SEARCHING FOR EVIDENCE-BASED ONCOLOGY: TIPS AND TOOLS FOR FINDING EVIDENCE IN THE MEDICAL LITERATURE

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Introduction

Evidence-based medicine is defined in the medical subject headings (MeSH) from the US National Library of Medicine (NLM) as "the process of systematically finding, appraising, and using contemporaneous research findings as the basis for clinical decisions. Evidence-based medicine asks questions, finds and appraises the relevant data, and harnesses that information for everyday clinical practice."[1] Finding relevant clinical articles involves the use of specific search strategies as quality filters to limit retrieval to clinically relevant studies.

Finding the best evidence to answer a clinical question in the medical literature can be a daunting task, especially for a busy clinician. However, general search skills and techniques to find evidence-based literature are applicable to evidence-based oncology searching as well.

To find appropriate evidence-based information, clinicians need specific skills, named SAS (search-analyze-store) skills.[2] This paper examines these search skills by outlining basic evidence-based search strategies, citing possible databases to use for oncology information, and noting specific oncology-related subject headings to use in searching biomedical databases. Specifically, skill with MEDLINE searches using such strategic resources as MeSH terminology, exploded subject headings, and Boolean search techniques are addressed. This review does not address the analysis and storage of search results.

The use of evidence-based search terms supplies an extra filter and allows the retrieval of quality information, thus producing a more focused retrieval of articles while saving time for the clinician. Combining two or more subject search terms often results in a large number of citations to review. For example, a general search on *breast neoplasms* and *adjuvant chemotherapy* retrieves almost 3,000 MEDLINE citations in PubMed. Limiting search results to those articles that not only are the most relevant for specific patients, but also document clinical outcomes is the purpose of using evidence-based search strategies.

General Search Strategies

MeSH is a controlled vocabulary used by the NLM to index articles in its databases. MeSH terminology provides consistency in retrieving information that may use different terms for the same concepts.[3] Using MeSH terminology limits retrieval to articles specifically pertaining to the topic. Subject headings are most useful when an idea is well defined in the literature. To broaden a search, combining both MeSH terms and text words can be helpful.

Searching with a text word that can occur anywhere in the citation is useful for "new" terms or for comprehensive searching.[4] Text word searching is effective in

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cancer searches for new anticancer drugs and for differing names of drugs that may appear in articles. Truncation can be used with text words that may have various endings, employing the specific truncation symbol specified for the search system. However, truncation should be used with caution. For example, a root word such as *oncol* will return citations that contain not only *oncology* and *oncologic*, but also *oncolytic*. Searching with text words may retrieve articles that contain the search term one or more times but are irrelevant to the search. Text words can also pose problems with spelling variations (eg, hematology or haematology) or with misspelled words.

To locate MeSH terms, specific print MeSH documents are available from the NLM and online through such systems as PubMed and OVID. When using the OVID system to search MEDLINE, the system defaults to searching by MeSH terms and will return possible selections for choice. From those choices, a click on the highlighted terms will show the tree structure relationships. The *scope note* provides a brief description of how the indexers at NLM apply that term.

MeSH terms are organized in a hierarchical scheme from broader to narrower subjects. A subject term relates to other terms with broader subjects above it in the tree structure and with narrower terms indented below it. When a searcher selects a term and chooses to explode that term, the original term and all the narrower related terms indented below it are included in the retrieval.

The search should be kept broad at first by not choosing the subject heading as the focus since that may make retrieval too narrow when adding additional terms for evidence-based medicine. Also, all subheadings applicable to the subject should be used initially. Whenever possible, use search terms to combine the cancer site and the histologic type of cancer (eg, *lung neoplasms* and *non-small cell lung carcinoma*). Using MeSH terminology to search MEDLINE does not always produce exact results because NLM indexers sometimes lack consistency in applying MeSH terms. However, MeSH terms provide a good starting point for any search.

Boolean search strategies are also helpful tools in retrieving precise results. These strategies are best viewed as algebraic logic applied to literature searches. Using *and* between terms requires that both terms must be present in the article, while using *or* between terms specifies that either term may be present. The use of *or* retrieves synonyms or related concepts and will broaden the search. Inserting *not* between terms indicates that one term must be present but not the other. Enclosing terms in parentheses means that those terms will be searched first and then combined with other terms of the search. These advanced search strategies are not available in all search systems.

MeSH Oncology Terms

MeSH terminology is continually updated, added to, and modified, so searchers must stay abreast of changes to get the best results. The oncology terms in MeSH are extensive and could be the subject of an entire study themselves. Awareness of all terms with the root *plasia* and of all terms for specific cancers denoted with the term *neoplasms* is necessary. All of these terms can be found in the tree structures of MeSH under the heading *neoplasms by site.* Terms for histologic types of cancer are equally plentiful and are listed in the tree structures under *neoplasms by histologic type*.

Specific oncology therapy terms that should be considered for evidence-based searching cover a wide range. Some examples of the terms that are useful for searching various chemotherapies include the broad heading of *antineoplastic and immunosuppressive agents*. Exploring that broad term provides individual generic drugs used for chemotherapy and also these terms:

- *antineoplastic agents, alkylating*
- *antineoplastic agents, combined*
- *antineoplastic agents, hormonal*
- *antineoplastic agents, phytogenic*
- *antibiotics, antineoplastic*

- *anticarcinogenic agents*
- *antimetabolites, antineoplastic*
- *immunosuppressive agents*
- *myeloablative agonists*

Other therapy terms to consider include the following:

- *chemotherapy, adjuvant*
- *adjuvants, pharmaceutic*
- *adjuvants, immunologic*
- *neoadjuvant therapy*
- *drug resistance, neoplasm gene therapy*
- *combined modality therapy*

Specific oncology diagnosis terms that may be used for evidence-based searching are noted below. However, to retrieve specific terms such as *sentinel lymph node biopsy*, a combination of terms is necessary: *lymph node excision* or *lymph nodes/pathology* and *biopsy* and *sentinel* (as a text word). Samples of oncology etiology terms include *genetic predisposition to disease*, *carcinogens*, *oncogenes*, and *oncogene, proteins*. Oncology prognosis terms would include all aspects of *mortality* and *morbidity, survival, survival analysis*, *SEER Program* (Survival, Epidemiology, and End Results Program), *disease-free survival*, and *disease progression*.

Although MeSH terminology is updated frequently, oncology is a dynamic and rapidly changing field. Thus, when a new concept or drug is the focus of a search, retrieval may be limited when using MeSH terms. Adding appropriate text words to MeSH terminology linked with *or* may be helpful.

Table 1. — Most Sensitive MEDLINE Search Strategy for Identifying Randomized Controlled Trials

Set No.	Term Search or Sets Combined
1.	randomized controlled trial.pt.
2.	exp randomized controlled trials
3.	random allocation
4.	double-blind method
5.	single-blind method
6.	1 or 2 or 3 or 4 or 5
7.	animal
8.	human
9.	7 not (7 and 8)
10.	6 not 9
11.	clinical trial.pt.
12.	exp clinical trials
13.	clin:.tw. adj trial:.tw.
14.	(singl:.tw. or doubl:.tw. or trebl:.tw. or tripl:.tw.) and (blind:.tw. or mask:.tw.)
15.	placebos
16.	placebo:.tw.
17.	random:.tw.
18.	exp research design
19.	7 or 8 or 9 or 10 or 11 or 12 or 13 or 14
20.	animal
21.	human
22.	20 not (20 and 21)
23.	19 not 22
24.	comparative study
25.	exp evaluation studies
26.	follow-up studies
27.	prospective studies
28.	control:.tw. or prospectiv:.tw. or volunteer:.tw.
29.	16 or 17 or 18 or 19 or 20
30.	animal
31.	human
32.	30 not (30 and 32)
33.	29 not 32

These terms provide the highest precision and specificity with stage 1 terms (sets 1-10). The other two stages (sets 11-23 and sets 24-33) are added when more retrieval is needed for the greatest sensitivity. Adapted from Dickersin K, Scherer R, Lefebvre C. Identifying relevant studies for systematic reviews. *BMJ*. 1994;309:1286-1291, with permission from the BMJ Publishing Group.

Types of Evidence-Based Searches and Concepts

There are four major types of evidence-based literature searches for clinical queries: therapy, diagnosis, etiology (causation/harm), and prognosis (natural history). Each one of these search types has specific index terms to use in combination with the subject terms to retrieve evidence-based articles. These methodological filter terms are sometimes called *hedges*. Different sets of index terms exist for each type of evidence-based search. These methodological filters have many terms in common and can be adapted for whatever MEDLINE search system is used.

Key concepts for evidence-based literature searching are sensitivity and specificity. "Sensitivity is the proportion of studies in the literature meeting criteria for scientific soundness and clinical relevance that are detected by a search, or the likelihood of retrieving relevant items. Specificity pertains to the proportion of less sound or less relevant studies excluded by the search strategy, or the likelihood of excluding irrelevant items. Precision refers to the proportion of all citations retrieved that are both sound and relevant."[5]

The clinician who prefers to scan a few relevant citations should begin with the specificity terms to retrieve high-quality citations, then add the sensitivity terms only if appropriate references are not found. If a comprehensive review of evidence-based studies is needed on a particular topic, then use all the sensitivity terms.

Table 2. — Research Methology Filters (Adapted for Ovid)

Therapy Search Terms	
Specificity	*(double.tw. and blind:.tw.)* or *placebo.tw.*
Sensitivity	*randomized controlled trial.pt.* or *drug therapy.sh.* or *therapeutic use.sh.* or *random:.tw.*
Diagnosis Search Terms	
Specificity	*sensitivity and specificity* or *(predictive.tw. and value:.tw.)*
Sensitivity	*sensitivity and specificity* or *sensitivity.tw.* or *diagnosis.sh.* or *diagnostic use.sh.* or *specificity.tw.*
Etiology Search Terms	
Specificity	*case-control studies* or *cohort studies*
Sensitivity	*cohort studies* or *risk* or *(odds.tw. and ratio:.tw.)* or *(relative.tw. and risk.tw.)* or *(case.tw. and control:.tw.)*
Prognosis Search Terms	
Specificity	*prognosis* or *survival analysis*
Sensitivity	*incidence* or *mortality* or *follow-up studies* or *mortality.sh.* or *prognos:.tw.* or *predict:.tw.* or *course.tw.*

tw = textword (or keyword), which directs the search to look for words or numbers as text (from the title, abstract, and other select fields) rather than as subject headings.

From Haynes et al.[7] Adapted with permission from the *Journal of American Medical Infromatics Association*.

Strategies for Evidence-Based Searches

Different search strategies to retrieve evidence-based citations from MEDLINE are plentiful in the literature. Dickersin[6] provided an extensive strategy for identifying randomized, controlled trials and reported sensitivity/specificity results in the field of ophthalmology. An adaptation of this strategy for use with the OVID search platform is listed in Table 1. This adaptation to OVID was developed for teaching purposes and includes the syntax needed to search OVID. The adapted strategy has not yet been verified against the sensitivity/specificity results that Dickersin reported.

Haynes and colleagues[7] devised evidence-based search strategies for all four types of searches. They measured sensitivity and specificity of those terms in MEDLINE for 1986 and 1991. Those search strategies are the basis of PubMed's current Clinical Queries option[8] and have been cited and expanded in print and online resources. Those strategies are used as a gold standard for evidence-based searching by many authors.[9-11] In fact, those same search strategies have been restated by Hunt et al[12] with an expansion of some terms, but measurement of results was not redone. Table 2 lists the search terms devised by Haynes et al[7] adapted for OVID.

Various search strategies to use in finding evidence-based articles

Table 3. — Online Search Filters

Searching OVID MEDLINE – Indiana University	http://www.medlib.iupui.edu/ref/ebmhedges.html
PubMed Clinical Table	http://www.ncbi.nlm.nih.gov/PubMed/clinicaltable.html
University of York (strategies for reviews and meta-analyses)	http://www.york.ac.uk/inst/crd/search.htm
University of Rochester – filters for OVID and PubMed (expanded terms)	http://www.urmc.rochester.edu/Miner/Links/ebmlinks.html
Centre for Evidence Based Medicine (UK) Winspirs & OVID	http://cebm.jr2.ox.ac.uk/docs/searching.html
Institute of Health Sciences, University of Oxford (UK)	http://wwwlib.jr2.ox.ac.uk/caspfew/filters
University of Alberta	http://www.med.ualberta.ca/ebm/main.htm

in the literature are available online (Table 3). Many of them provide versions to be used with several different search platforms.

Evidence-Based Oncology Search Examples

Therapy Evidence-Based Search

Sample search clinical question: Would a 65-year-old woman with a 1.1-cm breast neoplasm benefit from adjuvant chemotherapy?

Search strategy: *exp breast neoplasms* and *exp chemotherapy*, *adjuvant* and evidence-based search filters.

Diagnosis Evidence-Based Search

Sample search clinical question: How reliable is digital rectal examination for screening or diagnosis for prostate cancer?

Search strategy: *digital rectal exam:.tw.* or *(physical assessment and digital.tw.)* and *exp prostatic neoplasms* and evidence-based search filters.

Etiology (Causation/Harm) Evidence-Based Search

Sample search clinical question: Is the hepatitis C virus a cause of lymphoma?

Search strategy: *hepatitis C* and *exp lymphoma* and evidence-based search filters.

Prognosis Evidence-Based Search

Sample search clinical question: What is the predicted survival of a patient with idiopathic myelofibrosis?

Search strategy: *myelofibrosis* and *idiopathic.tw* and evidence-based filters.

To eliminate retyping search strategy terms, all of the different sets of terms can be stored in a word processing program. When performing an evidence-based search, open the search strategy document. Highlight the terms desired and copy. In the search system, place the cursor in the query box and choose *Paste* or *Paste Special* under *Edit*. The set of search terms should appear in the box. The search can then be performed and combined with the subject terms.

Additional Databases

Other databases are available that may be useful for evidence-based searching. For the oncologist, the Web site of the National Cancer Institute (NCI) is the home page for two additional resources, CANCERLIT and PDQ. CANCERLIT is a bibliographic database that contains citations and abstracts for journal articles and other publications. It can be searched using the same terms used in MEDLINE and combining them as in the previous searches. For easy searching, the step-by-step search form is best. CANCERLIT has some overlap with MEDLINE and also includes proceedings of meetings, symposia reports, theses, selected monographs, government technical reports, and dissertations.

Physician Data Query (PDQ) has many different parts to its database (eg, peer-reviewed summaries on cancer, a registry of cancer clinical trials, cancer-care directories) and is mostly full-text information. For evidence-based information, the treatment summaries for pro-

fessionals and the clinical trials sections are valuable. PDQ cannot be searched like traditional databases where search terms are entered for retrieval. Rather, selecting from predetermined categories of treatment information provides a wide variety of records. Information geared to patients is also available at PDQ. Clinical trials resources are available from the NCI Web site at http://cancertrials.nci.nih.gov.

Within the OVID databases, Evidence-Based Reviews indexes two journals, *ACP Journal Club* and *Evidence-Based Medicine*. The editors of these journals regularly screen the major clinical journals and identify studies that are both methodologically sound and clinically relevant. Then an enhanced abstract of the chosen article and a commentary on the value of the article are published. The journals cover general internal medicine specifically and other areas less comprehensively.

EMBASE/Excerpta Medica is an international biomedical database that can be helpful for evidence-based searching. It uses its own thesaurus of MeSH terms that should be consulted. For nursing and allied health, consult Cumulative Index to Nursing and Allied Health Literature (CINAHL). Psychological information can be found in PsycINFO. McKibbon et al[4] lists evidence-based search strategies for these last three databases.

A systematic review is defined by Cook et al[13] as involving the "application of scientific strategies, in ways that limit bias, to the assembly, critical appraisal, and synthesis of all relevant studies that address a specific clinical question."[4] Data from a systematic review may be appraised qualitatively or quantitatively. A meta-analysis is a type of systematic review that uses quantitative statistical methods. Finding systematic reviews within the literature can be a challenge. *Meta-analysis* is a MeSH term for a publication type, but not all indexers assign this term consistently. A thorough search strategy to identify systematic reviews and meta-analyses is available online at http://www.york.ac.uk/inst/crd/search.htm.

The foremost example of systematic reviews exists within the worldwide Cochrane Collaboration, which is committed to preparing, maintaining, and promoting the accessibility of systematic reviews of various interventions used in health care. The Cochrane Database of Systematic Reviews is available through OVID and through Web subscription. It includes the full text of regularly updated systematic reviews of the effects of healthcare. The Cochrane Database can be searched in the same fashion as other databases using subject terms and combining concepts. Evidence-based filters should not be used because this database consists only of pre-filtered systematic reviews.

Guidelines are another evidence-based resource. These are systematically produced statements about appropriate health care in specific clinical circumstances. Guidelines range from a set of "care maps" produced for local use to national recommendations from professional organizations. Guidelines specific to cancer care are available on the Internet through Web sites such as the Agency for Healthcare Research and Quality, the American Society of Clinical Oncology, Cancer Care Ontario, and the National Guideline Clearinghouse (Table 4).

The value of the Internet as a source of quality medical information has been much debated. While

Table 4. — Evidence-Based Oncology and Guidelines Web Sites

Cancer Care Ontario – Practice Guidelines Initiative (CCOPGI)	http://hiru.mcmaster.ca/ccopgi
Cancer Care Ontario – Program in Evidence-Based Care (PEBC)	http://hiru.mcmaster.ca/ccopgi/ebc.html
American Society of Clinical Oncology Clinical Practice Guidelines	http://www.asco.org/prof/pp/html/m_gs.htm
NCI CancerNet (PDQ & CANCERLIT)	http://cancernet.nci.nih.gov
Oncolink	http://cancer.med.upenn.edu
Agency for Healthcare Research & Quality (previously AHCPR)	http://www.ahcpr.gov
National Guidelines Clearinghouse	http://www.guidelines.gov

Table 5. — Web Resources on Evidence-Based Medicine: General Sites

Oxford University Centre for EBM	http://cebm.jr2.ox.ac.uk
Canadian Centre for Health Evidence	http://www.cche.net/
Bandolier	http://www.jr2.ox.ac.uk/Bandolier/painres/download/whatis/whatis.html
JAMA's series	http://www.shef.ac.uk/~scharr/ir/userg.html
Cochrane Collaboration	http://hiru.mcmaster.ca/cochrane/
BMJ Clinical Evidence Series	http://www.evidence.org/index-welcome.htm

its currency of information is difficult to rival, finding quality information demands "caveat surfer" (surfer beware). Booth[10] offers several solutions to finding quality medical information on the Internet, while advising that no substitute exists for personal critical appraisal of information. A comprehensive analysis of cancer information on the Internet showed quality ranging from mildly misleading, information so outdated as to be invalid, and clearly erroneous information.[14]

Other Evidence-Based Resources

Evidence-based print resources are growing and include journals and books. The *American College of Physicians' ACP Journal Club, Evidence-Based Medicine, Evidence-Based Nursing,* and *Evidence-Based Oncology* are examples of available journals. A list of books on evidence-based medicine can be found at the Web site of the Italian Evidence-Based Medicine Group.[15] The *BMJ Clinical Evidence* series and the *JAMA* series on "Users' Guides to the Medical Literature" on how to use the medical literature are excellent compilations on evidence-based medicine (Table 5).

Conclusions

Further research is needed to determine the value of existing evidence-based search strategies with oncology subject terms. These studies should evaluate the sensitivity and specificity of searches done with clinical filters and oncology.

Using evidence-based search strategies to search the medical literature can refine results and retrieve articles documenting clinical outcomes. Acquiring search skills for evidence-based practice will be helpful to clinicians throughout their careers. Medical libraries often teach skills in using evidence-based search strategies. An evidence-based search can provide an extra quality filter for information and also can be a valuable tool for finding the best information for clinical decision making.

URLs change frequently, so some of the addresses in this article may have been altered. Also, new sites are added continually, and information is updated often.

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