

Development of a subject search filter to find information relevant to palliative care in the general medical literature*

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Purpose: The research developed and validated palliative care search filters for use in the general biomedical literature.

Methods: Four general medical journals were hand-searched to identify articles relevant to palliative care, forming a "gold standard" reference set. Searches comprising Medical Subject Headings (MeSH) and text-words were created for use in Ovid MEDLINE, and retrieved references were compared to the gold standard. Sensitivity, specificity, accuracy, and precision rates were calculated.

Results: By hand-searching 20,501 articles published in the 4 journals during the 3-year study period (1999–2001), reviewers identified 773 items relevant to palliative care (3.8%). A master search combining 9 MeSH descriptors with 3 text-words achieved

45.4% sensitivity, 99.3% specificity, 73% precision, and 97.3% accuracy. Efforts to increase the sensitivity by modifying 3 relevant published but unvalidated searches did not improve the yield, except in 1 case which resulted in an improved sensitivity of 56.9% but was offset by reduced specificity (92.1%), precision (22%), and accuracy (90.8%).

Conclusions: The study confirmed that literature relevant to palliative care is difficult to identify in general medical journals. While the filter developed in this research represents the best trade-off between sensitivity, specificity, accuracy, and precision, the sensitivity is unacceptably low. Further research, such as frequency analysis of text-words and MeSH terms, is required to increase the sensitivity of searching in this subset of the literature.

INTRODUCTION

Efficient access to relevant information underpins efforts to translate research evidence into practice [1]. Those in clinical practice and service planning face many informational challenges. These challenges include dealing with the overwhelming volume of published health information, knowing what to look for and where and how to search, and judging the quality of found information [2].

Specific subject areas may bring their own additional difficulties to searching. One such area is palliative

care. This is a multidisciplinary field that aims to improve the quality of life of patients (and their families) facing the problems associated with a life-limiting illness by providing pain and symptom relief and spiritual and psychosocial support from diagnosis to death and bereavement [3].

Several features, however, make this inherently difficult to search. First, it is a diffuse topic. A wide range of topics are of interest to, but not the sole domain of, palliative care. Examples include not only symptom control but also interventions that may modify the clinical course of underlying life-limiting illnesses [4]. While specialized palliative and supportive care journals may provide a direct source of some subject-specific information, it may be that relevant material that

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can inform practice exists outside the specific palliative care literature and is published in the general medical literature. Identifying this literature can be especially important as the source journals may not be as regularly reviewed by palliative care clinicians and researchers as the specialist journals. The collective subjective experience of clinicians and researchers involved with this study suggested that even seemingly highly sensitive search strategies might fail to identify articles relevant to palliative care in general medical journals. This problem is significant, especially in an area as diffuse as palliative care [5].

Second, the language used to identify the discipline is crucial in searching. Early literature might not clearly be identified as relevant to the topic of palliative care due to the emerging nature of the field. Problems with consistent terminology and a lack of descriptiveness in papers may make searching difficult, a problem experienced in many biomedical fields [6]. Authors themselves may not conceive of their work as relevant to palliative care, may not nominate palliative Medical Subject Headings (MeSH) in the editorial process, or use language in writing their articles to indicate that it would interest the palliative care community.

The particular challenges of searching for literature relevant to palliative care suggest a potential role for subject search filters in searching for relevant information in the general medical literature. Methodological search filters in health emerged in the 1990s [7] and include a set of predetermined search terms used to restrict retrieved references in database searches to research studies that use particular methodological designs, such as randomized controlled trials (RCTs). Such filters are then combined with a searcher's subject-based search.

A recent review summarizes approaches to methodological filter development for systematic reviews, RCTs, diagnosis, diagnostic test evaluation, etiology, prognosis, treatment, clinical prediction rules, qualitative outcomes measurements, and evidence-based health care [8]. These filters are developed by comparing a gold standard set of articles found by hand-searching journals with the results of a range of different electronic searches. Comparisons between the gold standard and the developed searches are most commonly presented in terms of sensitivity and precision but often include specificity and accuracy [8]. The most well-known examples in health care are available from PubMed Clinical Queries [9] and have been developed using all four of these outcome measures. In general terms, specificity refers to the correct exclusion of irrelevant records, while traditional information retrieval research equates sensitivity to recall (proportion of relevant documents retrieved to all relevant documents) [10]. These measures are later defined in more detail. Sensitivity and specificity rates are important considerations as successful search results depend on what the searcher requires. While a search that is both highly sensitive and highly specific would be the ideal, generally there is a trade-off. Re-

Highlights

- Literature relevant to palliative care literature in general medical journals is difficult to identify.
- Barriers include the diffuse nature of this subject, authors may not identify their articles as relevant to the area, and Medical Subject Headings (MeSH) terms may not capture how palliative care is conceptualized.
- Subject-based search filters may assist searching by offering validated search strategies.
- Highly sensitive searches incorporating multiple text-words and phrases are required to overcome the demonstrated limitations of current MeSH terms in retrieving articles relevant to palliative care from the general medical literature.

Implications for practice

- Expert-constructed searches without formal validation may be insufficient for systematic reviews.
- Subject-based filters could ultimately improve the quality of searches utilizing methodological filters by more effectively identifying the underlying subject-based data set to which such filters are applied.
- Validated subject search filters supporting rapid retrieval of relevant content could be an important tool for clinicians, particularly in subject areas that are difficult to effectively search.

searchers may require more sensitive searches, preferring more comprehensive retrieval, while clinicians may prefer more specific searches, favoring a smaller set of relevant documents.

In reality, however, the contribution of a methodological filter to the overall retrieval of relevant records for the searcher still depends on the underlying subject-based search that is combined with that filter. Article retrieval by a subject search with low sensitivity will not be improved by combining it with a rigorously developed methodological filter with high sensitivity. Thus, well-developed, subject-based strategies are as important to the searcher as methodological filters. Failure to develop these may compromise the identification of relevant research that forms the basis of systematic reviews, ultimately contributing to bias [11].

While health care preeminently focuses on methodologies such as systematic reviews and RCTs, these levels of evidence are still scarce in palliative care. Methodological search filters that focus on level III evidence or higher are limited in usefulness in clinical disciplines such as palliative care that draw knowledge from diverse sources. For palliative care, the most urgent need is for the reliable retrieval of material relevant to subject, rather than retrieval by evidence level.

Diffuse topics such as palliative care might be well served by a subject search filter, developed in the same

way as a methodological search filter. This methodology has been used to evaluate subject-based searches in other areas, such as sleep [6] and pediatrics [12]. Such a filter would offer benefits such as time saving, embedding of information retrieval expertise in a search, and predetermined sensitivity and specificity rates that can continue to be improved. These search strategies will be invaluable in an era with the increasing expectation that clinicians with high levels of specialist knowledge but low levels of search expertise will do most searching [13]. Such strategies would be useful, not only to palliative care clinicians, educators, and researchers, but also to those involved in primary health and community care as these practitioners are increasingly becoming involved with the care and management of clients with life-limiting illnesses.

The overall aim of this study is to formulate and evaluate palliative care search filters for use in the general medical literature. It is part of a larger project, the Evidence Based (CareSearch) Project, which aims to widen the anthology of palliative literature and to ensure that quality information is readily available to clinicians and researchers in a format that can help to promote evidence-based practice [14].

METHODS

This research was undertaken from 2002 to 2005. Two expert palliative clinicians (Abernethy, Currow), one medical librarian (Sladek), and two researchers (Fazekas, Tieman) were involved with the design and oversight of the project. This study mimics the design of diagnostic test evaluation, whereby a new test (in this case, the search filter) is compared with the performance of an existing diagnostic test (in this case, the gold standard reference set). The bibliographic database used was Ovid MEDLINE. This version was chosen in preference to PubMed as it is the version used at the researchers' various institutions. It is also commonly available in clinical and research institutions and is therefore familiar to many who work in palliative care.

Gold standard reference set

The expert clinicians considered a range of general English-language medical titles for inclusion as the source journals for the study. It was their considered opinion that *JAMA*, *BMJ*, *The Lancet*, and *Annals of Internal Medicine* were appropriate as they provided a balance between North American and European perspectives. These titles were representative of major medical journals likely to be widely available, were peer reviewed, and had established reputations for consistency of publication. Rather than using a broad measure of journal quality, selected titles in the current study were those that were considered to include broad content fields as part of editorial policy and, as such, would likely include issues about palliative and end-of-life care.

These journals were hand-searched for the years 1999 to 2001, inclusive. These dates were chosen on the

Table 1

Topics identified as potentially relevant to end of life care for guidance of reviewers

Advanced directives	Fatigue/weakness
Anorexia/cachexia	Functional status
Bereavement	Hydration/hydration status
Cognition	Nausea/vomiting
Constipation	Pain
Cough	Policy issues
Dying	Service issues
Dysphagia/odynophagia	Skin problems
Dyspnoea	Terminal sedation
Edema	Urinary problems
Education	Withdrawal of support
Euthanasia/physician assisted suicide (PAS)	

basis that articles were old enough to be available electronically and indexed in major databases but recent enough to still be relevant and not to have had major changes to MeSH terms. Each journal issue was read by one of the three project staff (Abernethy, Currow, Fazekas) or one of three invited clinical reviewers. Reviewers were assigned issues from the four selected journals. Each reviewer was provided with a list of topics regarded as potentially relevant to palliative care by the project group to guide their decision making (Table 1). Any article or other item (including letters, reviews, and editorials) that was regarded as relevant to the topic was identified and marked on the associated table of contents. A project assistant then recorded the following details of the identified articles in an Excel spreadsheet: journal, year, volume, issue, pages, author, and title.

Where an individual reviewer was uncertain whether to identify an item as relevant to palliative care, the particular item was referred to the senior project clinician (Currow) for decision. To improve the reliability of record identification, a second review of all items indexed on Ovid MEDLINE for the four journals in the given years was completed by a research member of the project team (Tieman). Where discrepancies were found between the initial hand-search identification and the second electronic review, the additional items were referred to the senior project clinician for decision. The Excel spreadsheet was expanded to include a notation as to whether the individual item was indexed in Ovid MEDLINE and, if so, the unique identifier (UI) used by Ovid MEDLINE was added to the database. The final gold standard reference set comprised articles that had been identified by two reviewers as relevant to palliative care in content and that were indexed on the Ovid MEDLINE bibliographic database. A specific gold standard file (.txt) containing the citation details and the UI number from Ovid MEDLINE was created.

Development of search strategies

Two authors (Sladek and Tieman) explored the MeSH thesaurus for possible terms relevant to palliative care. This pool of potentially relevant terms was reviewed by the study group, who selected nine potential MeSH

descriptors and MeSH scope notes were reviewed for their relevance to palliative care to determine whether or not to use the explode function. All MeSH terms capable of being exploded were, with the exception of "Death," as its narrower terms included terms that were not deemed of specific interest to palliative care, including "Asphyxia," "Brain Death," "Cadaver," "Sudden Death," "Drowning," "Embryo Loss," and "Fetal Death." It was noted that by exploding "Terminal Care," "Euthanasia" was included. To ensure a maximally sensitive search, searching was not restricted to articles where the MeSH term was considered to be the major focus of the article.

The study group also agreed to include a limited number of text-words in the search strategy to examine their effect on retrieval. Three relevant text-word terms were identified based on the use of these terms in previous systematic reviews in palliative care: the terms being "Palliative," "Hospices," and "Terminal Care" [15–17]. Both singular words were truncated. Text-word searches were undertaken using the *tw* limit, not the *mp* default provided in Ovid MEDLINE, to ensure a true evaluation of the use of text-words appearing in the fields of title, author, and abstract.

The primary intention of the study was to design and validate a search strategy. However, to explore the comparative performance of this search, other searches already available in the palliative care area were sought. No existing validated search strategies for palliative care were found. However, three relevant published searches, two from major guideline reviews and one as a general search strategy for palliative care, were identified [17–19].

First, the published Cochrane PAPAS Review Group Search Strategy for the Ovid MEDLINE database was adapted [17]. This strategy had a very similar structure to the search developed in this study. Second, the search terms used in the search strategy to identify studies for supportive and palliative care in a National Institute of Clinical Excellence (NICE) guideline study [18] were run. Finally, neoplasm-specific content from a strategy published as part of a Scottish Intercollegiate Guideline Network (SIGN) guideline was removed, leaving the more palliative care-oriented terms [19]. This last strategy, in particular, offered a greater selection of potentially relevant text-words compared to this study's approach. These searches are referred to as the modified PAPAS, NICE, and SIGN searches.

Search strategies were run in Ovid MEDLINE, restricted to the four journal titles with the stated date ranges. Results of the individual search sets (title, author, source, UI) were saved to a local computer as a file using the reprint MEDLARS results format (.txt). The data were analyzed using a computer program called Search Strategy Validation (SSV). The program was written in Delphi 5 Professional for use in the Microsoft Windows environment. The researcher used a standard interface to load two text documents (Gold Standard and Search Results) for comparison. The

Figure 1
Search strategy evaluation parameters

	Relevant	Not Relevant
MEDLINE result		
Articles retrieved	a (correct inclusion)	b (incorrect inclusion)
Articles not retrieved	c (incorrect exclusion)	d (correct exclusion)
Where:	Sensitivity = $a/(a + c)$; specificity = $d/(b + d)$; precision = $a/(a + b)$; accuracy = $(a + d)/(a + b + c + d)$	

Search Results document contained the citation details and UIs downloaded from the individual Ovid MEDLINE searches and the Gold Standard document contained the citation details and the UI from Ovid MEDLINE created in the gold standard text file. The SSV program located and compared UIs of the two data sets. Data automatically generated by SSV included the number of articles based on the UIs in the following:

1. search strategies set
2. gold standard reference set and search strategies set
3. gold standard reference set but not in search strategies set
4. search strategy set but not in gold standard reference set

Using an approach adapted from Haynes [7], performance was evaluated by measures of sensitivity, specificity, precision, and accuracy as defined in Figure 1. Sensitivity indicates the proportion of hand-searched articles identified in the search against the total gold standard set (correct inclusions), while specificity describes the number of articles not identified by the search as a proportion of all the articles not included in the gold standard set (correct exclusions). Precision indicates the proportion of correctly retrieved articles against all the articles retrieved by the search, and accuracy describes the proportion of correctly included and correctly excluded articles as a proportion of the entire set of articles from the four journals for the study years.

The performance of each MeSH term and text-word against the gold standard reference set was initially assessed individually. As the underlying premise of this research was that palliative care literature is difficult to identify, four searches were run combining terms with the Boolean operator "OR": (1) the best four MeSH terms (selected on the basis of their individual sensitivity [%] score), (2) all nine MeSH terms, (3) all three text-word terms, and (4) the maximally sensitive search combining all nine MeSH terms with all three text-word terms. This latter search is referred to as the master search. Search results were saved and then compared to the gold standard reference set. The three modified PAPAS, NICE, and SIGN searches were run and similarly compared.

RESULTS

By hand-searching 20,501 articles published in the 4 journals during the 3-year study period, reviewers identified 773 items relevant to palliative care (3.8%).

Table 2

Summary of hand-search for palliative care articles in four general medical journals 1999–2001 (gold standard reference set)

Journal title	Total number of articles	Number of palliative care articles	Percentage of palliative care articles
<i>Annals of Internal Medicine</i>	1,562	96	6.2%
<i>British Medical Journal (BMJ)</i>	6,894	220	3.2%
<i>Journal of the American Medical Association (JAMA)</i>	3,972	200	5.0%
<i>The Lancet</i>	8,073	257	3.2%
Total	20,501	773	3.8%

These records formed the gold standard reference set. *Annals of Internal Medicine* had the highest proportion of articles relevant to palliative care (6.2%). Table 2 details the number of relevant articles for each journal.

The series of planned searches using MeSH terms and text-words were run (Table 3). Ultimately, all planned searches yielded consistently low sensitivity scores, and yet specificity scores were all higher than 99%. Sensitivity scores were low for all individual search terms, with “exp Terminal Care” having the highest sensitivity, retrieving 225 (29.1%) of 773 relevant articles, with 84% accuracy. The 2 single MeSH terms that shared the lowest sensitivity were “Hospices” and “Life Support Care,” each retrieving 5 (0.7%) of 773 articles, respectively. However, all single MeSH terms had specificity scores higher than 99%, with “Hospices” achieving 100% specificity. The single text-word with the highest sensitivity was “Palliat\$” (57/773, 7.4%), compared to 75 of 773 (9.7%) for the search strategy that combined all 3 text-words using the Boolean operator “OR.”

The 4 individual MeSH terms with the greatest sensitivity, were “exp Terminal Care,” “Palliative Care,” “Terminally Ill,” and “exp Advance Care Planning.” These were combined in a search using the Boolean operator “OR” and retrieved 315 of 773 records, with 40.8% sensitivity and 99.6% specificity. All 9 MeSH terms were then similarly combined, retrieving only 348 (45%) of the 773 relevant records, with a specificity of 99.37%.

The master search, which combined all 9 MeSH

terms with all 3 text-words, retrieved 351 (45.4%) of 773 relevant references, still with a high specificity of 99.3%. In other words, adding the 3 text-words to the combined MeSH term search only retrieved an additional 3 (0.4%) of 773 relevant articles.

The modified SIGN search increased the sensitivity from 45.4% to 56.9%, while reducing specificity from 99.3% to 92.1%. Precision however, was reduced substantially from 73% to 22%. The modified PAPAS search was virtually equivalent in sensitivity and specificity with the master search. However, the NICE search resulted in reduced sensitivity (40.6%), specificity (95.6%), precision (26.4%), and accuracy (93.5%) (Table 4). Table 5 compares the actual strategy used for the master search with the modified SIGN search.

DISCUSSION

The best performing search, the master search using nine MeSH terms and three descriptive text-words, still found less than half of the articles relevant to palliative care that were known to have been published in these general medical journals. This confirmed the researchers’ understanding at the outset: it is difficult to locate the literature relevant to palliative care in such journals.

While it is possible to improve sensitivity by the inclusion of additional terms, such as those used in the modified SIGN search, the trade-off is reduced specificity and reduced precision. In real terms, the modified SIGN search returned 1,996 articles compared to

Table 3

Summary of selected Medical Subject Headings and text-words by sensitivity, specificity, precision, and accuracy

Search terms	Sensitivity	Specificity	Precision	Accuracy
Medical Subject Headings				
“Exp Advance Care Planning”	6.2%	99.96%	85.7%	96.4%
“Exp Attitude to Death”	5.8%	99.91%	71.4%	96.4%
“Exp Bereavement”	1.6%	99.94%	50.0%	96.2%
“Death”	2.6%	99.91%	52.6%	96.2%
“Hospices”	0.7%	100.00%	100.0%	96.3%
“Life Support Care”	0.7%	99.94%	29.4%	96.2%
“Palliative Care”	14.9%	99.90%	85.2%	96.7%
“Exp Terminal Care”	29.1%	99.78%	84.0%	97.1%
“Terminally Ill”	7.5%	99.94%	84.1%	96.5%
All nine with Boolean “OR”	45.0%	99.37%	73.6%	97.3%
Text-words				
“Palliat\$”	7.4%	99.97%	90.5%	96.5%
“Hospice\$”	2.6%	100.00%	100.0%	96.3%
“Terminal Care”	0.4%	100.00%	100.0%	96.2%
“Palliat\$” OR “Terminal Care” or “Hospice\$”	9.7%	99.97%	92.6%	96.6%

Table 4

Results comparison of master search with modified Pain, Palliative and Supportive Care (PAPAS), National Institute of Clinical Excellence (NICE), and Scottish Intercollegiate Guideline Network (SIGN) searches

Search terms	Sensitivity	Specificity	Precision	Accuracy
Master search	45.4%	99.3%	73.0%	97.3%
PAPAS search	45.2%	99.3%	71.4%	97.3%
NICE search	40.6%	95.6%	26.4%	93.5%
SIGN search	56.9%	92.1%	22.0%	90.8%

481 from the master search, a much larger number. Further, the total set of relevant hand-searched articles was only 773, meaning that a substantial proportion of those returned from the SIGN search would not have been regarded as palliative in nature. While this increased sensitivity might benefit a researcher, the decrease in specificity would be frustrating for a clinician. The master search uses fewer search terms and

appears to be the best compromise between sensitivity, specificity, precision, and accuracy among the strategies evaluated in the current study.

The master search equals the performance of the modified PAPAS search, which would be considered the most relevant existing expert search strategy in palliative care. However, the failure of the master search and the other expert subject searches to achieve high sensitivity rates against the gold standard reference set supports the need for further research on identifying MeSH terms that are best able to retrieve the literature most relevant to palliative care.

While the master search was constructed using the most obvious MeSH terms and text-words, these terms were inadequate. Until such time as additional text-word terms are added to the master search and objectively assessed, it may also mean that this relevant material will not be identified in literature reviews relating to palliative care without hand-searching. Given that a key source of difficulty locating literature from

Table 5

Comparison of the search history for the master search with the modified SIGN search

Master search strategy	Modified SIGN strategy
1 (bmj or jama or lancet or annals of internal medicine).jn.	1 (special\$ adj2 palliat\$).tw.
2 limit 1 to yr = "1999-2001"	2 exp attitude to death/
3 exp advance care planning/	3 exp terminal care/
4 2 and 3	4 exp palliative care/
5 exp attitude to death/	5 palliation.tw.
6 2 and 5	6 palliative care\$.tw.
7 exp bereavement/	7 exp bereavement/
8 2 and 7	8 (bereaved or bereavement).tw.
9 death/	9 exp quality of life/
10 2 and 9	10 (quality adj2 life).tw.
11 hospices/	11 QOL.tw.
12 2 and 11	12 symptom management.tw.
13 life support care/	13 exp alternative medicine/
14 2 and 13	14 complementary therap\$.tw.
15 palliative care/	15 complementary medicine.tw.
16 2 and 15	16 alternative therap\$.tw.
17 exp terminal care/	17 alternative medicine.tw.
18 2 and 17	18 patient information.tw.
19 terminally ill/	19 support group\$.tw.
20 2 and 19	20 exp physician-patient relations/
21 palliat\$.tw.	21 counsel?r\$.tw.
22 2 and 21	22 macmillan nurs\$.tw.
23 hospice\$.tw.	23 care?giv\$.tw.
24 2 and 23	24 (cope or coping).tw.
25 "terminal care".tw.	25 fear.tw.
26 2 and 25	26 exp anxiety/
27 4 or 6 or 8 or 10 or 12 or 14 or 16 or 18 or 20 or 22 or 24 or 26	27 exp caregivers/
	28 exp mental health/
	29 exp family health/
	30 exp depression/
	31 exp patient participation/
	32 exp patient care team/
	33 exp professional-family relations/
	34 exp truth disclosure/
	35 exp counselling/ or exp pastoral care/
	36 *adaption, psychological/
	37 exp patient education/
	38 exp spouses/
	39 exp social isolation/
	40 psychosocial.tw.
	41 (psycho adj social).tw.
	42 psychological distress.tw.
	43 exp social support/
	44 (bmj or jama or lancet or annals of internal medicine).jn.
	45 limit 44 to yr = 1999-2001
	46 or/1-43
	47 45 and 46

a field as diverse as palliative care might be related to inconsistent indexing, this could have ramifications for the validity of reviews in this area [14].

This study raises questions about the reliance of users on the most readily identifiable MeSH terms that are relevant to palliative care. Given that the purpose of the study was to test whether a search strategy could identify relevant content in the general medical journals (rather than palliative care journals, specifically), it might be that authors publishing in general medical journals did not recognize the relevance of their papers to palliative care. Alternatively, they might be unfamiliar with relevant MeSH terms and therefore did not suggest appropriate MeSH terms and text-words for palliative care when submitting their papers for publication. It may also reflect the broader issue that the most obviously relevant MeSH terms may neither reflect how people conceptualize palliative care nor encompass the diverse range of topics relevant to palliative care.

The results indicate a need for further investigation of how palliative care is conceived and described, particularly with regard to the language used by general physicians and non-palliative care specialties. By systematically analyzing this language, relevant text-words and phrases may be identified to increase the sensitivity of searches. As yet, the analyses of the incorrectly excluded references have not been completed. Such further analyses will be useful in identifying any indexing terms for gold standard articles that were not identified in the Ovid MEDLINE searches. This could provide other text-words or MeSH terms that are being used to consistently capture some components of the general palliative care literature and that could be included to increase the sensitivity of the searches. Similarly, analyzing whether indexing relating to incorrect inclusions is inconsistent could further inform understanding of the use of MeSH terms. However, it is important to note that even with the relatively low sensitivity of the searches, the best performing searches are those that drew on MeSH descriptors, with the combined nine MeSH terms accounting for nearly all of the retrieved articles in the master search. This supports the view that the poor sensitivity is likely to be related to how palliative care is conceptualized and described rather than an insufficiency of MeSH terms.

In terms of the strengths and limitations, this research has been considered against the most recent review evaluating methodological search filters [8]. Importantly, a number of journals over a number of years were hand-searched, using a defined methodology. Multiple palliative care clinicians and an experienced medical librarian were involved. However, while previous research informed the initial selection of search terms (both MeSH and text-words), the final selection was subjective. Such an approach has been referred to as a "second generation" approach, which while useful, could be augmented objectively by frequency analyses of text-words, identified as a "third generation" approach [8].

The value of this type of study depended on the

validity of the gold standard set of references, as it was the set against which all searches were compared. The gold standard set of articles had two reviewers: one person hand-searched each journal issue and one person searched the electronic bibliographic references. Inter-rater reliability measures were not calculated, although these would have enhanced the ability to more objectively assess reliability. Generalizability of the results might be limited as the searching was intentionally restricted to general medical journals. It is not known how well the filters would perform using subject-specific palliative care journals or, indeed, general journals in other disciplines such as nursing, as this was not within the scope of the study. The generalizability of the results might also be limited by selecting the four journals, if these journals were not representative of the general medical literature.

A frequency analysis of the MeSH terms used for the gold standard reference set of articles may inform the relative importance of the MeSH terms in indexing and assist in identifying further indexing terms relating to palliative care. Content analysis of the abstract text and full text of the gold standard set of articles can enable the identification of text-words that could improve the sensitivity and accuracy of searches.

Further analysis is an important next step for future research, as increasing the sensitivity of the master palliative care search requires the use of additional MeSH terms, relevant text-words, and phrase searching. Further studies might then in turn replicate and validate such a sensitive search filter not only in Ovid MEDLINE. Strategies could be modified to the individual structure of other databases, such as CINAHL or EMBASE, then run and validated. However, in the short term, it will be possible to translate the current master search for use in the PubMed environment to increase its usefulness to the palliative care population.

The other key direction for future research would be the development of strategies for searching literature outside the biomedical model (e.g., the sociological literature), reflecting the breadth of palliative care practice. Developing effective search strategies for use in electronic databases outside the biomedical field offers many challenges but also the opportunity to improve retrieval of relevant materials that could improve palliative care practice.

CONCLUSION

This research has confirmed the difficulty of identifying articles relevant to palliative care in the general medical literature and the limitations of MeSH terms and commonly known related text-words. It also highlights the importance of a systematic approach to developing and validating search strategies from which to incrementally improve these strategies. Finding all of the relevant literature is important to both clinicians and researchers and imperative if palliative care is to be evidence based. However, this requires highly sensitive search strategies. The original intention of this

study was to define such sensitive search strategies. However, it now appears that it first may be necessary to analyze the content of language used by non-palliative specialties to identify how palliative care is conceived and described to identify any text-words and phrases that can contribute to further improving the sensitivity of the search strategy.

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