

# Effectiveness of Stroke Unit Care: A Special Report

Health Quality Ontario

October 2014

## Suggested Citation

This report should be cited as follows:

Health Quality Ontario. Effectiveness of stroke unit care: a special report [Internet]. Toronto: Queen's Printer for Ontario; 2014 October. 42 p. Available from: <http://www.hqontario.ca/evidence/publications-and-ohtac-recommendations/other-reports/special-reports>.

## Permission Requests

All inquiries regarding permission to reproduce any content in the *Ontario Health Technology Assessment Series* should be directed to [EvidenceInfo@hqontario.ca](mailto:EvidenceInfo@hqontario.ca).

## How to Obtain Special Reports From Health Quality Ontario

All special reports are freely available in PDF format at the following URL:  
<http://www.hqontario.ca/evidence/publications-and-ohtac-recommendations/other-reports/special-reports>.

## Conflict of Interest Statement

The members of the Division of Evidence Development and Standards at Health Quality Ontario are impartial. There are no competing interests or conflicts of interest to declare.

## About Health Quality Ontario

Health Quality Ontario is an arms-length agency of the Ontario government. It is a partner and leader in transforming Ontario's health care system so that it can deliver a better experience of care, better outcomes for Ontarians, and better value for money.

Health Quality Ontario strives to promote health care that is supported by the best available scientific evidence. The Evidence Development and Standards branch works with expert advisory panels, clinical experts, scientific collaborators, and field evaluation partners to conduct evidence-based reviews that evaluate the effectiveness and cost-effectiveness of health interventions in Ontario.

Based on the evidence provided by Evidence Development and Standards and its partners, the Ontario Health Technology Advisory Committee—a standing advisory subcommittee of the Health Quality Ontario Board—makes recommendations about the uptake, diffusion, distribution, or removal of health interventions to Ontario's Ministry of Health and Long-Term Care, clinicians, health system leaders, and policy-makers.

Health Quality Ontario's research is published as part of the *Ontario Health Technology Assessment Series*, which is indexed in MEDLINE/PubMed, Excerpta Medica/Embase, and the Centre for Reviews and Dissemination database. Corresponding Ontario Health Technology Advisory Committee recommendations and other associated reports are also published on the Health Quality Ontario website. Visit <http://www.hqontario.ca> for more information.

## About Health Quality Ontario Publications

To conduct its analyses, Evidence Development and Standards and its research partners review the available scientific literature, making every effort to consider all relevant national and international research; collaborate with partners across relevant government branches; consult with expert advisory panels, clinical and other external experts, and developers of health technologies; and solicit any necessary supplemental information.

In addition, Evidence Development and Standards collects and analyzes information about how a health intervention fits within current practice and existing treatment alternatives. Details about the diffusion of the intervention into current health care practices in Ontario add an important dimension to the review. Information concerning the health benefits, economic and human resources, and ethical, regulatory, social, and legal issues relating to the intervention may be included to assist in making timely and relevant decisions to optimize patient outcomes.

## Disclaimer

This report was prepared by the Evidence Development and Standards branch at Health Quality Ontario or one of its research partners for the Ontario Health Technology Advisory Committee and was developed from analysis, interpretation, and comparison of scientific research. It also incorporates, when available, Ontario data and information provided by experts and applicants to HQO. The analysis may not have captured every relevant publication and relevant scientific findings may have been reported since the development of this recommendation. This report may be superseded by an updated publication on the same topic. Please check the Health Quality Ontario website for a list of all publications: <http://www.hqontario.ca/evidence/publications-and-ohtac-recommendations..>

# Abstract

---

## Background

A stroke is a sudden loss of brain function caused by either the interruption of blood flow to the brain (ischemic stroke) or the rupture of blood vessels within the brain (hemorrhagic stroke). Approximately 80% of strokes are ischemic and 20% are hemorrhagic.

## Objective

To determine the effectiveness of a stroke unit compared with a general medical ward for the management of stroke.

## Data Sources

A literature search was performed using Ovid MEDLINE, Ovid MEDLINE In-Process and Other Non-Indexed Citations, OVID Embase, EBSCO Cumulative Index to Nursing & Allied Health Literature (CINAHL), the Wiley Cochrane Library, and the Centre for Reviews and Dissemination database, for studies published from January 1, 2006, until December 6, 2011.

## Review Methods

Abstracts were reviewed by a single reviewer, and full-text articles were obtained for studies meeting the eligibility criteria. Where appropriate, a meta-analysis was undertaken for explicit outcomes to determine the pooled estimate of effect of a stroke unit compared with a general medical ward. The degree of statistical heterogeneity among studies was assessed using the  $I^2$  statistic for each outcome. The quality of evidence was assessed according to the GRADE Working Group criteria.

## Results

One relevant Cochrane systematic review was obtained from the literature search, from which 11 randomized controlled trials met the inclusion criteria. Moderate quality evidence showed that, compared to persons admitted to a general medical ward, those admitted to a stroke unit had a 19% reduction in death, a 20% reduction in death or institutionalization, and a 21% reduction in institutionalization. Low quality evidence showed that there was a 13% reduction in death or dependency, and a 12-day reduction in the length of hospital stay in persons admitted to a stroke unit.

## Limitations

Published data were extracted from original reports. Unpublished data reported in the 2009 Cochrane review were included in the meta-analysis.

## Conclusions

Moderate quality evidence showed that persons admitted to a stroke unit had a significant reduction in death and the combined outcome of death or institutionalization, and a nonsignificant reduction in institutionalization. Low quality evidence showed that patients admitted to a stroke unit had a significant

reduction in the combined outcome of death or dependency and length of hospital stay and a nonsignificant reduction in the outcome of dependency.

# Plain Language Summary

---

A stroke is a sudden loss of brain function caused by interrupted blood flow to the brain or ruptured blood vessels in the brain. A stroke unit is a hospital ward dedicated to caring for people who have had a stroke. Nurses, doctors, and therapists who are experts in stroke provide care and work as a team. Not all hospitals have a stroke unit. In these hospitals, care is provided in a general medical ward. This review looked at how treatment in a stroke unit compares with treatment in a general medical ward. We looked at 11 studies involving 2,268 participants and found that patients who receive care in a stroke unit are more likely to survive and less likely to need long-term care. They also have shorter hospital stays.

# Table of Contents

---

<b>List of Tables</b> .....	<b>8</b>
<b>List of Figures</b> .....	<b>9</b>
<b>List of Abbreviations</b> .....	<b>10</b>
<b>Background</b> .....	<b>11</b>
Objective of Analysis .....	11
Clinical Need and Target Population.....	11
<i>Description of Condition</i> .....	11
<i>Prevalence and Incidence</i> .....	11
<i>Ontario Context</i> .....	11
Technology/Technique .....	11
<b>Evidence-Based Analysis</b> .....	<b>13</b>
Research Question .....	13
Research Methods.....	13
<i>Literature Search</i> .....	13
<i>Inclusion Criteria</i> .....	13
<i>Exclusion Criteria</i> .....	13
<i>Outcomes of Interest</i> .....	13
Statistical Analysis .....	14
Quality of Evidence .....	14
Results of Evidence-Based Analysis .....	15
<i>Meta-analysis</i> .....	22
<b>Conclusions</b> .....	<b>27</b>
<b>Existing Guidelines for Technology</b> .....	<b>28</b>
<b>Acknowledgements</b> .....	<b>30</b>
<b>Appendices</b> .....	<b>32</b>
Appendix 1: Literature Search Strategies .....	32
Appendix 2: Evidence Quality Assessment.....	36
<b>References</b> .....	<b>38</b>

# List of Tables

---

Table 1: Body of Evidence Examined According to Study Design .....	16
Table 2: Citation Status.....	17
Table 3: Characteristics of Studies Included for Analysis .....	18
Table 4: Proportion of Stroke Types Included in Studies .....	19
Table 5: Process Characteristics of Stroke Units .....	21
Table A1: GRADE Evidence Profile for Comparison of Stroke Units With General Medical Wards.....	36
Table A2: Risk of Bias Among Randomized Controlled Trials for the Comparison of Stroke Units With General Medical Wards .....	37



# List of Figures

---

Figure 1: Citation Flow Chart .....	15
Figure 2: Death .....	22
Figure 3: Death or Institutionalization .....	23
Figure 4: Institutionalization .....	23
Figure 5: Death or Dependency .....	24
Figure 6: Dependency .....	25
Figure 7: Length of Hospital Stay .....	26

# List of Abbreviations

---

<b>GRADE</b>	Grading of Recommendations Assessment, Development and Evaluation
<b>RCT</b>	Randomized controlled trial
<b>TIA</b>	Transient ischemic attack

# Background

---

## Objective of Analysis

The objective of this evidence-based analysis was to determine the effectiveness of a stroke unit compared with a general medical ward for the management of stroke.

## Clinical Need and Target Population

### Description of Condition

A stroke is a sudden loss of brain function caused by interruption of blood flow to the brain (ischemic stroke) or rupture of blood vessels within the brain (hemorrhagic stroke). Stroke can affect many functions, including the ability to move, see, remember, speak, reason, read, and write. (1) Approximately 80% of strokes are ischemic, and 20% are hemorrhagic. (1)

A transient ischemic attack (TIA), also known as a mini-stroke, is caused by a temporary interruption of blood flow to the brain. A TIA is an important warning sign that individuals are at increased risk of a complete stroke. (1)

### Prevalence and Incidence

Stroke is the leading cause of adult neurologic disability in Canada; about 300,000 people (1% of the population) live with its effects. (2)

In 2009, 10,238 men and 9,764 women presented to an emergency department in Ontario with a stroke or TIA. (3) The mean age was 72 years; more than half were between 66 and 84 years of age. Thirty-seven percent had a TIA, 5% had an ischemic stroke, and 9% had a hemorrhagic stroke; in 50%, the stroke type could not be determined. (3) About 1 in 3 stroke and TIA patients seeks medical attention within 2.5 hours of stroke onset. (3)

### Ontario Context

In 2008/2009, 30.3% of patients admitted to hospital with stroke or TIA spent some part of their hospital stay in a stroke unit. (3) This represents an increase from 2.7% in 2002/2003 and 18.6% in 2004/2005. (3)

## Technology/Technique

A stroke unit is a geographically discrete area in a hospital and comprises a multidisciplinary team of stroke care specialists who provide a complex package of care exclusively to persons who have had a stroke. (4) A stroke unit can be classified as acute, rehabilitation, or comprehensive (combines both acute and rehabilitation services). (4) Acute stroke units can be further classified as intensive, semi-intensive, or non-intensive. An intensive stroke unit has continuous monitoring, high nurse staffing levels, and life-support services. A semi-intensive stroke unit is similar to an intensive stroke unit, but without life-support capabilities. A non-intensive stroke unit has none of the features of intensive or semi-intensive stroke units. (4)

Because a stroke unit is a complex organizational intervention, the key factors responsible for its effectiveness remain unknown, but organizational structure and processes of care may have an influence.

(5) Consistent characteristics of a stroke unit include the following (5):

- a multidisciplinary team
- coordination of care through regular multidisciplinary meetings
- comprehensive assessment of medical problems and impairments
- disabilities; active physiological management
- early mobilization and avoidance of bed rest
- skilled nursing care
- early setting of rehabilitation plans involving carers
- early assessment
- planning of discharge needs

# Evidence-Based Analysis

---

## Research Question

What is the effectiveness of a stroke unit compared with a general medical ward on system- and patient-level outcomes for the management of stroke?

## Research Methods

### Literature Search

#### *Search Strategy*

A preliminary literature search identified 1 Cochrane database systematic review (4) and 1 web-based systematic review, (6) with literature search dates up to and including 2006 and 2011, respectively.

Another literature search was performed on December 6, 2011, using Ovid MEDLINE, Ovid MEDLINE In-Process and Other Non-Indexed Citations, Ovid Embase, EBSCO Cumulative Index to Nursing & Allied Health Literature (CINAHL), the Wiley Cochrane Library, and the Centre for Reviews and Dissemination database, for studies published from January 1, 2006, to December 6, 2011. (Appendix 1 provides details of the search strategies.) Abstracts were reviewed by a single reviewer and, for those studies meeting the eligibility criteria, full-text articles were obtained. Reference lists were also examined for any additional relevant studies not identified through the search.

### Inclusion Criteria

- English-language full-text publications
- published between January 1, 2006, and December 6, 2011
- randomized controlled trials (RCTs), systematic reviews, and meta-analyses of RCTs
- evaluation of organized stroke unit care based in a discrete ward with a dedicated stroke team
- general medical ward as the comparator
- adult population hospitalized for ischemic stroke

### Exclusion Criteria

- studies evaluating mobile stroke teams
- non-RCT study designs
- grey literature, including PhD theses, abstracts, and personal communications

### Outcomes of Interest

- death
- death or institutionalization
- institutionalization
- death or dependency
- dependency
- length of hospital stay

## Statistical Analysis

Where appropriate, a meta-analysis was undertaken for explicit outcomes to determine the pooled estimate of effect of a stroke unit compared with a general medical ward, using Review Manager 5, version 5.1.6. (7) Relative risk was used as the pooled summary estimate for binary data, and mean difference was used for continuous data.

The degree of statistical heterogeneity among studies was assessed using the  $I^2$  statistic for each outcome. A fixed- or random-effects model was used, following the guidance of the Cochrane handbook. (8) An  $I^2 > 50\%$  was considered to be substantial heterogeneity; in such cases, a subgroup analysis was undertaken (8) comparing comprehensive stroke units and rehabilitation stroke units.

## Quality of Evidence

The quality of the body of evidence for each outcome was examined according to the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) Working Group criteria. (9) The overall quality was determined to be high, moderate, low, or very low using a step-wise, structural methodology.

Study design was the first consideration; the starting assumption was that RCTs are high quality, whereas observational studies are low quality. Five additional factors—risk of bias, inconsistency, indirectness, imprecision, and publication bias—were then taken into account. Limitations in these areas resulted in downgrading the quality of evidence. Finally, 3 main factors that may raise the quality of evidence were considered: the large magnitude of effect, the dose response gradient, and any residual confounding factors. (9) For more detailed information, please refer to the latest series of GRADE articles. (9)

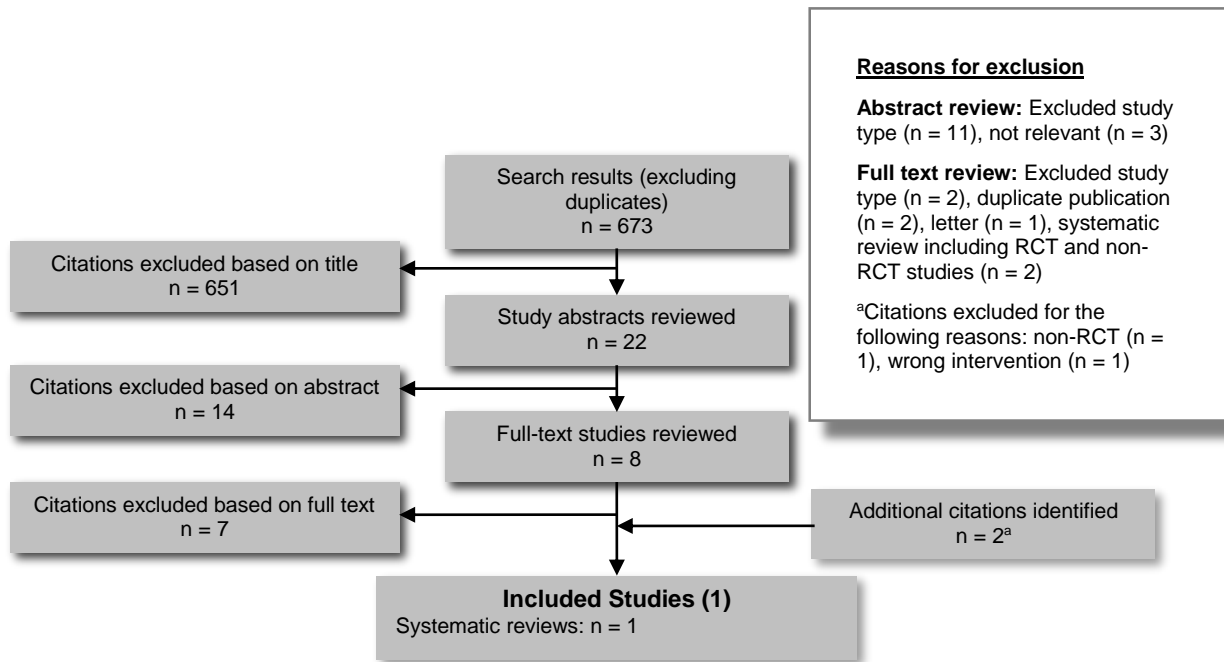
As stated by the GRADE Working Group, the final quality score can be interpreted using the following definitions:

<b>High</b>	High confidence in the effect estimate—the true effect lies close to the estimate of the effect
<b>Moderate</b>	Moderate confidence in the effect estimate—the true effect is likely to be close to the estimate of the effect, but may be substantially different
<b>Low</b>	Low confidence in the effect estimate—the true effect may be substantially different from the estimate of the effect
<b>Very Low</b>	Very low confidence in the effect estimate—the true effect is likely to be substantially different from the estimate of the effect

# Results of Evidence-Based Analysis

The database search yielded 673 citations published between January 1, 2006, and December 6, 2011 (with duplicates removed). Articles were excluded based on information in the title and abstract. The full texts of potentially relevant articles were obtained for further assessment. Figure 1 shows the breakdown of when and for what reason citations were excluded from the analysis.

One study (a Cochrane systematic review) met the inclusion criteria. (4)



**Figure 1: Citation Flow Chart**

Abbreviation: RCT, randomized controlled trial.

For each included study, the study design was identified and is summarized below in Table 1, a modified version of a hierarchy of study design by Goodman. (10)

**Table 1: Body of Evidence Examined According to Study Design**

Study Design	Number of Eligible Studies
<b>RCT Studies</b>	
Systematic review of RCTs	1
Large RCT	
Small RCT	
<b>Observational Studies</b>	
Systematic review of non-RCTs with contemporaneous controls	
Non-RCT with non-contemporaneous controls	
Systematic review of non-RCTs with historical controls	
Non-RCT with historical controls	
Database, registry, or cross-sectional study	
Case series	
Retrospective review, modelling	
Studies presented at an international conference	
Expert opinion	
<b>Total</b>	<b>1</b>

Abbreviation: RCT, randomized controlled trial.



Because the identified systematic review was both comprehensive and current, we selected RCTs from the review that met our inclusion criteria. Of the 31 studies included in the Cochrane review, 11 RCTs met the inclusion criteria. Table 2 shows which reports were included or excluded and the reasons for exclusion.

**Table 2: Citation Status**

Author, Year	Status	Reason for Exclusion
Indredavik et al, 1991 (11)	Included	—
Stevens et al, 1984 (12)	Included	—
Garraway et al, 1980 (13)	Included	—
Kaste et al, 1995 (14)	Included	—
Fagerberg et al, 2000 (15)	Included	—
Hankey et al, 1997 (16)	Included	—
Cabral et al, 2003 (17)	Included	—
Ma et al, 2004 (18)	Included	—
Juby et al, 1996 (19)	Included	—
Kalra et al, 1993 (20)	Included	—
Kalra et al, 1995 (21)	Included	—
Peacock et al, 1972 (22)	Excluded	Compared a mixed rehabilitation ward with a general medical ward
Patel et al, 2000 (23)	Excluded	Non-RCT
Svensson et al, date unknown (4)	Excluded	Grey literature
Sulter et al, 2003 (24)	Excluded	Compared a stroke care monitoring unit with a conventional stroke care unit
Gordon et al, 1966 (25)	Excluded	Evaluated the merits of a rehabilitation nurse on a general medical ward
Sivenius et al, 1985 (26)	Excluded	Compared intensity of treatment
Dey et al, 2005 (27)	Excluded	Evaluated a mobile stroke unit
Wood-Dauphinee et al, 1984 (28)	Excluded	Evaluated a mobile stroke unit
Feldman et al, 1962 (29)	Excluded	Compared a comprehensive rehabilitation program with a function-oriented medical program for people with hemiplegia or hemiparesis
Aitken et al, 1993 (30)	Excluded	Grey literature
Vemmos et al, 2001 (31)	Excluded	Abstract
Ronning et al, 1998 (32)	Excluded	Non-RCT
Kalra et al, 2000 (33)	Excluded	Evaluated a mobile stroke unit
Yagura et al, 2005 (34)	Excluded	Non-RCT
Cavallini et al, 2003 (35)	Excluded	Non-RCT
Von Arbin et al, 1980 (36)	Excluded	Non-RCT
Laursen et al, 1995 (37)	Excluded	Non-English publication
Illmavirta et al, 1994 (4)	Excluded	Grey literature
Strand et al, 1985 (38)	Excluded	Non-RCT
Hamrin, 1982 (39)	Excluded	Non-RCT

Abbreviations: RCT, randomized controlled trial.

The characteristics of the 11 RCTs included in this review are reported in Table 3.

**Table 3: Characteristics of Studies Included for Analysis**

Study	Type of Stroke Unit	Country	Study Sample, n	Mean Age, y	Population	Treatment Group	Control Group	Follow-up
Stevens et al, 1984 (12)	R	United Kingdom	228	NR	Persons with hemiplegia from stroke and who had received preliminary treatment in other wards	Stroke rehabilitation ward	General medical ward	12 months
Kalra et al, 1993 (20)	R	United Kingdom	245	78	Patients with acute onset of neurologic deficit of vascular origin lasting > 24 hours	Stroke rehabilitation unit	General medical ward	By discharge (13–105 days)
Kalra et al 1995 (21)	R	United Kingdom	71	79	Patients with severe stroke and poor prognosis (median 9 days between stroke and randomization)	Stroke rehabilitation unit	General medical ward	By discharge (16–126 days)
Juby et al, 1996 (19)	R	United Kingdom	176	69	Patients with first or recurrent stroke within 5 weeks of admission to study	Stroke rehabilitation unit	Conventional ward	3, 6, and 12 months
Hankey et al, 1997 (16)	NR	Australia	59	70	Patients with stroke (cerebral infarction or haemorrhage) of < 7 days' duration	Stroke unit	General medical ward	6 months
Fagerberg et al, 2000 (15)	C	Sweden	249	80	Persons ≥ 70 years with acute focal neurologic deficit of no apparent cause other than that of vascular origin ≤ 7 days before admission	Acute medical (75% of sample) or neurological (25% of sample) stroke unit integrated with continued geriatric stroke unit care after discharge	6 general medical wards	3 months and 1 year
Cabral et al, 2003 (17)	C	Brazil	74	68	Persons with acute stroke (first or recurrent) within 7 days of admission	Acute and rehabilitation stroke unit	Multiple general medical wards	6 months
Ma et al, 2004 (18)	C	China	392	62	Patients with acute focal neurologic defects caused by cerebral vessel disease and lasting > 24 hours	Acute and rehabilitation stroke unit	General medical ward	1 week, and at discharge (time NR)
Kaste et al, 1995 (14)	C	Finland	243	73	Patients with ischemic cerebral infarctions (80%), TIA (6%), hemorrhagic (9%), or subarachnoid hemorrhage (4%)	Department of neurology (stroke unit)	General medical ward	12 months
Indredavik et al, 1991 (11)	C	Norway	220	73	Patients with acute focal neurologic deficits of vascular origin lasting > 24 hours and presenting < 1 week to emergency	Stroke unit: geographically defined area designated for acute stroke patients; included acute medical and acute rehab treatment	General medical ward	6 and 52 weeks
Garraway et al, 1980 (13)	C	Scotland	311	73	Persons 60 years of age and older with a focal neurologic deficit of presumed vascular origin for at least 6 hours but no longer than 3 days	Acute and rehabilitation stroke unit	General medical ward	12 months

Abbreviations: C, comprehensive stroke unit; NR, not reported; R, rehabilitation stroke unit; TIA, transient ischemic attack.

The proportion of persons with an ischemic or hemorrhagic stroke or TIA in each study is reported in Table 4.

**Table 4: Proportion of Stroke Types Included in Studies**

Type of Stroke	Study										
	Stevens et al, 1984 (12)	Kalra et al, 1993 (20)	Kalra et al, 1995 (21)	Juby et al, 1996 (19)	Hankey et al, 1997 (16)	Fagerberg et al, 2000 (15)	Cabral et al, 2003 (17)	Ma et al, 2004 (18)	Kaste et al, 1995 (14)	Indredavik et al, 1991 (11)	Garraway et al, 1980 (13)
Ischemic, %	NR	NR	79	NR	86	92	NR	73	80	80	NR
Hemorrhagic, %	NR	NR	21	NR	14	4	NR	27	9	13	NR
TIA, %	NR	NR	0	NR	0	2	NR	0	6	3	NR
Other, %	NR	NR	0	NR	0	2	NR	0	4	4	NR

Abbreviations: NR, not reported; TIA, transient ischemic attack.

Indredavik et al (40) determined that 2 process characteristics of a stroke unit—early mobilization after stroke and adequate systemic hydration—were significantly associated with the outcome of discharge home within 6 weeks of stroke. Langhorne et al (5) identified 8 process characteristics of a stroke unit:

- multidisciplinary team
- co-ordinated care through regular multidisciplinary team meetings
- comprehensive assessment of medical problems, impairments, and disabilities
- active physiological management (careful management of physiological abnormalities)
- early mobilization and avoidance of bed rest
- skilled nursing care
- early setting of rehabilitation plans involving carers
- early assessment and planning of discharge needs

The 11 studies included in this report were evaluated for inclusion of the above 8 process characteristics in the stroke unit treatment groups (Table 5). A majority of studies included a multidisciplinary team, co-ordinated care through regular multidisciplinary team meetings, and early setting of rehabilitation plans involving carers. However, many of the process characteristics were not reported in the 11 studies (indicated by *x*); it is unknown whether these characteristics were part of care in the stroke units studied.

**Table 5: Process Characteristics of Stroke Units**

Stroke Unit	Author, Year	Multi-disciplinary Team	Coordinated Care Through Regular Team Meetings	Comprehensive Assessment of Medical Problems, Impairments, and Disabilities	Active Physiological Management	Early Mobilization and Avoidance of Bed Rest	Skilled Nursing Care	Early Setting of Rehabilitation Plans Involving Carers	Early Assessment and Planning of Discharge Needs
R	Stevens et al, 1984 (12)	✓	✓	x	x	x	x	✓	x
R	Kalra et al, 1993 (20)	✓	✓	x	x	x	x	x	✓
R	Kalra et al, 1995 (21)	✓	✓	✓	x	x	x	✓	x
R	Juby et al, 1996 (19)	✓	✓	x	x	x	x	✓	✓
NR	Hankey et al, 1997 (16)	✓	✓	✓	x	x	x	x	✓
C	Fagerberg et al, 2000 (15)	✓	✓	✓	✓	x	✓	✓	✓
C	Cabral et al, 2003 (17)	✓	✓	x	✓	x	✓	✓	x
C	Ma et al, 2004 (18)	✓	x	x	✓	✓	x	x	x
C	Kaste et al, 1995 (14)	✓	✓	✓	✓	x	x	✓	x
C	Indredavik et al, 1991 (11)	✓	✓	✓	x	x	x	✓	x
C	Garraway et al, 1980 (13)	x	x	x	x	x	x	x	x
	Total	10	9	5	4	1	2	7	4

Abbreviations: C, comprehensive stroke unit; NR, not reported; R, rehabilitation stroke unit.

✓ Process characteristic present.

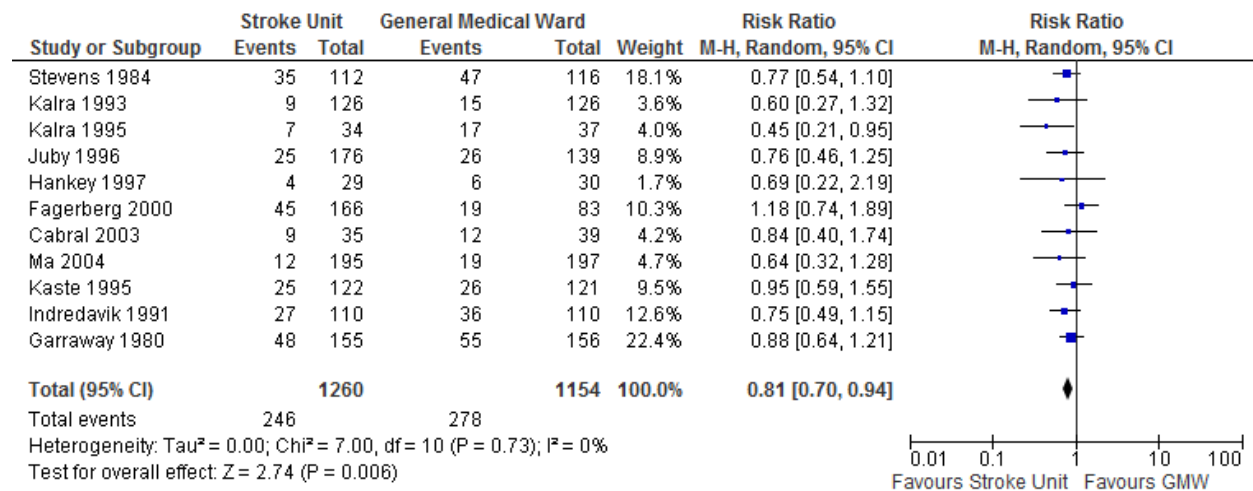
x Not mentioned in manuscript text.

## Meta-analysis

A meta-analysis was undertaken to evaluate the following outcomes: death, death or institutionalization, institutionalization, death or dependency, dependency, and length of hospital stay. For each outcome, the results of 11 studies were combined to derive pooled estimates of effect, and a random effects model was used to generate relative risk summary statistics for patients treated in stroke units versus those treated in general medical wards.

### Death

There was a significant relative risk reduction of 19% in death in persons admitted to a stroke unit compared with those admitted to a general medical ward (Figure 2). The  $I^2$  value was 0%, indicating no heterogeneity among studies, so a subgroup analysis was not completed. The quality of evidence was moderate.

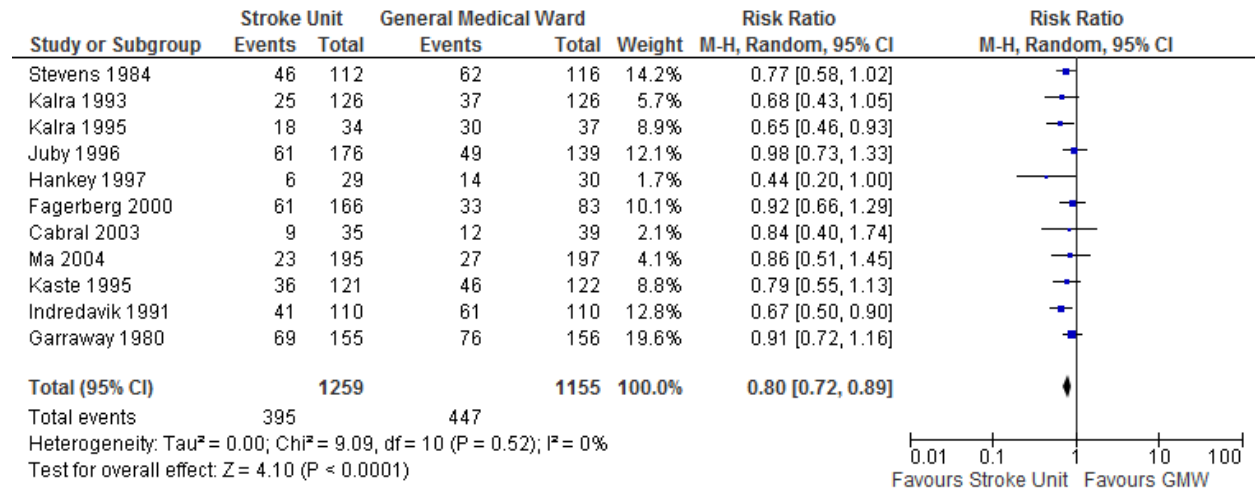


**Figure 2: Death**

Abbreviations: CI, confidence interval; df, degrees of freedom; GMW, general medical ward;  $I^2$ , index of heterogeneity; M-H, Mantel-Haenszel.

### Death or Institutionalization

There was a significant relative risk reduction of 20% in death or institutionalization in persons admitted to a stroke unit compared with those admitted to a general medical ward (Figure 3). The  $I^2$  value was 0%, indicating no heterogeneity among studies, so a subgroup analysis was not completed. The quality of evidence was moderate.

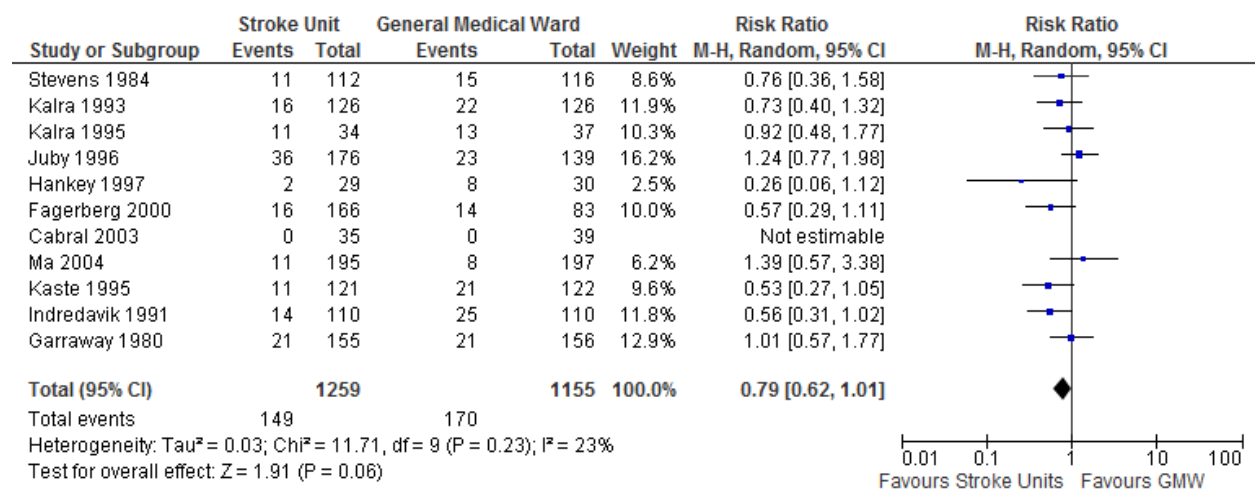


**Figure 3: Death or Institutionalization**

Abbreviations: CI, confidence interval; df, degrees of freedom; GMW, general medical ward;  $I^2$ , index of heterogeneity; M-H, Mantel-Haenszel.

### Institutionalization

There was a nonsignificant relative risk reduction of 21% in institutionalization in persons admitted to a stroke unit compared with those admitted to a general medical ward (Figure 4). The  $I^2$  value was 23%, indicating low heterogeneity among studies, so a subgroup analysis was not completed. The quality of evidence was moderate.

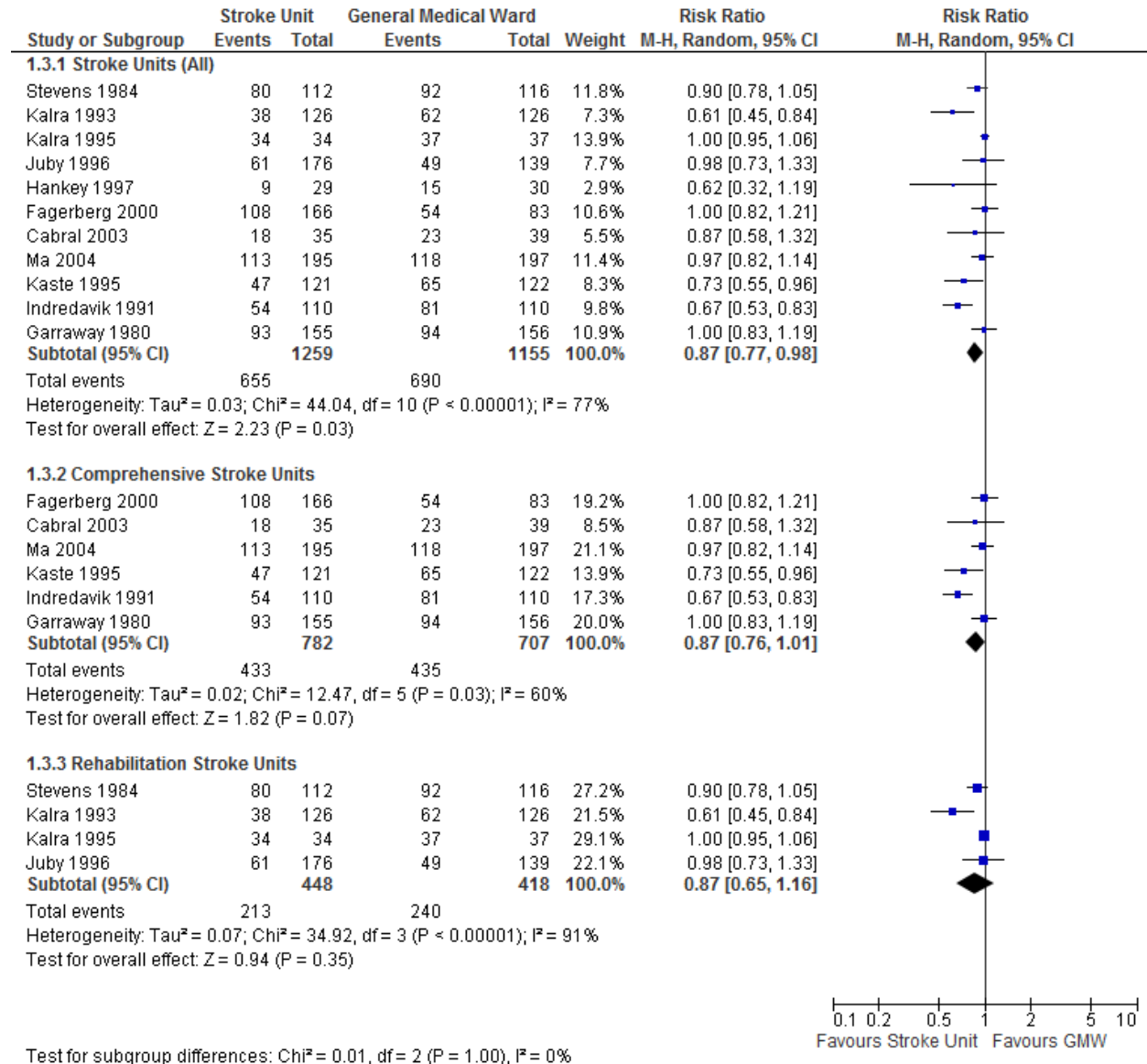


**Figure 4: Institutionalization**

Abbreviations: CI, confidence interval; df, degrees of freedom; GMW, general medical ward;  $I^2$ , index of heterogeneity; M-H, Mantel-Haenszel.

## Death or Dependency

There was a significant relative risk reduction of 13% in death or dependency in persons admitted to a stroke unit compared with those admitted to a general medical ward (Figure 5). The  $I^2$  value was 77%, indicating significant heterogeneity among studies. Subgroup analyses were completed, but results were nonsignificant and did not reduce heterogeneity. The quality of evidence was low.



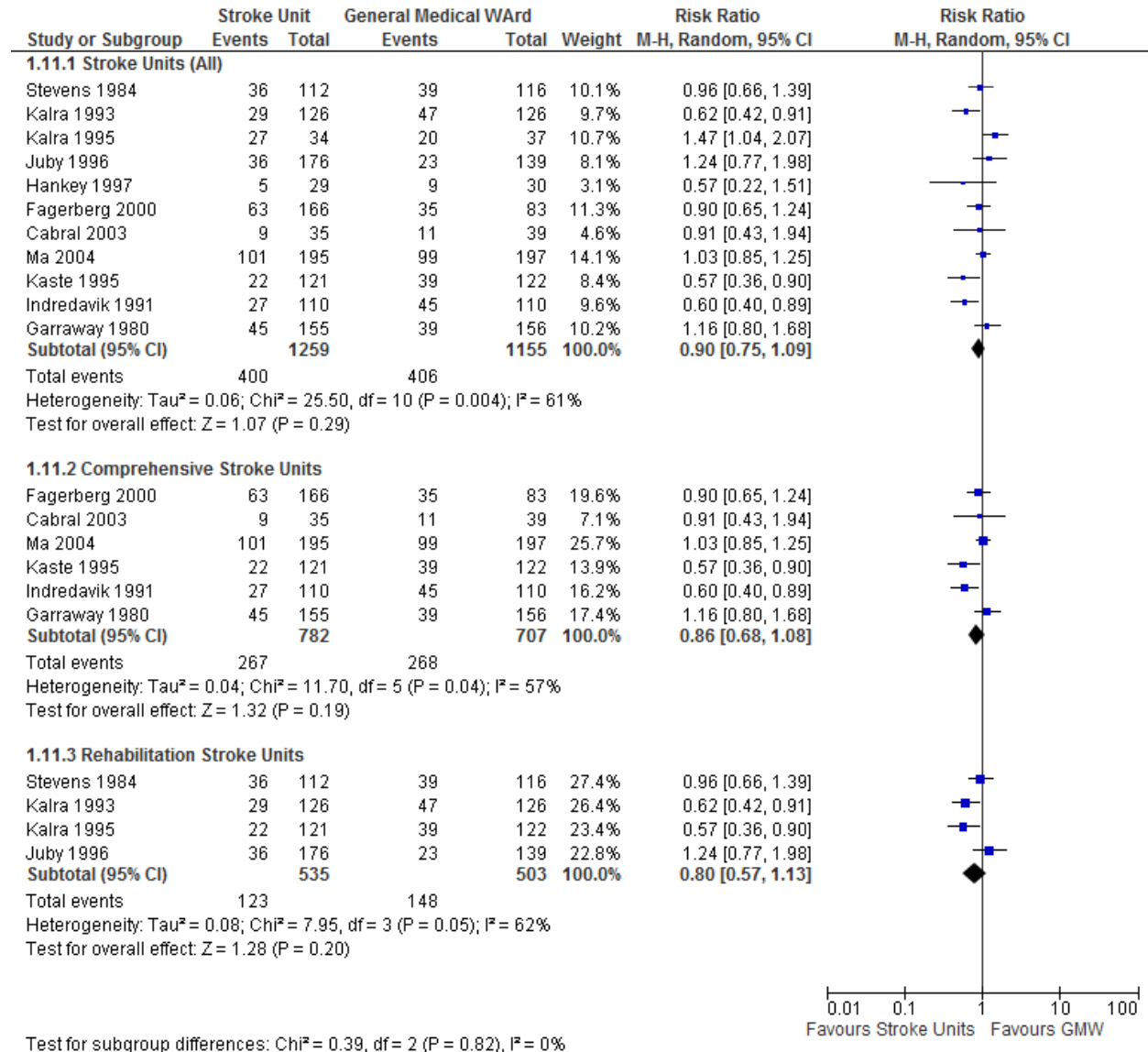
**Figure 5: Death or Dependency**

Abbreviations: CI, confidence interval; df, degrees of freedom; GMW, general medical ward;  $I^2$ , index of heterogeneity; M-H, Mantel-Haenszel.



## Dependency

There was a nonsignificant relative risk reduction of 10% in dependency in persons admitted to a stroke unit compared with those admitted to a general medical ward (Figure 6). The  $I^2$  value was 61%, indicating significant heterogeneity among studies. Subgroup analyses were completed, but results were nonsignificant and did not reduce heterogeneity. The quality of evidence was low.

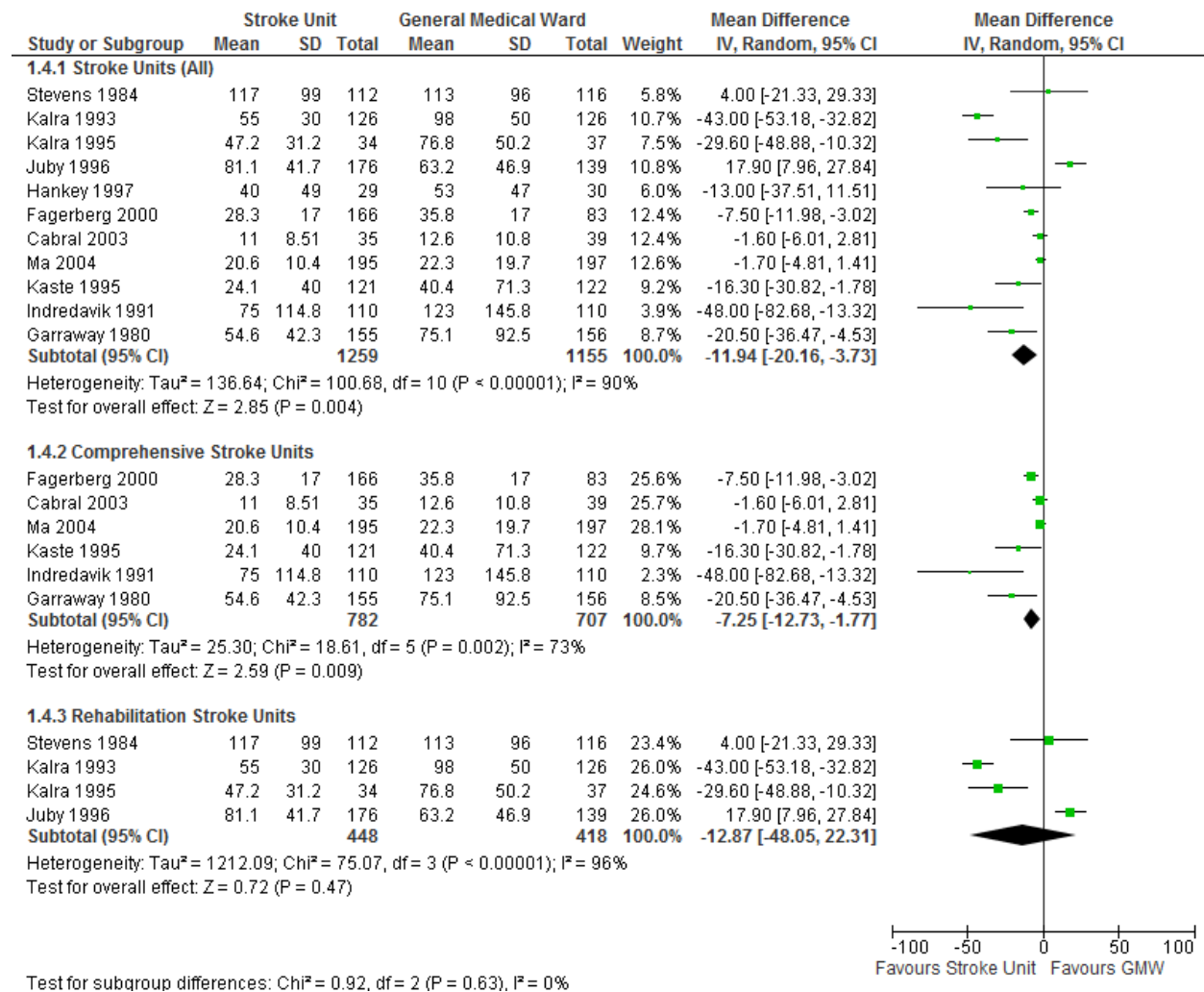


**Figure 6: Dependency**

Abbreviations: CI, confidence interval; df, degrees of freedom; GMW, general medical ward; I<sup>2</sup>, index of heterogeneity; M-H, Mantel-Haenszel.

## Length of Hospital Stay

There was a significant reduction in length of stay of 12 days for persons admitted to a stroke unit compared with those admitted to a general medical ward (Figure 7). The  $I^2$  value was 90%, indicating significant heterogeneity among studies. Subgroup analyses were completed, and there was a significant reduction in length of stay in studies evaluating comprehensive stroke units, but a nonsignificant reduction in length of stay in studies evaluating a rehabilitation stroke units. Significant heterogeneity remained in all subgroup analyses. The quality of evidence was low.



**Figure 7: Length of Hospital Stay**

Abbreviations: CI, confidence interval; df, degrees of freedom; GMW, general medical ward;  $I^2$ , index of heterogeneity; M-H, Mantel-Haenszel.

# Conclusions

---

Moderate quality evidence showed that persons admitted to a stroke unit had a significant reduction in death and the combined outcome of death or institutionalization, and a nonsignificant reduction in institutionalization. Low quality evidence showed that patients admitted to a stroke unit had a significant reduction in the combined outcome of death or dependency and length of hospital stay and a nonsignificant reduction in the outcome of dependency.

# Existing Guidelines for Technology

---

## Canadian Stroke Strategy

The Canadian Stroke Strategy *Canadian Best Practice Recommendations for Stroke Care 2010*, (41) a joint initiative of the Canadian Stroke Network and the Heart and Stroke Foundation of Canada, recommends that patients admitted to hospital because of an acute stroke or transient ischemic attack be treated in an interprofessional stroke unit.

*Patients should be admitted to a stroke unit which is a specialized, geographically defined hospital unit dedicated to the management of stroke patients. (41)*

*The core interprofessional team on the stroke unit should consist of healthcare professionals with stroke expertise from medicine, nursing, occupational therapy, physiotherapy, speech-language pathology, social work, and clinical nutrition. Additional disciplines may include pharmacy, (neuro) psychology, and recreation therapy. (41)*

Further guideline recommendations suggest that all patients with stroke who are admitted to hospital and who require rehabilitation be treated in a comprehensive or rehabilitation stroke unit by an interdisciplinary team. (41)

## Ontario Stroke System

The Ontario Stroke System Consensus Panel on the Stroke Rehabilitation System 2007 (42) recommends that all stroke survivors who would benefit from inpatient stroke rehabilitation be treated in a stroke rehabilitation unit or geographically defined unit with a stimulating environment.

## Ontario Stroke Evaluation Report

The Institute for Clinical Evaluative Sciences *Ontario Stroke Evaluation Report 2011* (3) recommends that acute stroke cases be treated by a team of experts, preferably in a dedicated unit. Expert care results in reduced complications and decreased death and disability. As well, the report further recommends that there be continued efforts to transport persons with stroke to hospitals with specialized stroke units (designated stroke centres) to sustain the trend of reduced mortality due to stroke. (3)

## Brain Attack Coalition

Guidelines about stroke units from the U.S. Brain Attack Coalition (43) include the following:

*There is an abundance of evidence to support the efficacy of stroke units in the care of persons with acute stroke. It is recommended that a stroke unit include continuous multichannel telemetry capable of monitoring blood pressure, pulse, respirations, and oxygenation. There should be written protocols that detail how changes in a patients' status are detected, how they are documented, and how medical staff are notified of such changes. Protocols of notification of medical staff of any changes in vital signs and/or neurological status should be specified. (43)*

## **American Stroke Association**

Recommendations from the American Stroke Association Task Force on the Development of Stroke Systems include the following: “a stroke system should use organized approaches (e.g. stroke teams, stroke units, and written protocols) to ensure that all patients receive appropriate sub acute care.” (44)

# Acknowledgements

---

## Editorial Staff

Jeanne McKane, CPE, ELS(D)

Elizabeth Jean Betsch, ELS

## Medical Information Services

Kellee Kaulback, BA(H), MIST

## Health Quality Ontario's Expert Panel on Stroke Units

Name	Role	Organization
Dr. Mark Bayley	Medical Director, Brain and Spinal Cord Rehab Program	UHN Toronto Rehab and Department of Medicine, University of Toronto
Ms. Christina O'Callaghan	Executive Director	Ontario Stroke Network
Dr. Gustavo Saposnik	Director, Stroke Outcomes Research Centre, Associate Professor of Medicine, Division of Neurology, St. Michael's Hospital	Institute for Clinical Evaluative Sciences, University of Toronto
Dr. Richard Swartz	Director, University of Toronto Stroke Program Medical Director, NE-GTA Regional Stroke Program, Associate Professor, Division of Neurology, Department of Medicine,	Sunnybrook Health Sciences Centre, University of Toronto
Dr. Robert Teasell	Professor of Physical Medicine and Rehabilitation, Schulich School of Medicine	Western University Lawson Research Institute St. Joseph's Health Care London
Dr. Paul E. Cooper	Senior Medical Director – Medicine, Chief, Department of Clinical Neurological Sciences	London Health Sciences Centre
Dr. Paul Ellis	Emergency Physician	University Health Network
Dr. Andrew Samis	Physician Stroke Champion and Staff Intensivist, Division of Critical Care	Quinte Health Care, Belleville Ontario
Dr. Moira Kapral	Division of General Internal Medicine & Clinical Epidemiology, Associate Professor, Department of Medicine, Scientist	University of Toronto Institute for Clinical Evaluative Sciences (ICES)
Dr. Murray Krahn	Director, THETA, F. Norman Hughes Chair and Professor, Department of Medicine and Faculty of Pharmacy	University of Toronto
Dr. Daniel Brouillard	Internist / Stroke Survivor	Kingston Heart Clinic

<b>Name</b>	<b>Role</b>	<b>Organization</b>
Dr. R. Loch MacDonald	Keenan Endowed Chair in Surgery Head, Division of Neurosurgery, Professor of Surgery, University of Toronto	St. Michael's Hospital
Dr. Ruth Hall	OSN Evaluation Lead and Adjunct Scientist	Ontario Stroke Network, Institute for Clinical Evaluative Sciences
Linda Kelloway	Best Practices Leader	Ontario Stroke Network
Rhonda Whiteman	Clinical Nurse Specialist, Stroke Best Practice Coordinator	Hamilton Health Sciences Centre
Rebecca Fleck	Occupational Therapist, Regional Stroke Education and Research Coordinator, Central South Regional Stroke Network	Hamilton Health Sciences Centre
Deborah Willems	Regional Rehabilitation Coordinator, Southwestern Ontario Stroke Network	London Health Sciences Centre
Holly Sloan	Speech–Language Pathologist	Trillium Health Centre Site, Credit Valley Hospital and Trillium Health Centre
Matthew Meyer	Research Coordinator, PhD Candidate, Epidemiology and Biostatistics	OSN & Lawson Health Research Institute, Schulich School of Medicine and Dentistry, Western University
Kathleen Lee	Social Worker	Health Sciences North
Linda Welham	Professional Resource, Case Costing and Decision Support	Southlake Regional Health Centre
Lori Marshall	Executive Vice President, Strategy, Performance and Aboriginal Health	Thunder Bay Regional Health Sciences Centre
Jin-Hyeun Huh	Pharmacy Director of Inpatient Operations, Department of Pharmacy	University Health Network
Derek Leong	Clinical Pharmacist, General Internal Medicine	University Health Network – Toronto General Hospital
<b>Ministry Representatives</b>		
Peter Biasucci	Manager, Acute and Rehabilitative Care Unit, Health Policy and Care Standards Branch, Health System Strategy and Policy Division	Ministry of Health and Long-Term Care
Jason Lian	Senior Methodologist, Health System Funding Policy Branch	Ministry of Health and Long-Term Care
Thomas Smith	Acting Program Manager, Provincial Programs Branch	Ministry of Health and Long-Term Care

# Appendices

---

## Appendix 1: Literature Search Strategies

### Stroke Units – Stroke MEGA Literature Search

Search date: December 5-6, 2011

Databases searched: OVID MEDLINE, OVID MEDLINE In-Process and Other Non-Indexed Citations, OVID EMBASE, Wiley Cochrane, EBSCO CINAHL, Centre for Reviews and Dissemination.

Database: Ovid MEDLINE(R) <1948 to November Week 3 2011>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <December 05, 2011>, Embase <1980 to 2011 Week 48>

- 1 exp Stroke/ or exp brain ischemia/ (273524)
- 2 exp intracranial hemorrhages/ use mesz (50434)
- 3 exp brain hemorrhage/ use emez (66291)
- 4 exp stroke patient/ use emez (5349)
- 5 (stroke or tia or transient ischemic attack or cerebrovascular apoplexy or cerebrovascular accident or cerebrovascular infarct\* or brain infarct\* or CVA or brain adj2 isch?emia or (cerebral adj2 isch?emia) or (intracranial adj2 hemorrhag\*) or (brain adj2 hemorrhag\*)).ti,ab. (320222)
- 6 or/1-5 (509939)
- 7 exp Hospital Units/ use mesz (67581)
- 8 exp Stroke Unit/ use emez (1106)
- 9 exp Skilled Nursing Facilities/ use mesz (3429)
- 10 ((stroke adj2 ward\*) or (stroke adj2 unit\*)).ti,ab. (4568)
- 11 exp Patient Care Team/ use mesz (49228)
- 12 Cooperative Behavior/ or exp Interprofessional Relations/ or exp Interinstitutional Relations/ use mesz (140691)
- 13 exp Nursing, Team/ use mesz (1985)
- 14 exp "Delivery of Health Care, Integrated"/ use mesz (6935)
- 15 exp interdisciplinary communication/ (12406)
- 16 exp TEAM NURSING/ use emez (20)
- 17 exp Cooperation/ use emez (31785)
- 18 exp TEAMWORK/ use emez (9089)
- 19 exp Integrated Health Care System/ use emez (4946)
- 20 ((transitional or multidisciplin\* or multifacet\* or multi-disciplin\* or multi-facet\* or cooperat\* or cooperat\* or interdisciplin\* or inter-disciplin\* or collaborat\* or multispecial\* or multi-special\* or share or sharing or shared or integrat\* or joint or multi-modal or multimodal) adj2 (care or team\*)).ti,ab. (41141)
- 21 or/7-20 (308326)
- 22 6 and 21 (7619)
- 23 limit 22 to english language (6333)
- 24 limit 23 to english language (6333)
- 25 limit 24 to yr="2006 -Current" (3522)
- 26 limit 25 to (meta analysis or randomized controlled trial) (198)
- 27 exp Technology Assessment, Biomedical/ or exp Evidence-based Medicine/ use mesz (64387)
- 28 exp Biomedical Technology Assessment/ or exp Evidence Based Medicine/ use emez (516761)
- 29 (health technology adj2 assess\$).ti,ab. (3051)
- 30 exp Random Allocation/ or exp Double-Blind Method/ or exp Control Groups/ or exp Placebos/ use mesz (379825)



- 31 Randomized Controlled Trial/ or exp Randomization/ or exp RANDOM SAMPLE/ or Double Blind Procedure/ or exp Triple Blind Procedure/ or exp Control Group/ or exp PLACEBO/ use emez (900712)  
 32 (random\* or RCT).ti,ab. (1256903)  
 33 (placebo\* or sham\*).ti,ab. (415406)  
 34 (control\* adj2 clinical trial\*).ti,ab. (35211)  
 35 meta analysis/ use emez (57708)  
 36 (meta analy\* or metaanaly\* or pooled analysis or (systematic\* adj2 review\*) or published studies or published literature or medline or embase or data synthesis or data extraction or cochrane).ti,ab. (252661)  
 37 or/26-36 (2165215)  
 38 25 and 37 (623)  
 39 remove duplicates from 38 (471)

## CINAHL

#	Query	Results
S25	S21 AND S24 Limiters - Published Date from: 20060101-20111231	108
S24	S22 or S23	154009
S23	random* or sham* or rct* or health technology N2 assess* or meta analy* or metaanaly* or pooled analysis or (systematic* N2 review*) or published studies or medline or embase or data synthesis or data extraction or cochrane or control* N2 clinical trial*	145959
S22	(MH "Random Assignment") or (MH "Random Sample+") or (MH "Meta Analysis") or (MH "Systematic Review") or (MH "Double-Blind Studies") or (MH "Single-Blind Studies") or (MH "Triple-Blind Studies") or (MH "Placebos") or (MH "Control (Research)")	82705
S21	S6 and S20	1793
S20	(S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14 or S15 or S16 or S17 or S18 or S19)	66643
S19	(MH "Nurse Liaison") OR "liaison"	1815
S18	(MH "Collaboration")	16613
S17	(MH "Interinstitutional Relations")	5409
S16	(MH "Interprofessional Relations+")	13700
S15	transitional N2 care or multidisciplin* N2 care or multifacet* N2 care or multi-disciplin* N2 care or multi-facet* N2 care or cooperat* N2 care or co-operat* N2 care or interdisciplin* N2 care or inter-disciplin* N2 care or collaborat* N2 care or multispecial* N2 care or multi-special* N2 care or share N2 care or sharing N2 care* or shared N2 care or integrat* N2 care or joint N2 care or multi-modal N2 care or multimedia N2 care or speciali* N2 care or dedicated N2 care	29186
S14	transitional N2 team* or multidisciplin* N2 team* or multifacet* N2 team* or multi-disciplin* N2 team* or multi-facet* N2* team* or cooperat* N2 team* or co-operat* N2 team* or interdisciplin* N2 team* or inter-disciplin* N2 team* or collaborat* N2 team* or multispecial* N2 team* or multi-special* N2 team* or share N2 team* or sharing N2 team* or shared N2 team* or integrat* N2 team* or joint N2 team* or multi-modal N2 team* or multimedia N2 team* or speciali* N2 team* or dedicated N2 team*	21828
S13	(MH "Health Care Delivery, Integrated")	3205
S12	(MH "Team Nursing")	315

S11	(MH "Cooperative Behavior")	2341
S10	(MH "Multidisciplinary Care Team+")	17796
S9	(stroke N2 ward*) or (stroke N2 unit*)	1022
S8	(MH "Skilled Nursing Facilities")	1644
S7	(MH "Stroke Units")	210
S6	S1 OR S2 OR S3 OR S4 OR S5	42479
S5	(MH "Stroke Patients")	1812
S4	stroke or tia or transient ischemic attack or cerebrovascular apoplexy or cerebrovascular accident or cerebrovascular infarct* or brain infarct* or CVA or brain N2 isch?emia or cerebral N2 isch?emia or intracranial N2 hemorrhag* or brain N2 hemorrhag*	38045
S3	(MH "Intracranial Hemorrhage+")	4609
S2	(MH "Cerebral Ischemia+")	5334
S1	(MH "Stroke")	24768

## Cochrane

ID	Search	Hits
#1	<a href="#">MeSH descriptor Stroke explode all trees</a>	3785
#2	<a href="#">MeSH descriptor Brain Ischemia explode all trees</a>	1862
#3	<a href="#">MeSH descriptor Intracranial Hemorrhages explode all trees</a>	1080
#4	<a href="#">(stroke or tia or transient ischemic attack or cerebrovascular apoplexy or cerebrovascular accident or cerebrovascular infarct* or brain infarct* or CVA or (brain NEAR/2 isch?emia) or (cerebral NEAR/2 isch?emia) or (intracranial NEAR/2 hemorrhag*) or (brain NEAR/2 hemorrhag*)):ti or (stroke or tia or transient ischemic attack or cerebrovascular apoplexy or cerebrovascular accident or cerebrovascular infarct* or brain infarct* or CVA or (brain NEAR/2 isch?emia) or (cerebral NEAR/2 isch?emia) or (intracranial NEAR/2 hemorrhag*) or (brain NEAR/2 hemorrhag*)):ab</a>	15916
#5	<a href="#">(#1 OR #2 OR #3 OR #4)</a>	17546
#6	<a href="#">MeSH descriptor Hospital Units explode all trees</a>	2391
#7	<a href="#">MeSH descriptor Skilled Nursing Facilities explode all trees</a>	46
#8	<a href="#">((stroke NEAR/2 ward*) or (stroke NEAR/2 unit*)):ti and ((stroke NEAR/2 ward*) or (stroke NEAR/2 unit*)):ab</a>	50
#9	<a href="#">MeSH descriptor Patient Care Team explode all trees</a>	1130
#10	<a href="#">MeSH descriptor Cooperative Behavior explode all trees</a>	459
#11	<a href="#">MeSH descriptor Nursing, Team explode all trees</a>	18
#12	<a href="#">MeSH descriptor Delivery of Health Care, Integrated explode all trees</a>	159
#13	<a href="#">MeSH descriptor Interdisciplinary Communication explode all trees</a>	79
#14	<a href="#">((transitional or multidisciplin* or multifacet* or multi-disciplin* or multi-facet* or cooperat* or co-operat* or interdisciplin* or inter-disciplin* or collaborat* or multispecial* or multi-special* or share or sharing or shared or</a>	179

[integrat\\* or joint or multi-modal or multimodal\) NEAR/2 \(care or team\\*\)\):ti and \(\(transitional or multidisciplin\\* or multifacet\\* or multi-disciplin\\* or multi-facet\\* or cooperat\\* or co-operat\\* or interdisciplin\\* or inter-disciplin\\* or collaborat\\* or multispecial\\* or multi-special\\* or share or sharing or shared or integrat\\* or joint or multi-modal or multimodal\) NEAR/2 \(care or team\\*\)\):ab](#)

#15	<a href="#">MeSH descriptor Interinstitutional Relations explode all trees</a>	39
#16	<a href="#">MeSH descriptor Interprofessional Relations explode all trees</a>	281
#17	<a href="#">(#6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16)</a>	4299
#18	<a href="#">(#5 AND #17), from 2006 to 2011</a>	54

### Centre for Reviews and Dissemination

Line	Search	Hits
1	MeSH DESCRIPTOR stroke EXPLODE ALL TREES	549
2	MeSH DESCRIPTOR brain ischemia EXPLODE ALL TREES	144
3	MeSH DESCRIPTOR intracranial hemorrhages EXPLODE ALL TREES	116
4	((stroke or tia or transient ischemic attack or cerebrovascular apoplexy or cerebrovascular accident or cerebrovascular infarct* or brain infarct* or CVA or brain adj2 isch?emia or (cerebral adj2 isch?emia) or (intracranial adj2 hemorrhag*) or (brain adj2 hemorrhag*)))	2108
5	#1 OR #2 OR #3 OR #4	2195
6	MeSH DESCRIPTOR Hospital Units EXPLODE ALL TREES	403
7	MeSH DESCRIPTOR Skilled Nursing Facilities EXPLODE ALL TREES	8
8	((stroke adj2 ward* or (stroke adj2 unit*)))	63
9	MeSH DESCRIPTOR Patient Care Team EXPLODE ALL TREES	193
10	MeSH DESCRIPTOR Cooperative Behavior EXPLODE ALL TREES	32
11	MeSH DESCRIPTOR Nursing, Team EXPLODE ALL TREES	3
12	MeSH DESCRIPTOR Delivery of Health Care, Integrated EXPLODE ALL TREES	47
13	MeSH DESCRIPTOR interdisciplinary communication EXPLODE ALL TREES	17
14	MeSH DESCRIPTOR Interinstitutional Relations EXPLODE ALL TREES	5
15	MeSH DESCRIPTOR interprofessional relations EXPLODE ALL TREES	39
16	((transitional or multidisciplin* or multifacet* or multi-disciplin* or multi-facet* or cooperat* or co-operat* or interdisciplin* or inter-disciplin* or collaborat* or multispecial* or multi-special* or share or sharing or shared or integrat* or joint or multi-modal or multimodal) adj2 (care or team*)))	515
17	#6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16	1108
18	#5 AND #17	92
19	(#5 and #18) FROM 2006 TO 2011	40

## Appendix 2: Evidence Quality Assessment

Table A1: GRADE Evidence Profile for Comparison of Stroke Units With General Medical Wards

Number of Studies (Design)	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Upgrade Considerations	Quality
<b>Death</b>							
11 RCTs	Serious limitations (-1) <sup>a</sup>	No serious limitations	No serious limitations	No serious limitations	Undetected	None	⊕⊕⊕ Moderate
<b>Death or Institutionalization</b>							
11 RCTs	Serious limitations (-1) <sup>a</sup>	No serious limitations	No serious limitations	No serious limitations	Undetected	None	⊕⊕⊕ Moderate
<b>Institutionalization</b>							
11 RCTs	Serious limitations (-1) <sup>a</sup>	No serious limitations	No serious limitations	No serious limitations	Undetected	None	⊕⊕⊕ Moderate
<b>Death or Dependency</b>							
11 RCTs	Serious limitations (-1) <sup>b</sup>	Serious limitations (-1) <sup>c</sup>	No serious limitations	No serious limitations	Undetected	None	⊕⊕ Low
<b>Dependency</b>							
11 RCTs	Serious limitations (-1) <sup>b</sup>	Serious limitations (-1) <sup>c</sup>	No serious limitations	No serious limitations	Undetected	None	⊕⊕ Low
<b>Length of Hospital Stay</b>							
11 RCTs	Serious limitations (-1) <sup>b</sup>	Serious limitations (-1) <sup>c</sup>	No serious limitations	No serious limitations	Undetected	None	⊕⊕ Low

Abbreviations: GRADE, Grading of Recommendations Assessment, Development and Evaluation; RCT, randomized controlled trial.

<sup>a</sup> 54% of studies had unclear treatment allocation concealment.

<sup>b</sup> Lack of concealment and blinding.

<sup>c</sup>  $I^2 > 50\%$ .

**Table A2: Risk of Bias Among Randomized Controlled Trials for the Comparison of Stroke Units With General Medical Wards**

Author, Year	Allocation Concealment	Blinding	Complete Accounting of Patients and Outcome Events	Selective Reporting Bias	Baseline Characteristics Comparable	Randomization Methods	Sample Size Calculation	Intention to Treat Analysis
Stevens et al, 1984 (12)	No limitations	Limitations <sup>a</sup>	No limitations	No limitations	No limitations	No limitations	Limitations <sup>b</sup>	Limitations <sup>c</sup>
Kalra et al, 1993 (20)	Limitations <sup>a</sup>	Limitations <sup>d</sup>	No limitations	No limitations	No limitations	Limitations <sup>a</sup>	Limitations <sup>a</sup>	No limitations
Kalra et al, 1995 (21)	No limitations	Limitations <sup>e</sup>	No limitations	No limitations	No limitations	No limitations	Limitations <sup>b</sup>	No limitations
Juby et al, 1996 (19)	Limitations <sup>a</sup>	No limitations	No limitations	No limitations	Limitations <sup>f</sup>	No limitations	Limitations <sup>b</sup>	Limitations <sup>c</sup>
Hankey et al, 1997 (16)	Limitations <sup>a</sup>	No limitations	No limitations	No limitations	Limitations <sup>g</sup>	No limitations	Limitations <sup>c</sup>	No limitations
Fagerberg et al, 2000 (15)	No limitations	No limitations	No limitations	No limitations	Limitations <sup>h</sup>	No limitations	Limitations	No limitations
Cabral et al, 2003 (17)	Limitations <sup>a</sup>	No limitations	No limitations	No limitations	No limitations	No limitations	Limitations <sup>b</sup>	No limitations
Ma et al, 2004 (18)	Limitations <sup>a</sup>	Limitations <sup>d</sup>	No limitations	No limitations	Limitations <sup>i</sup>	No limitations	Limitations <sup>b</sup>	No limitations
Kaste et al, 1995 (14)	No limitations	Limitations <sup>a</sup>	No limitations	No limitations	Limitations <sup>j</sup>	No limitations	Limitations <sup>c</sup>	Limitations <sup>c</sup>
Indredavik et al, 1991 (11)	No limitations	Limitations <sup>k</sup>	No limitations	No limitations	No limitations	No limitations	Limitations <sup>b</sup>	No limitations
Garraway et al, 1980 (13)	Limitations <sup>a</sup>	Limitations <sup>a</sup>	No limitations	No limitations	No limitations	No limitations	Limitations <sup>b</sup>	Limitations <sup>c</sup>

Abbreviations: CI, confidence interval; OR, odds ratio.

<sup>a</sup>Unclear methods.

<sup>b</sup>Not reported.

<sup>c</sup>Not done

<sup>d</sup>Not done; staff on both stroke unit and general medical ward unaware of study.

<sup>e</sup>Consultant on stroke rehabilitation unit not blinded.

<sup>f</sup>Greater proportion of women in stroke unit ( $P = 0.04$ ).

<sup>g</sup>Greater proportion of persons with lacunar syndrome in stroke unit (OR, 2.6; 95% CI, 0.86–7.6) and had absent or mild weakness (OR, 2.9; 95% CI, 0.98–8.4).

<sup>h</sup>Greater proportion of persons with angina pectoris in the stroke ( $P = 0.04$ ).

<sup>i</sup>Barthel Index greater in persons admitted to stroke unit ( $P = 0.01$ ).

<sup>j</sup>Greater proportion of persons with cardiac disorder in stroke unit.

<sup>k</sup>Outcome assessors not blinded.

# References

---

- (1) Heart & Stroke Foundation of Ontario. What is a Stroke? [Internet]. Toronto: Heart & Stroke Foundation of Ontario; [updated 2008 Jan 8; cited 2011 Sep 21]. Available from: [http://www.heartandstroke.on.ca/site/c.pyI3IeNWJwE/b.3581687/k.744C/Stroke\\_What\\_is\\_Stroke.htm](http://www.heartandstroke.on.ca/site/c.pyI3IeNWJwE/b.3581687/k.744C/Stroke_What_is_Stroke.htm)
- (2) Teasell R, Meyer MJ, Foley N, Salter K, Willems D. Stroke rehabilitation in Canada: a work in progress. *Top Stroke Rehabil.* 2009;16(1):11-9.
- (3) Hall R, Khan F, O'Callaghan C, Meyer S, Fang J, Hodwitz K, et al. Ontario stroke evaluation report 2011: improving system efficiency by implementing stroke best practices [Internet]. Toronto: Institute for Clinical Evaluative Sciences (ICES); [updated 2011; cited 2012 May 22]. Available from: [www.ices.on.ca](http://www.ices.on.ca)
- (4) Stroke Unit Trialists' Collaboration. Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. *Cochrane Database Syst Rev.* 2007;(4):CD000197.
- (5) Langhorne P, Pollock A, Stroke Unit Trialists' Collaboration. What are the components of effective stroke unit care? *Age Ageing.* 2002 Sep;31(5):365-71.
- (6) Teasell R, Foley N, Salter K, Bhogal S, Jutai J, Speechley M. Evidence-based review of stroke rehabilitation (14th edition) [Internet]. [place unknown]: Evidence-Based Review of Stroke Rehabilitation; [updated 2011; cited 2012 May 16]. Available from: <http://www.ebrsr.com/>
- (7) Review Manager (RevMan) [Computer program]. Version 5.1. Copenhagen: The Nordic Cochrane Centre. 2011.
- (8) Higgins JPT, Green S, editors. *Cochrane handbook for systematic reviews of interventions* Version 5.1.0 [Internet]. Oxford (UK): The Cochrane Collaboration; 2011 [cited 2012 May 16]. Available from [www.cochrane-handbook.org](http://www.cochrane-handbook.org)
- (9) Guyatt GH, Oxman AD, Schunemann HJ, Tugwell P, Knottnerus A. GRADE guidelines: a new series of articles in the *Journal of Clinical Epidemiology*. *J Clin Epidemiol.* 2011 Apr;64(4):380-2.
- (10) Goodman, C. *Literature searching and evidence interpretation for assessing health care practices*. Stockholm, Sweden: Swedish Council on Technology Assessment in Health Care; 1996. 81 p. SBU Report No. 119E.
- (11) Indredavik B, Bakke F, Solberg R, Rokseth R, Haaheim LL, Holme I. Benefit of a stroke unit: a randomized controlled trial. *Stroke.* 1991 Aug;22(8):1026-31.
- (12) Stevens RS, Ambler NR, Warren MD. A randomized controlled trial of a stroke rehabilitation ward. *Age Ageing.* 1984 Mar;13(2):65-75.
- (13) Garraway WM, Akhtar AJ, Hockey L, Prescott RJ. Management of acute stroke in the elderly: follow-up of a controlled trial. *Br Med J.* 1980 Sep;281(6244):827-9.

- (14) Kaste M, Palomaki H, Sarna S. Where and how should elderly stroke patients be treated? A randomized trial. *Stroke*. 1995 Feb;26(2):249-53.
- (15) Fagerberg B, Claesson L, Gosman-Hedstrom G, Blomstrand C. Effect of acute stroke unit care integrated with care continuum versus conventional treatment: a randomized 1-year study of elderly patients: the Goteborg 70+ Stroke Study. *Stroke*. 2000 Nov;31(11):2578-84.
- (16) Hankey GJ, Deleo D, Stewart-Wynne EG. Stroke units: an Australian perspective. *Aust N Z J Med*. 1997 Aug;27(4):437-8.
- (17) Cabral NL, Moro C, Silva GR, Scola RH, Werneck LC. Study comparing the stroke unit outcome and conventional ward treatment: a randomized study in Joinville, Brazil. *Arq Neuropsiquiatr*. 2003 Jun;61(2A):188-93.
- (18) Ma R, Wang Y, Qu H, Yang Z. Assessment of the early effectiveness of a stroke unit in comparison to the general ward. *Chin Med J (Engl)*. 2004;117(6):852-5.
- (19) Juby L, Lincoln N, Berman P. The effect of a stroke rehabilitation unit on functional and psychological outcome: a randomised controlled trial. *Cerebrovasc Dis*. 1996;6(2):106-10.
- (20) Kalra L, Dale P, Crome P. Improving stroke rehabilitation. A controlled study. *Stroke*. 1993;24(10):1462-7.
- (21) Kalra L, Eade J. Role of stroke rehabilitation units in managing severe disability after stroke. *Stroke*. 1995;26(11):2031-4.
- (22) Peacock PB, Riley CHP, Lampton TD, Raffel SS, Walker JS. Trends in epidemiology. Springfield: Thomas; 1972. Chapter 8. The Birmingham stroke epidemiology and rehabilitation study. p. 231-345.
- (23) Patel N, Louw S, Zwarenstein M. Organised care of acute stroke at Groot Schuur Hospital. Cape Town: University of Cape Town; 2000. 148 p.
- (24) Sulter G, Elting JW, Langedijk M, Maurits NM, DeKeyser J. Admitting acute ischemic stroke patients to a stroke care monitoring unit versus a conventional stroke unit: a randomized pilot study. *Stroke*. 2003 Jan;34(1):101-4.
- (25) Gordon EE, Kohn KH. Evaluation of rehabilitation methods in the hemiplegic patient. *J Chronic Dis*. 1966 Jan;19(1):3-16.
- (26) Sivenius J, Pyorala K., Heinonen OP, Salonen JT, Riekkinen P. The significance of intensity of rehabilitation of stroke: a controlled trial. *Stroke*. 1985 Nov;16(6):928-31.
- (27) Dey P, Woodman M, Gibbs A, Steele R, Stocks SJ, Wagstaff S, et al. Early assessment by a mobile stroke team: a randomised controlled trial. *Age Ageing*. 2005 Jul;34(4):331-8.
- (28) Wood-Dauphinee S, Shapiro S, Bass E, Fletcher C, Georges P, Hensby V, et al. A randomized trial of team care following stroke. *Stroke*. 1984 Sep;15(5):864-72.

- (29) Feldman DJ, Lee PR, Unterecker J, Lloyd K, Usk HA, Toole A, et al. A comparison of functionally orientated medical care and formal rehabilitation in the management of patients with hemiplegia due to cerebrovascular disease. *J Chronic Dis*. 1962 Mar;15:297-310.
- (30) Aitken PD, Rodgers H, French JM, Bates D, James OFW. General medical or geriatric unit care for acute stroke? A controlled trial. *Age Ageing*. 1993;22(2):4-5.
- (31) Vemmos K, Takis K, Madelos D, Synetos A, Volotasiou V, Tzavellas H. Stroke unit treatment versus general medical wards: long term survival. *Cerebrovasc Dis*. 2001;11(4):8.
- (32) Ronning OM, Guldvog B. Stroke unit versus general medical wards, II: neurological deficits and activities of daily living: a quasi-randomized controlled trial. *Stroke*. 1998 Mar;29(3):586-90.
- (33) Kalra L, Evans A, Perez I, Knapp M, Donaldson N, Swift CG. Alternative strategies for stroke care: a prospective randomised controlled trial. *Lancet*. 2000 Sep 9;356(9233):894-9.
- (34) Yagura H, Miyai I, Suzuki T, Yanagihara T. Patients with severe stroke benefit most by interdisciplinary rehabilitation team approach. *Cerebrovasc Dis*. 2005;20(4):258-63.
- (35) Cavallini A, Micieli G, Marcheselli S, Quaglini S. Role of monitoring in management of acute ischemic stroke patients. *Stroke*. 2003 Nov;34(11):2599-603.
- (36) von Arbin M, Britton M, deFaire U, Helmers C, Miah K, Murray V. A study of stroke patients treated in a non-intensive stroke unit or in general medical wards. *Acta Med Scand*. 1980;208(1-2):81-5.
- (37) Laursen SO, Henriksen IO, Dons U, Jacobsen B, Gundertoft L. Intensive rehabilitation after apoplexy: a controlled pilot study. *Ugeskr Laeger*. 1995 Apr 3;157(14):1996-9.
- (38) Strand T, Asplund K, Eriksson S, Hagg E, Lithner F, Wester PO. A non-intensive stroke unit reduces functional disability and the need for long-term hospitalization. *Stroke*. 1985 Jan;16(1):29-34.
- (39) Hamrin E. Early activation in stroke: does it make a difference? *Scand J Rehabil Med*. 1982;14(3):101-9.
- (40) Indredavik B, Bakke F, Slordahl SA, Rokseth R, Haheim LL. Treatment in a combined acute and rehabilitation stroke unit: which aspects are most important? *Stroke*. 1999 May;30(5):917-23.
- (41) Lindsay MP, Gubitz G, Bayley M, Hill MD, Davies-Schinkel C, Singh S, et al. Canadian best practice recommendations for stroke care. Ottawa (ON): Canadian Stroke Network; 2010. 230 p.
- (42) The Consensus Panel on the Stroke Rehabilitation System. Time is function. Toronto: Heart & Stroke Foundation of Ontario and Ontario Stroke System; 2007. 167 p.
- (43) Alberts MJ, Latchaw RE, Jagoda A, Wechsler LR, Crocco T, George MG, et al. Revised and updated recommendations for the establishment of primary stroke centers: a summary statement from the brain attack coalition. *Stroke*. 2011;42(9):2651-65.



- (44) Schwamm LH, Pancioli A, Acker JE, Goldstein LB, Zorowitz RD, Shephard TJ, et al. Recommendations for the establishment of stroke systems of care. *Circulation*. 2005;111(8):1078-91.

Health Quality Ontario  
130 Bloor Street West, 10<sup>th</sup> Floor  
Toronto, Ontario  
M5S 1N5  
Tel: 416-323-6868  
Toll Free: 1-866-623-6868  
Fax: 416-323-9261  
Email: [EvidenceInfo@hqontario.ca](mailto:EvidenceInfo@hqontario.ca)  
[www.hqontario.ca](http://www.hqontario.ca)

© Queen's Printer for Ontario, 2014