencing  | Face-to-face, manual/ workbook           | Didactic           | Nursing lecturer                     | Two, 2 hour sessions (repeated)           | N                                     |



| Author, Year         | Who Received Education and Training | Content of Education and Training             | Format of Delivery   | Method of Delivery     | Who Delivered Education and Training | Frequency and Duration                        | Barriers To Implementation Considered |
|----------------------|-------------------------------------|---|--|------------------------|--------------------------------------|---|---------------------------------------|
|                      |                                     | recovery, MDT role in rehabilitation          |  |                        |                                      |   |                                       |
| <b>Jones 2005</b>    | Nurses, HCAs                        | Moving, handling, and positioning of patients | Face-to-face lectures, manual/ workbook, practical workshops/ group discussion | Didactic & Interactive | 2 nursing lecturers                  | One, 1 day session plus two, 0.5 day sessions | NS                                    |
| <b>Kavanagh 2006</b> | Mixed (Not Specified)               | American Stroke Association (ASA) guidelines  | Face-to-face, practical, feedback  | Interactive            | Nurse educators                      | NS  | Y                                     |

| Author, Year                | Who Received Education and Training        | Content of Education and Training                            | Format of Delivery   | Method of Delivery     | Who Delivered Education and Training | Frequency and Duration               | Barriers To Implementation Considered |
|-----------------------------|--|--|--|------------------------|--------------------------------------|--------------------------------------|---------------------------------------|
| <b>Middleton<br/>2011</b>   | Nurses                                     | Clinical treatment protocols for fever, sugar and swallowing | Face-to-face, lectures, training CD, protocol, practical, on-the-job support, workshops/ discussions | Didactic & Interactive | NS                                   | Two sessions, duration not specified | Y                                     |
| <b>Morgenstern<br/>2002</b> | Mixed (Including Doctors, Primary care/GP) | Increasing awareness of stroke treatment protocols in the ED | Face-to-face, protocol, practical, feedback  | Didactic & Interactive | NS                                   | NS                                   | Y                                     |

| Author, Year                  | Who Received Education and Training  | Content of Education and Training                            | Format of Delivery                          | Method of Delivery     | Who Delivered Education and Training | Frequency and Duration | Barriers To Implementation Considered |
|-------------------------------|--|--|---|------------------------|--------------------------------------|------------------------|---------------------------------------|
| <b>Morgenstern 2003</b>       | Mixed (Including Doctors, Primary care/GP)                                   | Increasing awareness of stroke treatment protocols in the ED | Face to face, protocol, practical, feedback | Didactic & Interactive | NS                                   | NS                     | Y                                     |
| <b>Nikopoulou-Smyrni 2007</b> | Mixed (Including Nurses, Doctors, Physiotherapists, Occupational therapists) | Clinical reasoning in the assessment of stroke               | NS  | NS                     | NS                                   | NS                     | NS                                    |
| <b>Nir 2006</b>               | Nursing students   | Chronic and rehabilitative care, communication,              | Manual/ workbook, practical                 | NS                     | Member of study team                 | One, 2 hour session    | NS                                    |

| Author, Year      | Who Received Education and Training | Content of Education and Training  | Format of Delivery | Method of Delivery | Who Delivered Education and Training | Frequency and Duration | Barriers To Implementation Considered |
|-------------------|-------------------------------------|--|--------------------|--------------------|--------------------------------------|------------------------|---------------------------------------|
|                   |                                     | clinical nutrition,<br>correct use of<br>medication therapy.   |                    |                    |                                      |                        |                                       |
| <b>Smith 1999</b> | Paramedics/<br>technicians          | Stroke anatomy and<br>physiology, stroke<br>symptoms, National<br>Institutes of Health<br>Stroke Scale (NIHSS) | NS                 | NS                 | NS                                   | One, 4 hour session    | NS                                    |

|                      |  |  |  |             |  |                      |    |
|----------------------|--|--|--|-------------|--|----------------------|----|
| <b>Strasser 2008</b> | Mixed (Including Nurses, Doctors, Physiotherapists, Occupational therapists, Speech and language therapists, Social workers) | Team working, problem solving, and quality of care skills    | Face-to-face workshop, written action plans, telephone and videoconferences. | Interactive | 30 Team leaders (Physicians, Osteopaths, Nurses, Physiotherapists, Occupational therapists, Kinesiotherapists, Social workers, Speech and language therapists, Administrators) | One, 2.5 day session | NS |
| <b>Watkins 2013</b>  | Dispatchers  | Recognition of stroke, risk factors, stroke symptoms, stroke | On-line course   | Didactic    | EMS trainers trained to cascade the  | One, 2 hour session  | NS |

| Author, Year                  | Who Received Education and Training       | Content of Education and Training   | Format of Delivery | Method of Delivery | Who Delivered Education and Training | Frequency and Duration | Barriers To Implementation Considered |
|-------------------------------|---|---|--------------------|--------------------|--------------------------------------|------------------------|---------------------------------------|
|                               |   | mimics, effective communication with callers  |                    |                    | programme on-line.                   |                        |                                       |
| <b>Wojner-Alexandrov 2005</b> | Mixed (Including Paramedics/ technicians) | Brain Attack Coalition (BAC) and American Stroke Association (ASA) guidelines, Los Angeles Pre-hospital Stroke Screen (LAPSS) | NS                 | NS                 | NS                                   | NS                     | NS                                    |

Table 4: Type of staff participating and the number of studies in which they were included

| Staff type   | Number of studies   | Number of studies where staff group taught alone |
|--|---|--|
| Mixed group  | 9 <sup>16, 19, 20, 21, 23, 26, 27, 29, 30</sup>             | n/a  |
| Doctors  | 7 <sup>16, 19, 20, 21, 23, 26, 27</sup>                     | 0  |
| Nurses (including Students & Health Care Assistants) | 12 <sup>9, 12, 14, 15, 16, 18, 21, 22, 23, 25, 27, 31</sup> | 8 <sup>9, 12, 14, 15, 18, 22, 25, 31</sup>       |
| Physiotherapists                                     | 3 <sup>16, 21, 23</sup>                                     | 0  |
| Occupational Therapists                              | 3 <sup>16, 21, 23</sup>                                     | 0  |
| Speech and Language Therapists                       | 2 <sup>16, 23</sup>   | 0  |
| Pharmacists  | 1 <sup>17</sup>   | 1 <sup>17</sup>                                  |
| Social work  | 1 <sup>23</sup>   | 0  |
| <b>Primary Care</b>                                  |   |  |
| Physicians/ General Practitioners                    | 2 <sup>19, 20</sup>   | 0  |
| Paramedics/technicians                               | 5 <sup>13, 26, 27, 28, 30</sup>                             | 2 <sup>13, 28</sup>                              |
| Dispatchers  | 3 <sup>24, 26, 27</sup>                                     | 1 <sup>24</sup>                                  |

## Highlights

- Education and training can improve outcomes for people who have experienced stroke
- Education and training should be interactive and multi-disciplinary
- Supporting protocols or guidelines are associated with a positive impact on outcome

ACCEPTED MANUSCRIPT