



Research Centre  
for Palliative Care,  
Death & Dying



# Finding What Works: A Resource for Discovering Interdisciplinary Evidence-Based Information about Stroke

A white paper published by the Flinders Research Centre for Palliative Care, Death and Dying

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## About this White Paper

This publication is a RePaDD White Paper and Research Report. The RePaDD White Paper and Research Report Series provide researchers and policy makers with evidence-based data and recommendations. By organising, summarising and disseminating previous and current studies, the series aim to inform ongoing and future research in palliative care, death, and dying.

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## About the RePaDD

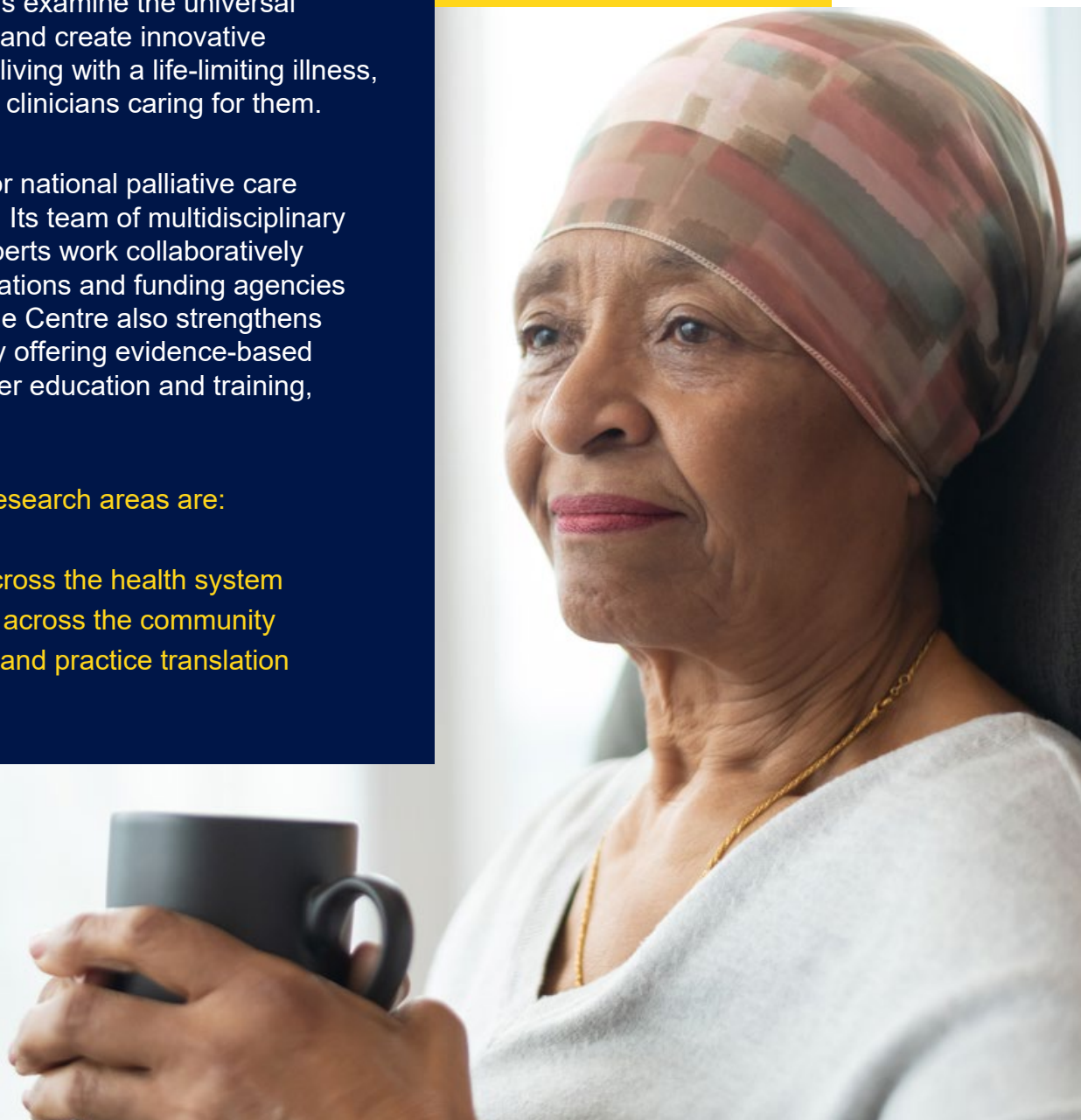
The Flinders Research Centre for Palliative Care, Death, and Dying (RePaDD) works to make a difference to the care of persons at the end of life.

RePaDD researchers examine the universal experience of dying and create innovative solutions for people living with a life-limiting illness, their carers, and the clinicians caring for them.

RePaDD leads major national palliative care projects in Australia. Its team of multidisciplinary researchers and experts work collaboratively with various organisations and funding agencies to deliver impact. The Centre also strengthens research capacity by offering evidence-based resources, researcher education and training, and scholarships.

RePaDD's current research areas are:

- Palliative care across the health system
- Death and dying across the community
- Online evidence and practice translation



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# Executive Summary

Ensuring that what is known to be effective can be applied in practice continues to be a challenging problem for health care professionals. To support the application of their own clinical expertise, practitioners in stroke rehabilitation (including physiotherapy, rehabilitation services, speech therapy and, occupational therapy) need access to evidence about what works in their field.

As the body of relevant literature grows, to do the challenges associated with finding and accessing relevant, up to date information. Moreover, while the ability to find literature that contains relevant information is a prerequisite for evidence-based clinical practice, the skills required to search effectively are both complex and difficult to develop.

This White Paper/Research Report outlines a reliable and effective means by which stroke practitioners in all fields (including stroke rehabilitation) can gain access to evidence that is useable, timely and relevant. By providing single-click access to comprehensive, reliable, and effective topic searches, this resource enables clinicians and researchers to find the latest available interdisciplinary evidence about stroke. This has the potential to improve patient outcomes by equipping researchers and clinicians with high quality information that can be used to better inform research and more effectively guide treatment decisions.

Guided by an Expert Advisory Group (EAG), our research team developed a Stroke Search Filter. The Filter is a high-performance search that retrieves references for literature relevant to all topics on stroke. To ensure that the most recent references are retrieved, we translated the search filter for the PubMed database (from Ovid Medline) in order to ensure that non-indexed literature is also harvested. While the Filter itself can be used across all areas related to stroke, the focus of the Stroke Topic Searches resource is on topics post diagnosis of stroke, emphasising rehabilitation, physiotherapy, and occupational therapy. A search sensitivity rating of 93.8% in the Filter Validation Set and a precision of 83.06% were achieved.

This White Paper describes the development of the Filter. It outlines the methodology employed to create the resource and the process by which it was tested, refined and validated. Limitations of the resource are also discussed.

Overall, it is hoped that the Filter will be used to improve patient outcomes by providing clinicians and researchers with a validated search strategy that can be used to gain real-time access to relevant, interdisciplinary, evidence-based information about stroke.

# Introduction

Ensuring that what is known to be effective can be applied in practice continues to be a challenging problem for health care across all areas. Evidence is needed to inform clinical judgement about rehabilitation and care of stroke patients. Practitioners in the wide range of disciplines involved in stroke rehabilitation (including physiotherapy, specialist rehabilitation services, speech therapy, and occupational therapy) need evidence about what works in their field, to underpin and support the application of their own clinical expertise. They must be able to find and access that evidence at the point of need. Manns, Norton, and Darrah<sup>1</sup> have written of the evidence-practice gap in the clinical decision-making of young physiotherapists and the need to use skills such as literature retrieval and evaluation. Arbesman, Lieberman, and Berlanstein<sup>2</sup> wrote of the establishment by the American Occupational Therapy Association of a series of evidence based projects to support the uptake of findings from the “best available research” in occupational therapy services including those for adults with stroke. Petzold et al.<sup>3</sup> found that clinicians required easy access to synthesised stroke research to facilitate their learning and use of evidence-based practice.

A fundamental prerequisite for using clinical evidence in clinical practice, teaching and research is the ability to find the literature that contains the relevant evidence. This evidence is largely in the form of published articles indexed in databases. Individual clinicians and researchers can be challenged

by the complexities of the different bibliographic databases where the literature is held and by the need to formulate a search strategy that will effectively extract relevant results. The number of records in the databases is growing enormously. PubMed now contains over 26 million records, of which over 130,000 articles deal with stroke.

There is pressure to access relevant evidence reliably and quickly, so that it can be of use in a clinical setting. Practitioners caring for stroke patients may be based in small organisations such as nursing homes or community centres, or they may be sole practitioners; in either case, they will not necessarily have access to the large commercial databases of literature. Even if they have such access, the skills required to search the literature effectively are challenging. How does one best target the topic of interest and be sure that the most recent and relevant information will be retrieved? Terms used to index the literature on stroke in Medline and PubMed include Stroke; Brain infarction; Brain Stem Infarctions; Cerebral Infarction; Lateral Medullary Syndrome. Related terms include Brain ischemia and Intracranial hemorrhages. Natural language terms frequently occurring in stroke literature include: stroke, apoplexy, cerebrovascular accident, intracerebral hemorrhage and infarct volume, among many. Effective searching in this literature requires knowledge and decisions about which terms are the best for retrieval and should be used.

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# Methods

Search filters offer one solution to the problem of finding literature by enabling brokered access to the underlying evidence base for rapid retrieval and utilisation. Search filters are combinations of search terms designed to retrieve records with a common feature.<sup>4</sup> They are usually validated searches built experimentally following an objective methodology. Search filters may be tested for sensitivity, precision, and specificity, with a balance of sensitivity and precision offering greatest clinical utility. A search filter is typically designed for a particular database and has a known effectiveness in the body of literature concerned.

We undertook the development of a topical search filter to interrogate the medical literature on stroke, in order to create a reliable means for stroke health practitioners in all fields, including those fields related to stroke rehabilitation, to access relevant published evidence. We employed an established methodology, used previously by CareSearch Palliative Care Knowledge Network ([www.caresearch.com.au](http://www.caresearch.com.au)) and Flinders Filters (<http://www.flinders.edu.au/clinical-change/research/flinders-filters/>), to develop topical search filters in palliative care and other health areas. Among these search filters are: the Palliative Care Search Filter<sup>5</sup>, the Heart Failure Search Filter<sup>6</sup>, the Residential Aged Care Search Filter<sup>7</sup>, the Primary Care Search Filter<sup>8</sup>, the Aboriginal and Torres Strait Islander Healthcare Search Filter<sup>9</sup>, the Bereavement Search Filter<sup>10</sup>, and the Dementia Search Filter<sup>11</sup>. The search filters are objectively derived and validated, as detailed in the associated published papers.

We established an EAG to guide the development of the Stroke Search Filter. This group provided essential expert advice (from both clinical and research perspectives) on the scope of the filter, on the key terminology, journals, and publications associated with the topic and on the choice of a gold standard

set of representative relevant references. During the filter development process, EAG members provided post hoc relevance assessment of draft filter retrievals in Medline and in the non-indexed subset of PubMed. The EAG was composed of the project team and investigators (the authors of this paper) together with additional representation from clinical and research experts in stroke. Members of the EAG provided expertise in the areas of rehabilitation, occupational therapy, physiotherapy, stroke nursing, and stroke-related biomedical research.

The EAG and project team determined that the scope of the stroke search filter would be broad, encompassing all aspects of stroke from risk and prevention, through diagnosis and treatment, associated conditions, and post stroke complications, rehabilitation, recovery, and all outcomes of stroke. Basic science aspects in the literature would be included, as well as all medical, nursing, and allied health areas. The Stroke Search Filter would be developed and validated as a broad and powerful search filter to retrieve a high proportion of all literature on stroke, delineated by the broad scope outlined above. Literature about narrower topics within stroke, especially those post-diagnosis which were the chief interest of many in the EAG, would be targeted by the creation of individual topic searches. These clinically important topics would be identified by the EAG members. Each topic would be retrieved by a search created and tested by an experienced research librarian within the project team, using terms combined with the validated Stroke Search Filter.

Core to the creation of the Stroke Search Filter was the establishment of a Gold Standard Set of references that were relevant to the topic of stroke and encompassed the scope required for the search filter. The references must be held in the database for which the filter is designed and were required to be in English (as the

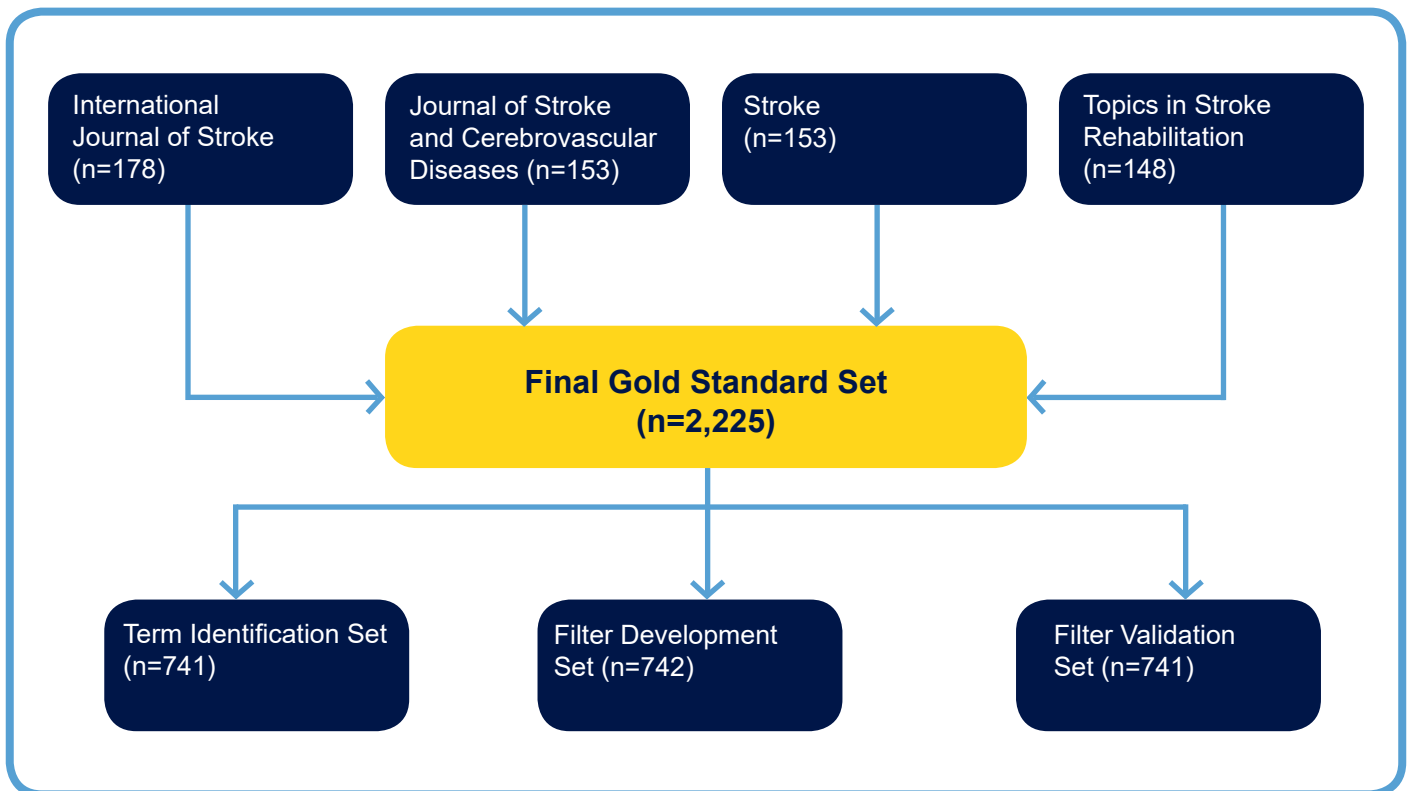


search filter will be in English) and to contain abstracts (to give sufficient text for analysis during development). The Stroke Search Filter was created in the Ovid Medline database.

The EAG members ratified four key stroke journals as a suitable source for the Gold Standard Set (International journal of stroke: official journal of the International Stroke Society, Topics in stroke rehabilitation, Journal of stroke and cerebrovascular diseases, Stroke: a journal of cerebral circulation), they considered that all articles in the journals were relevant to stroke, and that the scope of topics covered within the journals matched the desired broad

scope for the search filter. All four journals are indexed in Medline and would provide sufficient articles for a Gold Standard Set of acceptable size for development of the search filter. References were collected from Ovid Medline for all articles in the four journals for the years 2009 – 2012 (inclusive) and stored in an EndNote Library. Any without abstracts were removed. The total number of references collected for the Gold Standard Set was 2225 (**Fig. 1**).

The Gold Standard Set was divided into three subsets (**see Fig. 1**), for development and validation of the Stroke Search Filter. Each of the three tasks of identification of terms, iterative development of the search



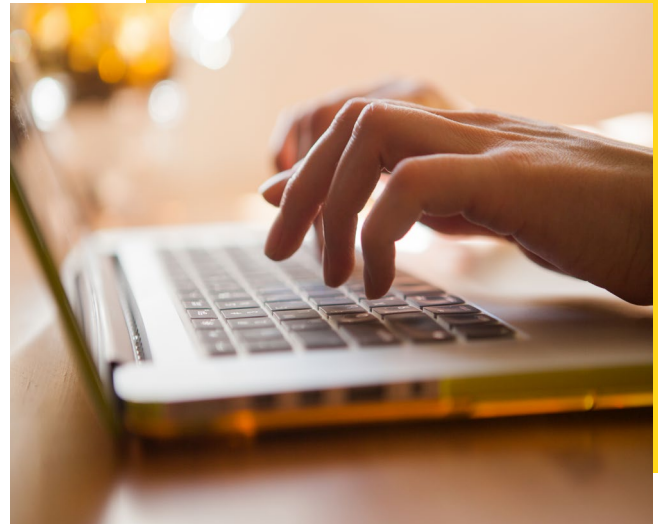
**Figure 1. The Stroke Search Filter Gold Standard Set**

strategy based on term performance, and, finally, validation of the search strategy, is undertaken in a different subset, in order to minimise bias.

Candidate terms for inclusion in the draft search strategy were derived from frequency analysis of index terms (MeSH, i.e. Medical Subject Headings) in the Term Identification Set, from frequency analysis of natural language terms in the Term Identification Set, and from the identification of terms potentially uniquely associated with stroke (with advice from the EAG). Additionally, we reviewed the relevant concept hierarchies in the Medline MeSH thesaurus for an overview of term interrelationships and histories, and consulted the search strategies used by the Cochrane Stroke Group<sup>12</sup>. All candidate terms were tested for uniqueness and for their performance (singly and in combination) in retrieving references in the Filter Development Set. The best performing set of terms formed a draft search strategy that was then tested in the Filter Validation Set, to give a rating for sensitivity; i.e., the percentage of known relevant items retrieved by the strategy.

A precision estimate was achieved by post hoc relevance testing of the Stroke Search Filter strategy. Sets of 250 records were retrieved from open Medline and reviewed by pairs of reviewers from the EAG, for an assessment of the relevance of each retrieval. The percentage of records with a maximum of “Yes” ratings indicates the precision performance.

Following the creation and validation of the Stroke Search Filter in Ovid Medline, we translated the filter for equivalent performance in the indexed set of PubMed,



and created an additional strategy to combine with it to identify relevant records in the non-indexed section of PubMed. The PubMed database contains both indexed and non-indexed records. The non-indexed subset includes very recent references that are yet to be indexed; providing a means of retrieving relevant evidence from this most recent literature can be a significant benefit to both clinicians and researchers. We used established methodology previously used by CareSearch and Flinders Filters for translation of a search filter from Ovid Medline to PubMed<sup>13</sup>. This method requires the creation of a “Lost Set” of references. This set contains those references that would not be retrieved if indexing were not available and if the terms that are the index terms (the MeSH terms) in the search filter do not appear as text words in the title or abstract of the record. Textual analysis of the records in the Lost Set provides candidate natural language terms occurring with high frequency in the records, to test for their ability to retrieve relevant items.

# Results

## OVID MEDLINE STROKE SEARCH FILTER

Candidate stroke terms (both MeSH and text words) retrieving over 3% of references in the Term Identification Set are shown in Table 1.

**Table 1. Most frequent candidate terms for stroke identified in the Term Identification Set**

Term	Record Occurrence in Term	% Record Occurrence in Term
<b>MeSH</b>		
Stroke	597	80.57
Brain Ischemia	226	30.5
Tissue Plasminogen Activator	90	12.15
Fibrinolytic Agents	87	11.74
Thrombolytic Therapy	84	11.34
Cerebral Hemorrhage	71	9.582
Ischemic Attack, Transient	51	6.883
Cerebral Infarction	40	5.398
Infarction, Middle Cerebral Artery	37	4.993
Carotid Stenosis	29	3.914
Brain Infarction	27	3.644
<b>Textwords/phrases</b>		
Stroke.ti,ab	699	94.33
Acute ischemic.ti,ab	136	18.35
Poststroke.ti,ab	73	9.852
Intracerebral hemorrhage.ti,ab	62	8.367
Tissue plasminogen activator.ti,ab	51	6.883
Infarct volume*.ti,ab	32	4.318

With a recall of 90.3% (or 670/742), the individual term which best performed with respect to retrieving articles in the Filter Development Set was the MeSH term Stroke (exploded to include the narrower terms below it: Brain Infarction; Brain Stem Infarctions; Lateral Medullary Syndrome; Cerebral Infarction; Dementia, Multi-Infarct; Infarction, Anterior Cerebral Artery; Infarction, Middle Cerebral Artery; Infarction, Posterior Cerebral Artery; Stroke, Lacunar). The EAG verified that these narrower terms were appropriate to include in the strategy for

the desired scope of the search filter. The MeSH term Stroke (not exploded) retrieved 609/742.

The text word stroke retrieved a high number of references; however, because the word stroke occurs in the literature with other meanings (relating to swimming stroke, heat stroke etc. as well as being often used as a general term in English (e.g. “at one stroke”)) it was not considered suitable as a text word search term. We also tested combinations of high performing MeSH terms in the

Term Identification Set, with the text word stroke; two of these combinations increased retrieval: the phrase brain ischemia/ AND stroke.ti,ab was the next best performing term (217/742 = 29.25%) and increased retrieval by 12 records.

Recall in this set was maximised by including the text word phrases acute ischaemic and acute ischemic, both combined with the text

word stroke using AND, and the text word poststroke and text word phrase post stroke. The truncated text word phrase lacunar infarct\$ was also included (it increased retrieval by one record in the FDS).

With a recall in the Filter Development Set of 707/742 or 95.28%, the final best performing search for sensitivity in the Filter Development Set was the nine term search:

### Stroke Search Filter Version 1:

*exp stroke/ or (brain ischemia/ and stroke.ti,ab.) or Ischemic attack, transient/ or ((acute ischaemic and stroke) or (acute ischemic and stroke)).ti,ab. or lacunar infarct\$.ti,ab. or poststroke.ti,ab. or post stroke.ti,ab. or (cerebral hemorrhage/ and stroke.ti,ab.) or (carotid stenosis/ and stroke.ti,ab)*

Post hoc relevance testing by pairs of reviewers for Version 1 gave a precision estimate of 82.4%. Analysis was undertaken of the results, indicating that three terms warranted further review and analysis of their performance in the sets of references receiving majority Yes and majority No ratings. These terms were: Cerebral Infarction/; Cerebral hemorrhage/ and stroke.ti,ab; and lacunar infarct\$.ti,ab. The decision was made to retain the first two (on the basis that: (1) a majority of the EAG believed Cerebral infarction to be unique to stroke, and it is a narrower term in MeSH of stroke; and (2) the gain from including Cerebral hemorrhage/ and stroke.ti,ab outweighed

the risk of retrieving irrelevant references) but to remove lacunar infarct\$.ti,ab – responsible for the addition of two records in the evaluated set, both of which received unanimous No ratings. This decision was confirmed by the reviewers.

Removing *lacunar infarct* resulted in a small loss of sensitivity but slight gain in precision as measured by the post hoc relevance assessment undertaken by the seven reviewers. The final eight term Medline Stroke Search Filter therefore consists of combinations of five MeSH terms and five text words (restricted to title and abstract fields).

exp stroke/ or (brain ischemia/ and stroke.ti,ab.) or Ischemic attack, transient/ or ((acute ischaemic and stroke) or (acute ischemic and stroke)).ti,ab. or poststroke.ti,ab. or post stroke.ti,ab. or (cerebral hemorrhage/ and stroke.ti,ab.) or (carotid stenosis/ and stroke.ti,ab)

*Recall in Filter Validation Set (n=742) = 93.8%*

*Recall in Gold Standard Set (n=2225) = 94.38%*

*Precision Estimate: Post Hoc Relevance (majority of Relevant ratings by sets of three or four reviewers) = 83.06%*

## PUBMED TRANSLATION OF STROKE SEARCH FILTER

The Ovid Medline eight term Stroke Search Filter was translated for PubMed as shown:

Stroke[mh] OR (brain ischemia[mh:noexp] AND stroke[tiab]) OR Ischemic attack, transient[mh] OR (acute ischaemic[tiab] AND stroke[tiab]) OR (acute ischemic[tiab] AND stroke[tiab]) OR poststroke[tiab] OR post stroke[tiab] OR (cerebral hemorrhage[mh:noexp] AND stroke[tiab]) OR (carotid stenosis[mh] AND stroke[tiab])

Equivalence was demonstrated. Both the Medline version of the filter and the PubMed translation run in the indexed section of PubMed retrieved the same 2100/2225 (94.38%) of the Gold Standard Set references.

To develop a search to interrogate the non-indexed subset of PubMed, we investigated the performance of candidate terms, as described in Methods above. We found that stroke[tiab] (title OR abstract) was picking up too many irrelevant retrievals, whereas requiring the word stroke to appear in the title resulted in a more focused set. This was a trade-off between creating a highly sensitive search strategy, such as might be required for systematic review searching, or a more clinically useful search with fewer irrelevant retrievals, where some relevant items may be missed. We take into account that this non-indexed material will eventually largely be indexed, resulting then in the capacity to retrieve references indexed with the term Stroke/ (and benefit from the validated 93.8% sensitivity of the Stroke Search Filter).

We added the ISSNs of the four journals used to create the Gold Standard Set, since it was determined by the EAG that all articles in these journals are relevant to the topic of the

Stroke Search Filter, and in the non-indexed component of the filter we do not have the full search filter functionality to retrieve the references.

We conducted external testing of the first 250 retrievals from PubMed (non-indexed component only, since the indexed set retrieval had already been tested). The first 250 references retrieved on November 30, 2015 using the non-indexed component strategy above, in English and with abstracts, were sent to two external reviewers, members of the EAG, from Allied Health and Neuroscience backgrounds respectively. 207/250 references (82.8%) were rated Yes by both reviewers.

Note that the terms post stroke[tiab] and poststroke[tiab] are not repeated in the non-indexed component of the Stroke Search Filter as their inclusion in the main search filter as textwords means that they are already searching across the entire PubMed database.

The final full PubMed translated version of the Stroke Search Filter is shown below (non-indexed component is bolded in white).

(Stroke[mh] OR (brain ischemia[mh:noexp] AND stroke[tiab]) OR Ischemic attack, transient[mh] OR (acute ischaemic[tiab] AND stroke[tiab]) OR (acute ischemic[tiab] AND stroke[tiab]) OR poststroke[tiab] OR poststroke[tiab] OR (cerebral hemorrhage[mh:noexp] AND stroke[tiab]) OR (carotid stenosis[mh] AND stroke[tiab])) OR (Stroke\*[ti] OR 1747-4949[is] OR 1074-9357[is] OR 1524-4628 [is] OR 1074-9357 [is] OR 1532-8511 [is] OR BrainInfarct\*[tiab] OR BrainStemInfarct\*[tiab] OR LateralMedullarySyndrome\*[tiab] OR Cerebral Infarct\*[tiab] OR Multi-infarct Dementia[tiab] OR Cerebral Artery infarct\*[tiab] OR transientIschemicattack\*[tiab] OR transientischaemicattack\*[tiab] OR cerebral ischemi\*[tiab] OR cerebrovascular event\*[tiab] OR cerebrovascular accident\*[tiab] OR medullary infarct\*[tiab] OR cerebral artery occlusion[tiab] OR mcao[tiab] OR cerebral ischaemi\*[tiab] NOT medline[sb]) AND eng[la]

## STROKE SEARCH FILTER TOPIC SEARCHES

Finally, a set of topic searches was created, using the topics identified by the EAG as important for clinical and research purposes. Using the validated Stroke Search Filter as a basis, internally derived and tested terms are added with the AND operator, to retrieve information on key topics of clinical interest, such as (in the Rehabilitation category) Return to work of stroke patients, Speech therapy for stroke patients or Sexuality and stroke patients. These topic searches can be expressed as URLs, enabling web links to be embedded in web pages, giving clinicians, and researchers one-click access to real-time PubMed search results.



# Discussion

An intuitive search for stroke literature, using the MeSH heading Stroke/ and exploding it to include all narrower terms beneath, would find 1972/2225 (88.63%) of the Gold Standard Set of relevant stroke references, created for this project with clinical expert advice. This high number reflects the well-delineated literature in the field and the power of the indexing in Medline. Nevertheless, there are at least 11 records in every hundred that would not be retrieved. We were able to increase retrieval in the full Gold Standard Set to 2100/2225 (94.38%) with the inclusion of additional terms as shown. A more sensitive search could be built, capable of retrieving more of the remaining 125 records in the Gold Standard Set, but our investigations showed that this would be at the loss of precision, and therefore less clinically useful.

Busy health professionals do not have time or inclination to sort through irrelevant records to find those that are useful. The records not retrieved from the Gold Standard Set were analysed. MeSH terms that occurred with high frequency in this remaining set were relevant but not unique to the field of stroke; they included: Carotid Artery Diseases; Cardiovascular Diseases; Intracranial Arteriosclerosis; Vision Disorders; Magnetic Resonance Imaging; Alzheimer Disease; Aneurysm, Ruptured; Cerebral Arteries; Cerebrovascular Disorders. These 125 references were relevant to stroke but not chiefly about stroke, therefore had not been indexed with any of the MeSH terms in the draft stroke search filter: Stroke (and all its narrower terms, listed above), and Ischemic Attack, Transient. There were references about conditions associated with stroke but not unique to stroke such as aphasia or visual field defects. Nor did the identified text words or text word

combinations retrieve the references. If the filter were made more sensitive to pick up these references, this sensitivity would be offset by a greater number of irrelevant references that would be also be retrieved.

The role of the EAG in this project was very important. They provided guidance to ensure that the outcome would be useful in clinical and research settings, to people who work in this field but do not necessarily have expertise in constructing complex search strategies. Their assessment of relevance helps to reduce bias that would be introduced if the project team members, with searching but not subject expertise, were solely responsible for designing the searches. The finished product is a search filter that embeds technical expertise, clinical knowledge, and validated test results. It is a search strategy of known effectiveness that can be used on an ongoing basis to access real-time search results on the free open platform of PubMed.

The PubMed searches can be tailored to provide access to all retrieved references, or, for those who wish it, access to only those references that are immediately available to view in free full text. This can be a useful feature for those in small organisations without paid access to journal subscriptions. Many useful references are available in full and free online and will be retrieved with the Stroke Search Filter in PubMed.

It is also possible for users to construct their own topic searches in PubMed, using the Stroke Search Filter as a basis and combining it with their own search terms. We provide instructions for how to do this, for topics that are not included in our existing set of stroke topic searches.

# Conclusions

We have created a Stroke Search Filter which retrieves references from the Medline database for literature relevant to all topics in stroke. We have demonstrated the effectiveness of this search filter through validation in a gold standard set of references derived from a core set of stroke journals, followed by external post hoc relevance assessment by reviewers with clinical and research expertise.

The Stroke Search Filter is a high performing search with a sensitivity rating of 93.8% in the Filter Validation Set and a precision of 83.06%. We translated the search filter for the PubMed database and provided an additional component to the search which retrieves the non-indexed literature in PubMed. This contains the most recent references.

The PubMed search strategy has enabled to us to publish a stroke literature searching resource containing a set of searches across a wide variety of stroke-related topics. Many of these are in the area of stroke rehabilitation. While the Stroke Search Filter itself can be used across all areas related to stroke, the focus of the Stroke Topic Searches resource is on topics post diagnosis of stroke. The focus for the project investigator group was post diagnosis, especially aspects of rehabilitation, physiotherapy, and occupational therapy. Topic searches provided will connect clinicians and researchers in these areas with the latest evidence from PubMed, providing single-click access and a reliable search of known effectiveness. This evidence is available to be incorporated into practice and inform further research, enhancing outcomes for stroke patients, carers and families.

1

The Stroke Search Filter is a high performing search with a sensitivity rating of 93.8% in the Filter Validation Set and a precision of 83.06%.

2

Topic searches provided will connect clinicians and researchers in these areas with the latest evidence from PubMed, providing single-click access and a reliable search of known effectiveness.

3

This evidence is available to be incorporated into practice and inform further research, enhancing outcomes for stroke patients, carers and families.



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