Report on the Development of a Glaucoma Search Filter

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

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Acknowledgements

About this White Paper

This publication is a RePaDD White Paper and Research Report.

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

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Acknowledgement of Country

Flinders University was established on the lands of the Kaurna nation, with the first University campus, Bedford Park, located on the ancestral body of Ngannu near Warriparinga.

Warriparinga is a significant site in the complex and multi-layered Dreaming of the Kaurna ancestor, Tjilbruke. For the Kaurna nation, Tjilbruke was a keeper of the fire and a peace maker/law maker. Tjilbruke is part of the living culture and traditions of the Kaurna people. His spirit lives in the Land and Waters, in the Kaurna people and in the glossy ibis (known as Tjilbruke for the Kaurna). Through Tjilbruke, the Kaurna people continue their creative relationship with their Country, its spirituality, and its stories.

Flinders University acknowledges the Traditional Owners and Custodians, both past and present, of the various locations the University operates on, and recognises their continued relationship and responsibility to these Lands and waters.

About the RePaDD

Death and dying will affect all of us. The Research Centre for Palliative Care, Death, and Dying or RePaDD works to make a difference to the care of persons at the end of life.

We 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. Our members lead major national palliative care projects in Australia. Our team of multidisciplinary researchers and experts work collaboratively with various organisations and funding agencies to deliver impact. We also strengthen research capacity by offering evidence-based resources, researcher education, and training and scholarships.

Our research

We focus on the following research areas:

Palliative care across the health system: We conduct clinical and service studies and develop online palliative care resources and applications. Our work in this area contributes towards ensuring that quality palliative care can be delivered in all healthcare settings - whether in hospitals, aged care, homes, hospices, clinics, or the community.

Death and dying across the community: We examine and respond to community and consumer attitudes, views, and needs with respect to death and dying and palliative care. Our research in this area empowers the wider community to make informed decisions by raising awareness and building death literacy.

Online evidence and practice translation: We build, synthesise, and disseminate the evidence for palliative care. We also create innovative digital solutions to improve evidence translation and use. Our research in this area builds palliative care capacity of the health and aged care workforce, access and use of information by health consumers and the community.

Further information can be found at flinders.edu.au/repadd

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Executive Summary

Glaucoma is second only to cataracts as the leading cause of blindness worldwide. Despite its prevalence, clinicians and researchers may not have the skills or time required to locate the timely, high-quality evidence needed to provide the best care for patients with this condition.

To facilitate access to high-quality information and evidence on glaucoma, Flinders Filters partnered with the Flinders Centre for Ophthalmology, Eye and Vision Research to create a functional, evidence-based search filter that provides clinicians and others with 'one click' access to a high performing literature search.

This White Paper outlines the general methodology used to develop and validate a glaucoma search filter in OvidSP Medline, and translate it for PubMed. It also details the creation of a sample set of expert topic searches for glaucoma.

Using a gold standard set derived from clinical guidelines, a validated OvidSP Medline glaucoma search filter was created that was capable of retrieving 95% of literature of known relevance to glaucoma; as well as a validated PubMed translation of this filter with an equivalent level of performance in the MeSH-indexed subset of PubMed.

The search filter has been made available online and can be combined with selected topic searches via easy to use embedded hyperlinks to find high level focused evidence.

Ultimately, it is hoped that the search filter described in this White Paper will help clinicians and others treat those with - or at risk of – glaucoma more effectively by enabling access to high level, focused evidence simply by clicking a link.

1. Development of a Glaucoma Search Filter

The methodology described in this paper was undertaken in four phases:

- The construction of a gold standard set.
- Term identification.
- Filter development.
- Filter validation.

1.1 Construction of the glaucoma gold standard set

The glaucoma topical search filter was created using a variation of the methodology used to develop the methodological search filters established in PubMed as Clinical Queries.[1] At the centre of this methodology is the 'gold standard set', a set of references of known relevance to the topic of interest. The closed universe created by a gold standard set makes it possible to establish what a filter retrieves and what it fails to retrieve (its sensitivity). The relative proportion of irrelevant references it pulls in (its specificity) is determined by post hoc assessment of relevance of retrieved references, undertaken by experts in the field.

1.2 Gold Standard Set

In discussions with the expert reference group it was decided that national and international guidelines for glaucoma would form the basis of the gold standard set. The gold standard set included references from the following guidelines:

Australian Guidelines:

NHMRC Glaucoma "for the Screening , Prognosis, Diagnosis, Management and Prevention of Glaucoma 2010"	Australia	2010	1991-2010

US Guidelines:

PPP Primary Open-Angle Glaucoma Suspect	US	2010	1969-2010
PPP Primary Open-Angle Glaucoma	US	2010	1960-2010
PPP Primary Angle Closure	US	2010	1966-2010

European Guideline:

"Terminology and Guidelines for Glaucoma" – European Glaucoma Society	Europe	2008	1957-2008

UK Guideline:

NICE Glaucoma "Diagnosis and management of chronic open angle glaucoma and ocular hypertension"	UK	2009	1977-2008

The references of these guidelines were compiled in an EndNote Library and screened for irrelevance and duplicates.

Criteria for exclusion:

- Articles not found in Medline.
- Articles not in English.
- Articles without an abstract.
- Articles that were not about glaucoma (i.e. were about methodology of guidelines, ethics, indigenous Australians, care pathways, drugs, economics, costs but not specifically relevant to glaucoma).

The gold standard set comprised of a total of 921 references.

1.3 Expert reference group

An expert reference group was established to guide the development of the glaucoma search filter. The group provided clinical expert advice on scope, on terminology and on sources and selection of gold standard set references. The members of the expert reference group also undertook assessment of relevance of references and post hoc assessment of the effectiveness of the filter retrieval.

Members of the expert reference group

Associate Professor Jamie Craig
Dr John Landers
Dr Tiger Zhou
Dr Katja Ullrich

1.4 Division of the gold standard set

The gold standard set (n=921) was divided into three sets to avoid the bias inherent in validating a filter within the same set of records used to create it. These sets were: a Term Identification Set (n=307); a Filter Development Set (n=307); and a Filter Validation Set (n=307).

The Research Randomizer[2] program randomly sampled 307 references by record number from the gold standard set to the Term Identification Set which was set up as a new group within the EndNote Library. The remaining 614 references were randomly assigned (by record number) into two separate groups of 307 references each. These three distinct sets as well as the entire gold standard set were then recreated in OvidSP Medline.

2. Search Filter Development

2.1 Term identification for glaucoma

Term identification for the filter was based on the following:

1. Separate frequency analyses of the Medical Subject Headings (MeSH) terms and title/abstract.
    i. Textwords of the 307 references in the Term Identification Set.
2. Review of the relevant concept 'trees' and other details in the Medline MeSH thesaurus for an overview of term interrelationships and histories.
3. Clinical advice from the expert reference group.

2.2 Frequency analysis of MeSH terms

In order to identify the most frequently occurring glaucoma MeSH terms, all MeSH terms associated with the 307 records in the Term Identification Set were exported from EndNote and saved as a list in text file format. A major or minor topic focus designation is irrelevant to this study, therefore the asterisk mark (*) used to indicate a major topic focus was stripped from the start of MeSH terms. Similarly, all subheadings attached to main headings were removed in order to identify only main heading frequency. All non-MeSH terms, such as those from the Medline record's CAS Registry/EC Number/Name of Substance field, were also deleted. The edited list was then imported into

Microsoft Excel and sorted alphabetically.

Before tallying the MeSH terms, the list was filtered for terms not semantically associated with glaucoma. Terms such as those describing gender or a specific study type (e.g. prospective or double-blind method) were removed.

This produced a list of MeSH terms ranked by total number of appearances across all 307 records. As a MeSH term needs only to occur once in a Medline record for that record to be retrievable, this list was then used to determine the total number of unique records each MeSH term returned (its 'record occurrence'). It was decided a priori that only terms capable of retrieving 5% or more of the records in the Term Identification Set (n ≥15) would be considered for the filter.

2.3 Frequency analysis of words/phrases in title and abstract

The titles and abstracts of all records in the EndNote Term Identification Set were exported and saved as a text file. This text file was then imported into Writewords[3], a text analysis website, which created a list of single textwords and phrases (in combinations of five, four, three, two terms) by decreasing frequency. By identifying the most frequently occurring contexts, a weighted, ranked list of candidate search terms was created.

Each term was searched across the title and abstract fields of the Term Identification Set records to determine the number of unique records each retrieved (i.e. record occurrence).

Again, terms and phrases selected for further testing were those that retrieved 5% or more of the records (n ≥ 15). Table 1 (below) lists the MeSH and textwords discovered through frequency analysis.

Table 1. Candidate terms identified through frequency analysis

Note: $ = Truncation

MeSH terms:
exp Glaucoma (exploded to include all the narrower terms in the hierarchy)
Ocular Hypertension
Glaucoma
Glaucoma, Angle-Closure
Glaucoma, Neovascular
Glaucoma, Open-Angle
Hydophthalmos
Intraocular Pressure
Trabeculectomy
Gonioscopy
Optic Disk
Optic Nerve Diseases
Visual Field Tests
Tonometry, Ocular
Ophthalmology
Anterior Chamber
Vision Disorders
Visual Fields
Visual Acuity
Textwords: Glaucoma$, glaucoma, open angle, primary open angle, glaucomatous$, angle closure, Ocular Hypertension, Trabeculectom$, suspect$, primary angle closure$, primary angle closure, poag, normal tension, oag, antiglaucoma$, gonioscopy.

2.4 The One Hundred (100) Test

Terms that retrieved over 5% were then subjected to the '100 test'. The 100 test identifies frequently occurring terms that are uniquely or highly associated with glaucoma.

Each term was run individually in Medline with results restricted to retrieving only those records with abstracts and that were in English. The first 100 references were analysed to determine their relevance to glaucoma. In addition a second test was used to confirm this relevance and combat bias. This test looked at the candidate terms results (i.e. number of records in the whole of Medline) and compared it to the candidate term without any glaucoma association (by running the search Term NOT glaucoma.mp.). The results of this test demonstrated a high correlation with the results of the '100 test'.

Terms in the '100 test' with over 75% relevance to glaucoma were then retained.

Glaucoma terms with the highest record occurrences in the Term Identification Set and capable of retrieving more than 5% of that set, and with ≥ 75% in the '100 test' are shown in Table 2 below. Terms suspected of being uniquely associated with Glaucoma but not retrieving more than 5% of the Term Identification Set were also retained.

Table 2. Most frequent terms for glaucoma identified by the Term Identification Set

Terms	Record Occurrence (total n=307)	% Record Occurrence
MeSH		
Term	291	94.78%
Term	147	47.88%
Term	118	38.43%
Term	60	19.54%
Term	55	17.91%
Term	41	13.35%
Term	17	5.53%
Term	1	0.32%
Textwords/phrases		
Glaucoma$	282	91.85%
glaucoma	279	90.87%
open angle	129	42.01%
primary open angle	66	21.49%
glaucomatous$	59	19.21%
angle closure	50	16.28%
Ocular Hypertension	49	15.96%
Trabeculectom$	46	14.98%
suspect$	29	9.44%
primary angle closure$	27	8.79%
primary angle closure	27	8.79%
poag	26	8.46%
normal tension	18	5.86%
oag	18	5.86%
antiglaucoma$	16	5.21%
gonioscopy	16	5.21%

2.5 Glaucoma filter development

Each candidate term was searched individually in the Filter Development Set established in Medline and ranked according to the number of records retrieved. MeSH terms were searched without being focused to main topic or exploded to capture narrower, more specific concepts. The exception to this was glaucoma which was exploded in MeSH. Textwords were tested with and without truncation.

An objective method for building the filter was adhered to. In this method, the term with the highest recall (T1) is automatically chosen for inclusion in the filter. T1 is then used as a baseline to determine the unique contribution of each of the remaining candidate terms when combined with it using the OR search operator. Terms that do not retrieve anything in addition to T1 are eliminated. The term that performs best in combination with T1 is selected for inclusion in the filter and labelled T2. The search strategy 'T1 OR T2' then becomes the new baseline search and all remaining terms are trialled in combination with this baseline using OR to determine the term making the next best unique contribution (T3). 'T1 OR T2 OR T3' then becomes the new baseline, and so on until the remaining candidate terms no longer retrieve any additional records in the Filter Development Set.

2.6 Results

With a recall of 94.79% (or 291/307) in the Filter Development Set, the individual term which best performed with respect to retrieving articles was the exploded MeSH term glaucoma.

Recall in this set was maximised by the addition of the truncated textword glaucoma$.

This improved recall to 96.4% (296/307).

The remaining eleven references were analysed to determine why they hadn't been retrieved by the two term strategy.

The references were more generally about vision impairment (including diabetic retinopathy), intraocular pressure and drugs used to treat IOP. These results had not been indexed with the MeSH term glaucoma nor use glaucoma in the title or abstract and so were not retrieved. Vision impairment and intraocular pressure had been investigated and were excluded from further testing due to the low relevancy to glaucoma. 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 final best performing search for sensitivity in the Filter Development Set was therefore the two term search: (Exp glaucoma/ OR glaucoma$.ti,ab.).

Following further investigation it was determined that using the field descriptor .mp. rather than [title/abstract] retrieved a more sensitive search. The .mp. command forces a search on title, abstract and

MeSH fields within the OvidSP Medline database (It's equivalent in PubMed is [tw]).

Note: The $ sign is the OvidSP truncation marking.

2.7 Adjustments to the draft filter

Further analysis of the terms, together with terminology suggested by the Expert Reference Group, led to further adjustment to the draft filter to include some additional textwords and a MeSH term.

The MeSH terms trabeculectomy, gonioscopy and ocular hypertension were considered as potential terms to add to the filter. Expert advice was sought on whether the terms were uniquely associated with glaucoma. Following advice from the expert

advisory group trabeculectomy was included in the filter.

The OvidSP Medline glaucoma filter comprises of three terms.

exp Glaucoma/ OR glaucoma$.mp. OR trabeculectomy/

2.8 Glaucoma filter validation

The OvidSP Medline glaucoma filter was run in two datasets to check the consistency of its performance.

The first of these was the Filter Validation Set, derived from the gold standard set of citations (n=307). The second check used the full, reconstructed gold standard set of glaucoma citations (n=921). Results are shown in Table 3.

Table 3. Glaucoma filter performance in two validation sets

Testing set	No. citations retrieved from set	% Recall
Filter Validation Set	294/307	95.7
Full Gold Standard Set	877/921	95.2

3. Translating OvidSP Medline Filter for PubMed

The OvidSP Medline filter was translated for PubMed. PubMed offers several advantages over OvidSP Medline:

1. PubMed searches can be converted into hyperlinks for real time interrogation of the PubMed database
2. PubMed provides access to more content than OvidSP Medline
3. PubMed is freely available and readily accessible without institutional subscription.

The PubMed database consists of two components: Medline citations indexed with the National Library of Medicine's MeSH terms; and other citations not yet indexed with MeSH terms due to their stage of processing (e.g. in process), or those not selected for MeSH indexing. Optimal translation of a Medline search filter for PubMed requires an awareness of these two categories of citations within the database.

Where the MeSH-indexed proportion is concerned, an accurately translated filter should retrieve the exact same set of references as the set retrieved in Medline. To achieve this equivalency, the OvidSP search syntax has to be carefully converted into PubMed's own unique search syntax.

To retrieve references not yet indexed with MeSH terms, the PubMed version of the filter must include a textword translation of the validated filter. This translation is restricted to searching on the non-indexed portion of PubMed so that it doesn't overlap with the component designed to retrieve the MeSH-indexed references. This textword translation is not expected to retrieve with the same degree of sensitivity and precision as a search based on MeSH terms. Low sensitivity and precision are not vital concerns in this portion of the search as its inclusion is only an interim measure.

Relevant but as yet non-indexed glaucoma citations missed by the textword search translation should eventually be retrieved by MeSH terms once they have been assigned.

3.1 PubMed translation of the Medline-indexed component

The filter was directly translated from Medline syntax to PubMed syntax and then run against the Filter Development Set. Equivalence was established by demonstrating the same retrieval of the Filter Development Set in both Medline and PubMed. The PubMed translation for retrieving glaucoma citations in the indexed subset of PubMed is:

> glaucoma[mh] OR glaucoma*[tw] OR trabeculectomy[mh]

Note: The [tw] tag is equivalent to the .mp. search command in OvidSP Medline. It forces a search on title, abstract and MeSH term fields.

3.2 PubMed textword translation for retrieving citations not indexed for Medline

Once equivalence is established between the Medline and PubMed search (searching the indexed content of PubMed) a search string must be established to retrieve relevant content from the non-indexed portion of PubMed.

The following methodology was used to identify textword equivalents of glaucoma filter MeSH terms:

1. The translated filter was run in PubMed and the results limited to English language, MeSH-indexed citations with abstracts published between 2012 and 2013.
2. The translated filter was then run again with all MeSH search terms restricted to searching on the title and abstract fields of each citation by converting the [mh] search tag to the [tiab] one. This search simulates a search on PubMed's non-indexed subset where retrieval depends on term occurrence in the citation's title and/or abstract.
3. The citations retrieved by filter MeSH terms (step 1) but not their textword equivalents (step 2) were identified.
4. Frequency analysis of the titles and abstracts of these 'lost

citations' revealed alternative natural language terms that could be incorporated in the filter to enhance its retrieval of PubMed's non-indexed literature. These were tested individually and together to find the best performing combination of terms.

The identified terms were: trabeculoplasty, trabeculectom* (a truncated form of trabeculectomy) and angle closure.

The final textword translation of the PubMed filter, designed to retrieve content in PubMed non-indexed subset contains the following terms:

> (glaucoma*[tw] OR trabeculectom*[tw] OR trabeculoplasty[tiab] OR angle closure*[tiab])

Note: * indicates truncation.

3.2.1 Glaucoma search filter

When put together with the search component designed for retrieving indexed content, the full and final PubMed glaucoma filter becomes:

> ((((glaucoma[mh] OR glaucoma*[tw] OR trabeculectomy[mh]) AND medline[sb]) OR *((glaucoma*[tw] OR trabeculectom*[tw] OR trabeculoplasty[tiab] OR angle closure*[tiab]) NOT medline[sb]))*

Note: the textword translation is shown in italics.

Recall of the entire gold standard set (n=921) was 877, establishing a sensitivity of 95.22.

4. Post Hoc Relevance Testing

4.1 Post hoc relevance testing results

A post hoc screening was performed on both the indexed and non-indexed portions of the search filter. The project sought to measure the validated PubMed filter's real world precision by calculating the number of relevant citations retrieved as a subset of the first 250 citations retrieved. Two screenings, of 250 articles each, were created to determine the precision of the indexed (Medline) and non-indexed portions of the filter using post hoc relevance testing.

The indexed search string was run in PubMed, restricting the results to English with abstracts and the Medline database. The first 250 results were retrieved and sent to pairs of reviewers for assessment of relevance. This process was repeated for the non-indexed search string run in PubMed.

Results of post hoc relevance assessment by reviewers indicated that the filter had a high precision.

In the indexed portion 223/250 (89.2%) references were identified as being relevant to glaucoma by two reviewers.

In the non-indexed portion 204/250 (81.6%) references were identified as being relevant to glaucoma by two reviewers.

Overall the filter had a precision performance of 85.4% (427/500).

The overall high performance of the filter in both sensitivity and precision rendered further improvements and testing unnecessary.

5. Set of Expert Topic Searches

A suite of associated topic searches were created to accompany the glaucoma filter. The subject of these topic searches were derived from a number of sources:

- Textwords and MeSH terms with high frequency occurrence identified in the frequency analysis stages of the project.

- Topics included in the Australian NHMRC glaucoma guideline NHMRC Guidelines for the Screening, Prognosis, Diagnosis, Management and Prevention of Glaucoma 2010.[4]
- Topics included in the reference text Shield's Textbook of Glaucoma.[5]

The list is presented in Table 4 below.

Table 4. Complete list of expert topic searches

Clinical topics	Populations	Specific Glaucoma's
Risk Factors	Aboriginal and Torres Strait Islander People	Primary Angle-Closure Glaucoma
Screening	Genetic predisposition	Open Angle Glaucoma
Diagnosis	Rural and Remote	Neovascular Glaucoma
Treatment		Uveitic Glaucoma
Management		Normal Tension Glaucoma
Prognosis		Suspect Glaucoma
Filtering Surgery		Childhood Glaucoma
Laser Surgery		
Drainage Implant Surgery		
Nonpenetrating Glaucoma Surgery		
Medication		
Exfoliation Syndrome		
Disease Progression		
Diabetes		
Diabetic Retinopathy		
Myopia		
Quality of Life		
Cataract		

5.1 Limits Applied to Topic Searches

Two methodological search filters will be built into all topics to offer searchers the option to limit results to the highest levels of evidence only, i.e. systematic reviews and randomised controlled trials.

The methodological filters are based upon the validated methodological filters developed by Haynes et al.[6] at McMaster University which have been adopted by the National Library of Medicine in the clinical queries database for PubMed and Medline.

This filter combines the PubMed Clinical Queries systematic review filter with the Clinical Queries therapy filter. A broad (balanced) and a narrow (specific) filter has been applied to all topic searches.[1]

Conclusion

The final products from the research conducted by the Flinders Filters Team include:

- A validated OvidSP Medline glaucoma search filter, capable of retrieving 95% of literature of known relevance to glaucoma.

- A validated PubMed translation of this filter that has an equivalent level of performance in the MeSH-indexed subset of PubMed.

- An experimentally-derived textword translation of the validated PubMed filter for retrieving PubMed's unindexed, or not-yet-indexed, citations with optimal efficacy.

- A set of hyperlinked expert glaucoma PubMed searches on topics of interest that can be launched as one-click, real-time searches of the PubMed database.

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