



Conference Paper

Knowing How Good Our Searches Are: An Approach Derived from Search Filter Development Methodology

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Received: 10 Aug. 2015

Accepted: 30 Oct. 2015

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Abstract

Objective – Effective literature searching is of paramount importance in supporting evidence based practice, research, and policy. Missed references can have adverse effects on outcomes. This paper reports on the development and evaluation of an online learning resource, designed for librarians and other interested searchers, presenting an evidence based approach to enhancing and testing literature searches.

Methods – We developed and evaluated the set of free online learning modules for librarians called Smart Searching, suggesting the use of techniques derived from search filter development undertaken by the CareSearch Palliative Care Knowledge Network and its associated project Flinders Filters. The searching module content has been informed by the processes and principles used in search filter development. The self-paced modules are intended to help librarians and other interested searchers test the effectiveness of their literature searches, provide evidence of search performance that can be used to improve searches, as well as to evaluate and promote searching expertise. Each module covers one of four techniques, or core principles, employed in search filter development: (1) collaboration with subject experts; (2) use of a reference sample set; (3) term identification through frequency analysis; and (4) iterative testing. Evaluation of the resource comprised ongoing monitoring of web analytics to determine factors such as numbers of users and geographic origin; a user survey conducted online elicited qualitative information

about the usefulness of the resource.

Results – The resource was launched in May 2014. Web analytics show over 6,000 unique users from 101 countries (at 9 August 2015). Responses to the survey (n=50) indicated that 80% would recommend the resource to a colleague.

Conclusions – An evidence based approach to searching, derived from search filter development methodology, has been shown to have value as an online learning resource. More information is needed about the reasons why people are using the resource beyond what could be ascertained by the survey results.

Introduction

Effective searching is of central importance to the acquisition of published evidence across all disciplines of study and to informing practice and policy in diverse fields. Evidence based practice has a strong presence in the health sciences (medicine, nursing, and allied health), and health is the sphere of activity within which the work in this paper is situated. However, evidence based approaches (such as the undertaking of systematic reviews) are now embedded in many other areas, including environmental science, engineering, and computer science. These approaches are also found in areas of policy, education, management, and social sciences (Hayman and Tieman, 2015b).

In health, decisions made about treatment of patients can have significantly different outcomes depending on the evidence on which those decisions are based. Adverse effects can result from wrong or missing information in any field of endeavour. Scientific development builds on research that has gone before and must be underpinned by accurate information. As librarians well understand, the key to the discovery of the best available evidence is a well-executed search.

Together with the need to search and find the best available evidence, to underpin practice, research, and policy, is the challenge of searching effectively. Databases of complex and differing structures hold a massive and

increasing amount of bibliographic information. The quantity of published and indexed articles is vast, even without considering the “grey literature” that must also be searched for a comprehensive search, such as one undertaken for a systematic review. The Scopus database contains 55 million records; Web of Science captures 65 million cited references annually; PubMed in June this year (2015) grew to 25 million records.

The technical challenges of searching are increasing, with a range of databases available in most fields of study, often using different thesauri and different search syntax. Effective searching requires an understanding of Boolean search techniques as well as knowledge of how they have been implemented in the particular search interface of each database. McGowan and Sampson (2005) have written of the need for expert searchers to understand “the specifics about data structure and functions of bibliographic and specialized databases, as well as the technical and methodological issues of searching.”

One tool available to enhance searching effectiveness is the search filter. We define the search filters created at CareSearch and Flinders Filters as follows: a search filter is a validated search strategy built for a particular bibliographic database and with known performance effectiveness. Each term in the strategy has been tested for its recall of references from a gold standard set. Many search filters are now available from a range of

different sources. They may be methodology-based search filters (designed to retrieve literature of a particular study type) or subject-based search filters (designed to retrieve literature on a particular subject). Several useful websites provide information about where to find search filters and documentation about their development and validation, for example, the InterTASC Information Specialists' Sub-Group Search Filter Resource is an excellent source of information about methodological search filters (<https://sites.google.com/a/york.ac.uk/issgsearch-filters-resource/home>).

Search filters are of variable quality and it is important to understand how to use them and how to judge them. Not all are validated. There are useful appraisal tools for search filters, for example, the detailed ISSG Search Filter Appraisal Checklist (Glanville, et al., 2008) and the CADTH CAI (Bak, et al., 2009).

The search filters developed by CareSearch Palliative Care Knowledge Network (<http://www.caresearch.com.au>) and its associated project Flinders Filters (<http://www.flinders.edu.au/clinical-change/research/flinders-filters/>) are topical (subject-based) search filters on topics including palliative care, heart failure, bereavement, dementia, primary health care, and Australian Indigenous health care. These filters were developed in OvidSP Medline and translated for use in PubMed and are available online for use by anyone to conduct a search of tested and known reliability. We have also published articles on the search filter development and methodology employed for each filter listed above. (Brown et al. 2014; Damarell, Tieman, Sladek, and Davidson, 2011; Hayman and Tieman, 2015, May 28; Sladek et al., 2006. Tieman, Lawrence, Damarell, Sladek, and Nikolof, 2014; Tieman, Hayman, and Hall, 2015). An important element of search filter development is that the process of development is not only rigorous, but also documented and transparent.

The librarians working within these two projects to create search filters are part of a team developing an experimental research searching method. We have for some time discussed how the processes we use to develop the filters have caused us to re-examine the way we undertake general literature searching. The detailed technical bias minimisation approach we employ in search filter design and assessment offers opportunities to see how some of these conceptual approaches could be applied in the day-to-day literature searching undertaken by librarians and others. The receipt of the Health Informatics Innovation Award in 2012 from Health Libraries Australia and Medical Director (then Health Communication Network) provided an opportunity to create an online resource to capture elements of these processes and make them available for use by librarians and others who might find them useful.

Investigation of existing online continuing professional development tools for librarians showed few resources available on expert searching. Most guides to searching effectively in online bibliographic databases are user guides written by librarians for their patrons; these focus on using and understanding the different databases, and general searching principles. Sampson and McGowan (2005) wrote of librarians testing their retrieved sets, stating: "the librarian must have the expertise to develop test strategies to verify the performance of terms and elements of the search, adjusting or abandoning nonperforming elements. Often these tests rely on comparison against a strategy from a previously published review or the recall of a set of key references supplied by subject experts." However, we found few tools available to teach how to do this. One example we found was the excellent online training on building search strategies provided by Wichor Bramer's slide presentations (<http://www.slideshare.net/wichor>). Another is Dean Giustini's useful presentation on search techniques (<http://www.slideshare.net/giustinid/expert-searching-for-health-librarians-2012>). The PRESS

(Peer Review of Electronic Search Strategies) tool is a validated tool for peer reviewing search strategies that, as well as providing quality assurance for the search itself, is likely to enhance searching skills through peer review and support, and use of the associated evidence based assessment checklist (McGowan, Sampson, and Lefebvre, 2010). The chapter on designing search strategies in the Cochrane Collaboration handbook (Higgins and Green, 2011) is an indispensable guide to searching systematically, and we hope that the Smart Searching modules will provide some approaches to support the searching methods within that guide.

Aims

We aimed to provide an online resource that would be self-paced, accessible and free to use, and that would introduce librarians (and other interested searchers) to techniques for applying an evidence based approach to their own searching practice. The module would utilise approaches used in research activities associated with search filter development adapted for individual and local searching contexts.

We also planned to undertake evaluation of the resource to gauge its usefulness. The intended audience is chiefly librarians, and the resource is likely to be of most use to those in the health sector. We expect that it will also be useful to librarians beyond health, as the principles are widely applicable to all searching. We hope that it may also be of use to anyone (librarian or not) with a keen interest in searching. A moderate level of searching expertise is desirable for those using the modules.

Methods

Development of the resource. We created an open-access website in Google Sites at <https://sites.google.com/site/smartsearchinglogical/home>. The website consists of four self-paced modules requiring no logon to use. All modules can be accessed at any time without the

requirement to complete assessment first. Simple quizzes are provided.

The methods suggested in the modules can be applied to sensitive or specific searches, as the need arises. They are likely to be principles and approaches already used by expert searchers; we hope that setting them out in this way will be useful and that elements of the approach can be used and adapted as necessary. The framework for searching in the modules reflects the stages used in search filter development and draws on some of the techniques used in their development.

Our search filters are created using steps such as those set out in Figure 1.

In drawing on this process to shape the learning modules, we focussed on the following key elements: (1) Expert Advisory Group (EAG); (2) Gold Standard Set; (3) Term identification; and (4) Validation.

The EAG ensures the clinical usefulness of the search filter and minimises bias that we (as searching experts but not necessarily subject experts) might bring to the search strategy. EAG members provide advice on the scope of the filter, potential search terms, and possible sources of a representative gold standard set; they are also available to test draft search retrievals for relevance, as part of the validation process.

The gold standard set is a set of references representative of the entire scope of the topic to be retrieved by the search, and externally confirmed as relevant to the topic. This set is divided into three subsets so that term identification, creation, and validation can all be done within different sets of data; again, aiming to reduce any potential bias that could arise from building and testing within the same set.

Term identification is the process of analysing the titles, abstracts, and subject headings of the

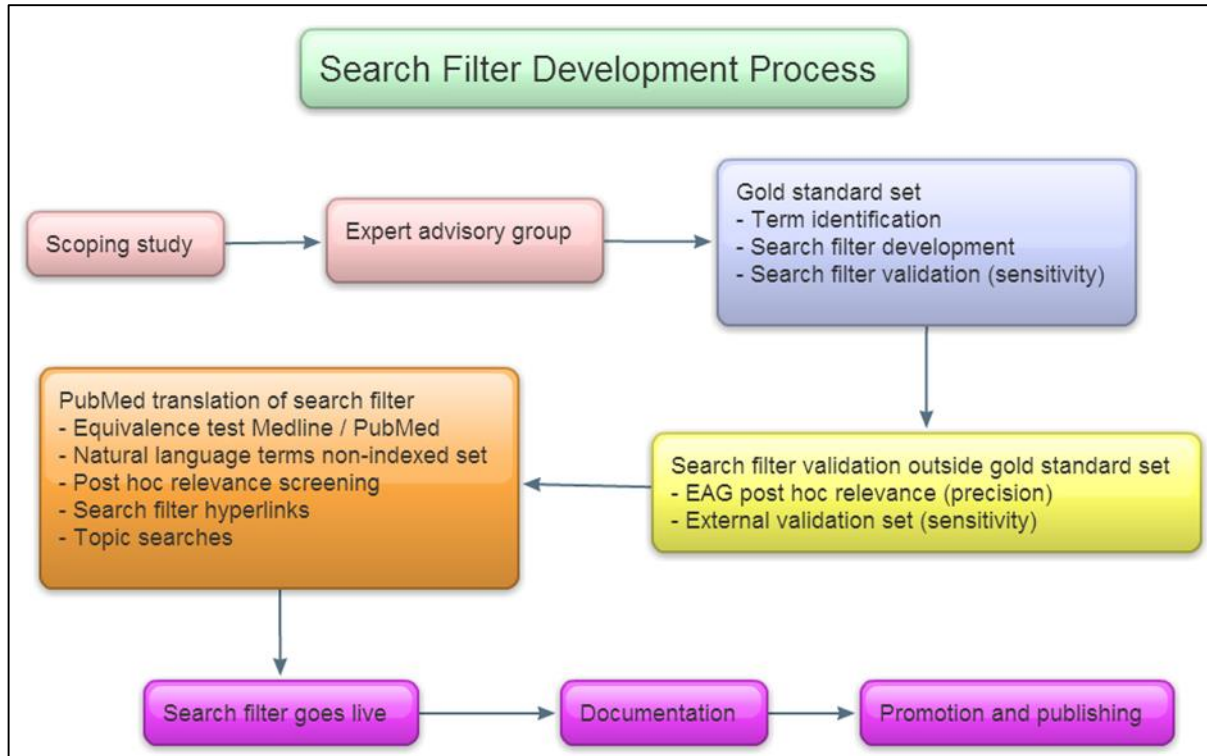


Figure 1
Steps in Search Filter Development at CareSearch and Flinders Filters

references to identify text words (natural language terms) and controlled headings (usually MeSH terms) to be tested for their recall effectiveness in the gold standard set.

Validation includes the testing of the search strategy within a subset of the gold standard set, within the entire gold standard set, and often within an external validation set, to arrive at a percentage that is a measure of its retrieval performance. Its ability to retrieve items known to be relevant (e.g., within the gold standard set) gives a sensitivity percentage rating; the number of relevant records retrieved out of a total set retrieved by the search strategy gives the precision percentage rating (using relevance assessment by external reviewers).

We drew from these four approaches as follows.

(1) EAG became Module 1: Subject Experts. The formal expert advisory group crucial to the

search filter development process can be represented by seeking external advice from a subject-matter expert. This person may simply be the researcher or clinician who has requested the search, or may be a colleague in that field. Advice they provide can help reduce bias that the librarian might bring to the search and can add a dimension to the search of external knowledge about the subject area. This knowledge can provide useful advice about appropriate scope for the search (e.g., dates when research in the subject changed significantly, or concepts that are uniquely associated with the topic), relevant terminology (e.g., synonyms in common use), key papers, journals, database, organisations, websites or authors in the field (they may even have a personal collection of papers to function as a potential sample reference set). They may also be able to undertake a relevance assessment of draft search retrievals, enabling adjustment of the search. While both librarians and health

professionals are busy and always working under time constraints, it can nevertheless be extremely valuable to get some suggestions to inform the development of a search strategy before the search and some feedback after the search – both can supply useful information about the effectiveness of the search that will allow the librarian to analyse and tweak it. If it is not retrieving key papers that have been recommended in the field, why not? Check the index terms and text words and see if any have been missed. If it is retrieving a large number of items that are not relevant, why is this happening? Check the search terms that are retrieving the irrelevant items and see what happens if they are removed.

(2) Gold Standard Set became Module 2: Sample Set. The creation of a formal gold standard set, employed in the development of a search filter, is a major piece of work using an established methodology. Without going to those lengths for a literature search, we nevertheless suggest that creating a sample set of references to guide a search can still be very useful. A sample set of references, known to be relevant to the search topic, provides a test set for (1) identifying terms used in the literature for the topic and (2) testing the effectiveness of the search in retrieving references known to be relevant. The contents and relevance of this sample set should be externally verified, not a set derived from the search that is being tested. Possible sources of a sample set are: a collection of papers provided by an expert in the subject; a published database in the field; references from key papers known to be relevant (included studies in systematic reviews are an excellent source as they have been assessed as relevant within the systematic review process); articles from relevant and authoritative journals in the field.

(3) Term Identification became Module 3: Term Identification. Term identification is a standard process that already occurs in all literature searching to some extent. Thorough analysing and testing of candidate terms for your search strategy is a very useful technique for ensuring a

high performing search strategy that will capture a high proportion of relevant items and a low proportion of irrelevant ones. In the full search filter development model, we undertake extensive research, analysis, and testing of potential search terms for each subject. In general literature searching it is still possible to do some investigation and analysis to help identify the best terms for the search. Sources for the terms will be: Medical Subject Headings (MeSH) or other database-specific thesauri, e.g., Emtree, IEEE Thesaurus, CINAHL subject headings, ERIC Thesaurus; expert suggestions of relevant terms; analysis of key references (the sample set). It is useful to confirm with the subject expert that the candidate terms are correct and relevant. We suggest analysis of the frequency of text words (natural language terms) in searchable fields in the sample reference set, typically the title and abstract fields. This will give alternative candidate terms to test, i.e., those known to be associated with relevant references.

(4) Validation became Module 4: Testing. Testing can be done at a number of levels, from simple checks through to formal external validation. Any element of testing introduced can result in an improved search. The search strategy is built by combining candidate terms and testing sequentially against the sample set to see how many references are retrieved. Testing the terms and their performance in a set of known relevance is important, as it can assist in identifying what is not retrieved and why; it can identify terms that add nothing to the search results; and it will facilitate adjustment of the search to improve results. This type of test (assessing retrieval within a set of known relevant items) tests the sensitivity (or recall) of a search; that is, its ability to retrieve relevant items. Testing for precision (i.e., how many of the retrieved citations are relevant) is also important. To assess this, we suggest external expert assessment of the relevance of number of relevant items the search has retrieved in a sample search in the open database. A comprehensive systematic review search

requires maximum sensitivity and there is less concern with a high degree of precision. The searcher wishes to retrieve all relevant items and is willing to risk a large number of irrelevant retrievals. Clinicians may however prefer that most items retrieved are relevant and not wish to wade through a large number of irrelevant items. It is possible and important to increase or decrease the sensitivity depending on the requirements of the end user. As sensitivity increases, precision will decrease, and vice versa. Testing is an iterative process that feeds back into the development of the search strategy, improving it each time, and resulting in an enhanced search that is less likely to miss key references.

Each module contains an explanation of the principle and why it is important. It also contains a worked scenario of a librarian undertaking a search for a clinician that goes across all four modules sequentially to illustrate the process as it might occur in practice.

The development of the modules was guided by an advisory group with expertise in searching, health librarianship, health informatics, and education drawn from organisations across Australia (listed at <https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxzbWFydHNIYXJjaGluZ2xvZ2ljYWx8Z3g6MjNmZWJkODJiOWYzNzczNw>).

Evaluation. Detailed web usage statistics are available using Google Analytics, because the resource site is built in Google Sites. Statistics available include: numbers of users by day since the site was launched, shown as total visits and unique visitors; total page views; time spent on site and bounce rate, as well as the geographic location of users. The web statistics are regularly measured and reported on the Smart Searching website itself using the programme SeeTheStats (<http://www.seethestats.com>). Feedback is sought directly from users on the site via email.

A survey of users worldwide was conducted in April 2015. The questions asked are provided in Appendix A. The survey aimed to ascertain the occupations of the users, the nature of the organisations and disciplines where the users worked, and qualitative information about the usefulness of the resource. Ethics approval was obtained from Flinders University to conduct the survey. The user survey was pretested with colleagues for technical function and its content was reviewed by a senior colleague and with peers before it was disseminated. All questions were optional and no identifying data was obtained. Notices informing users about the survey were put on the site itself and were sent to health librarian and searching email lists in Australia and overseas. These were the same channels used to promote the site when it was launched.

A workshop presenting the Smart Searching resource was held as a satellite event in conjunction with the 8th International Evidence Based Library and Information Practice Conference (EBLIP8), in Brisbane, Queensland, Australia, in July 2015. The workshop was attended by approximately 50 people over 2 sessions and was an opportunity to receive some direct feedback from participants about the content and usefulness of the resource.

Results

Web Analytics. A summary of web statistics is presented in Figure 2. They cover the period from launch on May 25, 2014 to the time of writing this article (August 9, 2015).

The figure shows the increase in usage of the site that occurred when the user survey was promoted in April 2015.

Figure 3 shows the top 10 countries by visit. Bounce rates are significantly lower (and session duration longer) for visitors from Australia, the United Kingdom, New Zealand, Canada, and Ireland, suggesting these users are using the site more extensively. Details for the top 20 countries

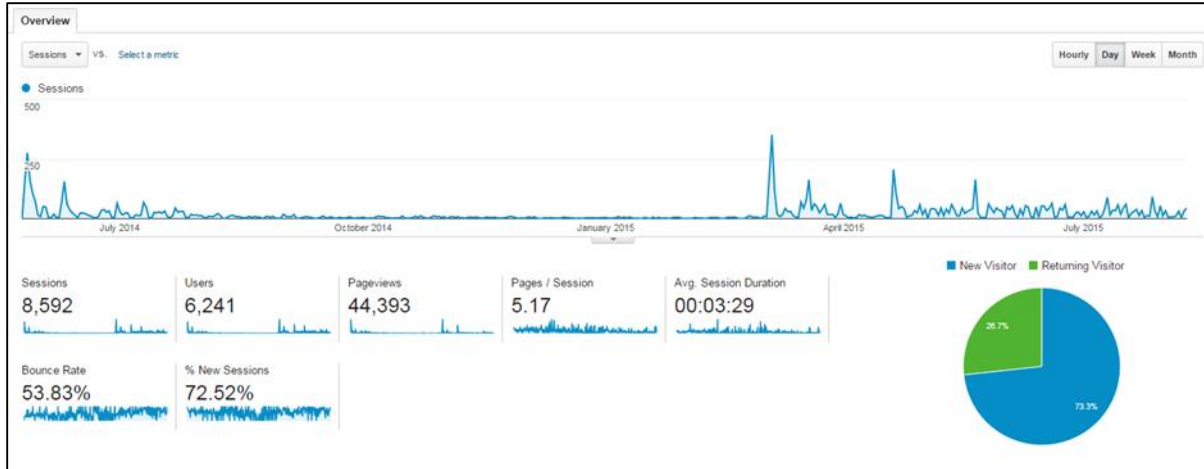


Figure 2
Google Analytics (Overview) for the Smart Searching website (August 9, 2015)

Country	Sessions	% New Sessions	New Users	Bounce Rate	Pages / Session	Avg. Session Duration
	8,592 <small>% of Total: 100.00% (8,592)</small>	73.29% <small>Avg for View: 72.52% (1.06%)</small>	6,297 <small>% of Total: 101.06% (6,231)</small>	53.83% <small>Avg for View: 53.83% (0.00%)</small>	5.17 <small>Avg for View: 5.17 (0.00%)</small>	00:03:29 <small>Avg for View: 00:03:29 (0.00%)</small>
1. Australia	2,263 (26.34%)	62.17%	1,407 (22.34%)	38.22%	7.28	00:05:36
2. United States	1,919 (22.33%)	80.88%	1,552 (24.65%)	64.72%	3.74	00:02:23
3. United Kingdom	1,000 (11.64%)	67.60%	676 (10.74%)	39.80%	6.96	00:04:23
4. Canada	828 (9.64%)	73.31%	607 (9.64%)	41.79%	6.06	00:03:19
5. (not set)	587 (6.83%)	99.83%	586 (9.31%)	87.56%	1.10	00:00:28
6. Ireland	296 (3.45%)	69.26%	205 (3.26%)	44.59%	5.06	00:03:09
7. New Zealand	224 (2.61%)	69.20%	155 (2.46%)	39.29%	7.67	00:04:54
8. Spain	165 (1.92%)	22.42%	37 (0.59%)	89.09%	1.55	00:00:51
9. Netherlands	123 (1.43%)	68.29%	84 (1.33%)	45.53%	6.72	00:03:34
10. China	121 (1.41%)	100.00%	121 (1.92%)	88.43%	0.97	00:00:12

Figure 3
Google Analytics (Geographic Location for the Smart Searching website (August 9, 2015)

visiting the site are shown in Appendix B, and up-to-date statistics are made available on the Smart Searching website under Usage and Feedback.

Overall, these statistics show a total of 8,592 visits by 6,297 unique users (Figure 2), from 101 countries (one country location being “not set”).

User Survey. A total of 50 people responded to the survey. While this is a small percentage of

the 3,855 unique users of the site at the end of April 2015, nevertheless it provides an indication of a range of views from users in different occupations and countries. Table 1 summarises demographic responses.

Table 2 shows responses relating to the use of the site and views about its usefulness.

Finally, Table 3 provides a selection of comments providing a representative overview

Table 1
Smart Searching User Survey responses to demographic questions

Occupation	Librarian 41 (80.39%) Other information professional 7 (13.73%) Student 2 (3.92%) Other 1 (1.96%)
Country	Australia 21 (42%) USA 16 (32%) UK 10 (20%) Canada 1 (2%) Cyprus 1 (2%) Netherlands 1 (2%)
Discipline (self-described)	Health / Health care / Health sciences 34 (68%) Medicine 2 (4%) Nursing 2 (4%) Biomedicine, health 1 (2%) Education 1 (2%) Health / Medicine 1 (2%) Health and Social Care 1 (2%) Health Promotion 1 (2%) Health, children, housing, aboriginal 1 (2%) Health, Psychology 1 (2%) Medical school / allied health 1 (2%) Public library 1 (2%) Regulatory 1 (2%) Social Sciences 1 (2%) Youth 1 (2%)

Table 2
Smart Searching User Survey responses to qualitative questions

Have you applied any of these techniques in your searching practice?	Yes, all or most	18 (36%)
	Yes, a few	13 (26%)
	No, but I may do so	10 (20%)
	No, but it has made me think differently about my searching	5 (10%)
	No, and I am not likely to do so	1 (2%)
	No Response	3
Do you think you would use this approach for testing?	Not Sure	23 (46%)
	Yes	20 (40%)
	No	3 (6%)
	No Response	4
Would you recommend this site to a colleague?	Yes	40 (80%)
	No	0 (0%)
	Not sure	9 (18%)
	No Response	1

Table 3
Smart Searching User Survey responses to open-ended qualitative questions

Site Function
<i>Systematic and methodical approach</i>
<i>Clear and easy to use (13 other responses were similar to this)</i>
<i>Template applicable across disciplines</i>
<i>While the content is useful- the constant arrow moving would not be appealing to busy clinicians or medical librarians</i>
Time constraints
<i>Time is the major factor, followed closely by access to the subject experts</i>
<i>it can possibly save me some time as I spend a lot of time in my job training and assisting health researchers in building effective literature searches</i>
<i>Time restraints, level of information need does not usually require that level of sensitivity (several like this)</i>
<i>Very useful, however not sure if I would have time to test every search in a real life work situation.</i>
Value
<i>Reassessing the way I approach things</i>
<i>The more knowledge/ideas we share about improving search techniques the more beneficial it is to the profession</i>
<i>I can see the value in being able to 'qualify' and measure my searching outcomes</i>
<i>Informative...I bet there are other librarians who, just like me, are not utilizing these techniques properly.</i>
<i>Adding those extra dimensions increases the robustness of our searching and helps to systematise the things we do</i>
<i>I tend to be more intuitive than systematic with my searches [...] Reporting would force me to ensure consistency!</i>
<i>Seems great as a refresher for me but will also be really useful for staff training purposes</i>
<i>I don't think that librarians test their search strategy and I feel it is an important tool to argue our competence and relevancy, especially in private enterprise</i>
<i>It gives a measure of effectiveness that speaks for itself...numbers are extremely hard to dispute!</i>

of the responses to open-ended questions about the value of the resource. The selection of comments has been reviewed by members of the Smart Searching Advisory Group. A review of the comments identified three main themes: Site Function; Time Constraints; Value.

Other Feedback. There has been very little response to requests on the site for direct feedback, other than one detailed and useful response which led to some small adjustments, chief of which was the addition of a recommendation of the tool PubReminer (<http://hgserver2.amc.nl/cgi-bin/miner/miner2.cgi>). Formal evaluation from the workshop following the EBLIP8 Conference was undertaken. Of those responses 22 of 26 rated the workshop as useful (4) or very useful

(18). Informal feedback on the day was positive, with one participant commenting that it “was a new way to think about approaching searching”.

Discussion

The high rate of usage of the website Smart Searching internationally suggests that there is a desire for this type of information, and this is supported by many of the comments received in the user survey, some of which are shown above under Value. There appears to be a gap in available resources providing instructions at an advanced level for developing and testing search strategies, especially free and online. Some important guides have been cited in the introduction, but there appears to be an appetite for a step-by-step learning resource. Such a

resource could be useful for continuing professional development for librarians themselves, especially in, but not confined to, the health sector. One survey respondent commented that the approach is “applicable across disciplines” which has certainly been the intention, although the examples provided are from health. The general principles apply to all searching in any field. Potentially such resources might also be useful to others (not only librarians) who are conducting sophisticated searches, such as researchers experienced in advanced searching in their own fields.

Overall the responses were positive, with 80% responding “Yes” to the key question “Would you recommend this site to a colleague?” (Table 2). Of the 50 respondents 14 commented favourably on the clarity and logical approach of the site. There appeared to be general agreement amongst many of the survey respondents that there is a need both to improve and to measure our searching performance.

Several respondents commented on the time-consuming nature of this approach (although one person believed it might save time, presumably if used to teach clients to conduct their own searches). We are very conscious that it may seem long-winded and cumbersome to test iteratively every term. It is suggested more as an overall way of thinking about searching than with an expectation that every search would require every step illustrated in the Smart Searching scenarios. The intention is for users to dip in and out as desired (and as appropriate for the particular search) and apply the elements they wish of this approach. We believe that any additional testing applied to any search has the potential to improve it. Another aspect of this approach that has the potential to be time-consuming, both for the librarian and their “subject expert”, is the consultation between them, and the requirement for the subject expert to do some checking and verification during the process. This is something that can add enormous value but may be difficult to achieve in practice. It is worth remembering that the

result of such investment of time and effort is a strong search with an ongoing value. It can be embedded on a website for reuse and can be used to set up a search alert; ultimately it may save time for the librarian and the client, and should have the immediate outcome of higher quality search results.

The question about using this method for testing one’s searches received a less clear positive response than other areas. Of the respondents 46% were unsure whether they would use this method to do this (Table 2). This may reflect that it is probably the most novel part of the approach and may be a more complex area of the site to follow. We believe that testing searches objectively provides an opportunity for librarians to provide some evidence of the effectiveness of their searching. To quote one respondent (Table 3): “I don’t think that librarians test their search strategy and I feel it is an important tool to argue our competence and relevancy”. It may be that there is agreement with this but that this particular method does not appeal, or is not clear. One response indicated that this section (4.2) was difficult to follow. In following up the survey results, and making adjustments to the site in response, we will review this section of the site and aim to clarify it with additional examples.

Some respondents commented that they already apply these or similar techniques, and we expect that highly experienced searchers would not need to use these modules. One respondent did not like the quizzes and would like to see them removed while another respondent singled out the quizzes as a highlight. Two respondents raised the issue of the nature and role of the subject experts, and whether this section is oversimplified or incorrect (librarians can also be subject experts). We believe that this is an important distinction: although librarians may indeed also be subject experts, it is a different role.

Evaluation of the Smart Searching resource was limited by the difficulty of eliciting responses

from users. The number of users (50) responding to the online survey is a small percentage of the over 6,000 people who have used it to date worldwide. We do not know how far they represent the users of the site as a whole. As far as geographic location is concerned, 42% of respondents were from Australia, 32% from the United States, and 20% from the UK; this compares to the following percentages for website users at that time: Australia 26%; United States 22%; United Kingdom 12%.

While comments received were useful and informative, and overall positive, we would still like more information about why people are using it and whether they are finding what they are seeking. A future survey will be conducted attempting to find out more about people's level of experience of this type of searching before they started the module and about the type of work they do, as well as more information about any differences use of the modules has made to their practice.

Conclusions

We have developed a set of learning modules for librarians called Smart Searching, premised on the use of techniques undertaken by the CareSearch Palliative Care Knowledge Network and Flinders Filters in development of search filters. We wish to emphasise that while this approach is derived from the search filter development model we use, it is a different process from the full development of a search filter using the methodology detailed in our published papers on the various search filters. It is a highly abbreviated and simplified approach, based nevertheless on the same principles of transparency, thoroughness, iteration, and minimisation of bias.

The self-paced modules are intended to help librarians (and others) test the effectiveness of their literature searches, providing evidence of search performance that can be used to improve searches, as well as evaluate and promote searching expertise. The four modules deal

respectively with each of four techniques: collaboration with subject experts; use of a reference sample set; term identification through frequency analysis; and iterative testing.

The modules are provided free on the web and were launched on May 25, 2014. The resource appears to be well-used and valued. In the period from launch to the writing of this article (August 2015), web analytics show that 8,568 sessions worldwide were conducted on the modules, from 6,211 individual users in 101 countries. A user survey conducted in April 2015, while limited, provided an overall positive response from 50 survey participants across 6 countries, with 80% stating they would recommend it to a colleague. The survey also provided useful qualitative information which will guide further development of the resource.

We developed this resource because we believe that effective searching is of paramount importance and should be accorded the respect of a scientific approach. Literature searching, as a key underpinning element of evidence based practice, must be able to be subjected to a scientific process of rigorous testing and falsifiability. Search strategies should be documented, transparent, and reproducible. We should always ask: "What has my search missed - and why?"

We will maintain and aim to improve the resource and welcome feedback, comments, and suggestions.

Acknowledgements

CareSearch Palliative Care Knowledge Network is funded by the Australian Department of Health.

The author acknowledges with gratitude the work of her colleague Yasmine Shaheem and the contribution of the Advisory Group for the Smart Searching website.

Acknowledgement is also warmly given to Health Libraries Australia and Medical Director (formerly HCN) for the Health Informatics Innovation Award 2012 that supported the development of Smart Searching.

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Appendix A

Smart Searching User Survey

Question 1: Country of Residence

Question 2: Occupation

Librarian
Other information professional
Researcher
Student
Other (please describe):

Question 3: Organisation Type

(e.g. university, government department, hospital)

Question 4: Discipline/Subject Area

(e.g. health, education, law)

Question 5: How did you find out about this site?

Choose all that apply

Email list
Google search
Other search engine
Newsletter or journal article
Colleague

Website link
Other (please give details if you can):

We see you selected Email list above. If you can, please supply the name of the list here

We see you selected Newsletter or journal article above. If you can, please supply the title(s) here

We see you selected Website link above. If you can, please supply any information about the website here

Question 6: What did you find most useful about this site?

Question 7: What did you find least useful about this site?

Question 8: Would you recommend this site to a colleague?

Yes
No
Not sure

Please give a reason for your answer to Question 8

Question 9: Are there any changes you would like to see?

Question 10: Have you applied any of these techniques in your searching practice?

Yes, all or most
Yes, a few
No, and I am not likely to do so
No, but I may do so
No, but it has made me think differently about my searching

Please give a reason for, and/or any comments about, your answer to Question 10

Question 11: Do you think you would use this approach for testing or reporting on your searching strategy effectiveness (as described in the Testing section of the site)?

Yes
No
Not sure

Please give a reason for, and/or any comments about, your answer to Question 11

Any other comments or suggestions?

Appendix B

Location of visitors (top 20 countries) to the Smart Searching Website (May 25, 2014 - August 9, 2015)

Country	Acquisition			Behaviour		
	Sessions	% New Sessions	New Users	Bounce Rate	Pages / Session	Avg. Session Duration
	8,592 % of Total: 100.00% (8,592)	73.29% Avg for View: 72.52% (1.06%)	6,297 % of Total: 101.06% (6,231)	53.83% Avg for View: 53.83% (0.00%)	5.17 Avg for View: 5.17 (0.00%)	00:03:29 Avg for View: 00:03:29 (0.00%)
1. Australia	2,263 (26.34%)	62.17%	1,407 (22.34%)	38.22%	7.28	00:05:36
2. United States	1,919 (22.33%)	80.88%	1,552 (24.65%)	64.72%	3.74	00:02:23
3. United Kingdom	1,000 (11.64%)	67.60%	676 (10.74%)	39.80%	6.96	00:04:23
4. Canada	828 (9.64%)	73.31%	607 (9.64%)	41.79%	6.06	00:03:19
5. (not set)	587 (6.83%)	99.83%	586 (9.31%)	87.56%	1.10	00:00:28
6. Ireland	296 (3.45%)	69.26%	205 (3.26%)	44.59%	5.06	00:03:09
7. New Zealand	224 (2.61%)	69.20%	155 (2.46%)	39.29%	7.67	00:04:54
8. Spain	165 (1.92%)	22.42%	37 (.59%)	89.09%	1.55	00:00:51
9. Netherlands	123 (1.43%)	68.29%	84 (1.33%)	45.53%	6.72	00:03:34
10. China	121 (1.41%)	100.00%	121 (1.92%)	88.43%	.97	00:00:12

11. Japan	101 (1.18%)	98.02%	99 (1.57%)	80.20%	2.45	00:02:10
12. Sweden	85 (0.99%)	65.88%	56 (3.26%)	38.82%	7.25	00:04:58
13. Russia	84 (0.98%)	25.00%	21 (0.33%)	90.48%	1.13	00:00:14
14. Norway	82 (0.95%)	63.41%	52 (0.83%)	39.02%	8.11	00:07:42
15. Germany	79 (0.92%)	98.73%	78 (1.24%)	82.28%	1.41	00:00:39
16. South Korea	51 (0.59%)	100.00%	51 (0.81%)	84.31%	1.08	00:00:42
17. Brazil	41 (0.48%)	100.00%	41 (.65%)	85.37%	1.83	00:01:11
18. France	41 (0.48%)	95.12%	39 (0.62%)	82.93%	1.46	00:00:25
19. Italy	41 (0.48%)	92.68%	38 (0.60%)	68.29%	4.37	00:01:13
20. India	26 (0.30%)	96.15%	25 (0.40%)	61.54%	5.00	00:04:08