Users' guide to the surgical literature: how to perform a literature search

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Surgeons are instrumental in providing appropriate, cost-effective health care.[1] This responsibility implies that we must try to maintain a standard of care that is consistent with the best available evidence. To pursue an evidence-based approach to surgical care, a surgeon must be able to review relevant articles from the literature in an efficient manner. Therefore, the contemporary surgeon must have a simple mechanism for carrying out a complete literature search. Other publications in this evidence-based surgery series have described how to review various articles from the surgical literature. In this paper, we provide the surgeon with guidelines for searching the literature and a template for constructing an effective search strategy.

Clinical scenario

You are a busy surgeon in a high-volume surgery practice. During your regular "OR day," a colleague notices that you do not give heparin prophylaxis for postoperative deep vein thrombosis (DVT) in patients undergoing colorectal surgery. Your colleague suggests that a more aggressive approach to DVT prophylaxis is appropriate and encourages you to change your practice. You are concerned that heparin may increase the risk of perioperative hemorrhage. You wish to determine the most effective means of reducing the risk for postoperative DVT but are uncertain how to proceed. Therefore, you will need to carry out a literature review, which you hope to have completed before your next major case in 2 days' time.

Developing a strategy for a literature search

The essential component of an effective search strategy is an appropriately designed question. The question usually arises out of some uncertainty in clinical care. The question should be clear and focused — describing a patient or clinical problem, the intervention or exposure, relevant comparisons and the outcomes of interest. This is the PICO method for producing well-designed clinical questions (Table 1).[2,3] It is helpful to describe the clinical problem in your own words. This method forms the basis for an effective search strategy by building an appropriately worded question, a task that is not as simple as it seems and can be a time-consuming exercise. However, an appropriately constructed question facilitates subsequent literature search.

Underscoring the key words in the question now helps you to identify initial search terms. Use of these terms will create a search strategy based on text words. Text words are those exact words found in the study title or abstract. Selecting general or nonspecific terms will generate a long list of studies, many of which may be unrelated to your question. Conversely, more specific search

terms will result in a more effective and focused search strategy. We have constructed a search strategy using text words in Fig. 1.

Searching the literature

Once you have developed the clinical question, the next step is to decide which tool you should use to search the literature. Most journal articles relevant to the practising surgeon are indexed in the National Library of Medicine (NLM) MEDLINE database. MEDLINE contains bibliographic citations from over 4000 biomedical journals published in the United States and 70 other countries. It has more than 10 million citations dating from 1966 to the present. Other databases are available that may be more appropriate for specialized searches of the literature (e.g., EMBASE is a widely used biomedical and pharmaceutical database), but we will focus only on MEDLINE in this discussion.

Currently, MEDLINE may be searched most effectively "online" using a personal computer and standard Internet access. Online searching of MEDLINE through a search engine is generally easier to use and more current than print searching (i.e., *Index Medicus*).[4] In this article we will focus on electronic or computer search strategies.

MEDLINE may be searched at no cost using the NLM Internet search engine PubMed (Fig. 2). This search engine constructs and performs complex queries or searches of a database of information (MEDLINE). Other online search engines are available. A comparison of commonly used MEDLINE services is available at **www.medmatrix.org /info/medlinetable.asp**. Table 2 provides information about the free "four star" search engines as rated by Medical Matrix. We suggest the reader start with PubMed, although any of the listed search engines may

be used. MEDLINE may also be searched offline at any site providing access to archived MEDLINE citations that may be stored in CD-ROM format (e.g., university libraries).

One advantage of PubMed is that it searches another database at the same time: PREMEDLINE. PREMEDLINE allows you to search for the author, title and abstract of journal articles before the records have been indexed in MEDLINE. Certain journals may not be indexed for over a year after publication whereas PREMEDLINE records are updated daily. The ability to access more recent articles through this database may improve the accuracy and yield of your search. If you want to be sure to include PREMEDLINE in your search then your strategy must have text words.

Preappraised evidence-based reviews

Resources are now available that provide preappraised evidence-based reviews of selected medical and surgical clinical problems. The literature is reviewed for studies that meet rigid methodologic criteria. The body of evidence is then analyzed, interpreted and summarized by experts in the field. Examples of preappraised information sources are the elec-

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Table 1

The PICO Method of Constructing a Question From a Clinical Scenario

Step	Description
Population	For patients undergoing colorectal surgery …
Intervention	will DVT prophylaxis with heparin …
Comparison	as compared with no method of DVT prophylaxis …
Outcome	produce fewer overall complications?

PICO = patients, intervention, comparison, outcome of interest, DVT = deep vein thrombosis.
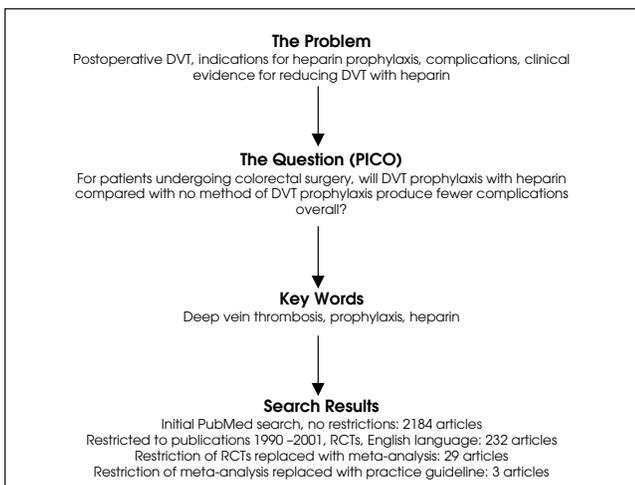
FIG. 1. Example algorithm for carrying out a literature search. DVT = deep vein thrombosis; PICO = problem, intervention, comparison, outcome; RCTs = randomized controlled trials.
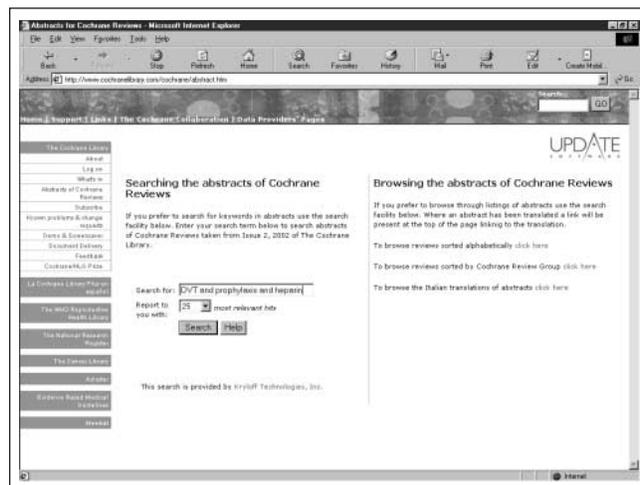
FIG. 2. Home page of the PubMed search engine for searching MEDLINE. Copyright of the National Center for Biotechnology Information (NCBI), National Library of Medicine, Bethesda, Md.

tronic version of ACP Journal Club (available at **www.acpjc.org**) and the Cochrane Library (containing systematic reviews and a register of randomized controlled trials) at **www.cochranelibrary.com** (Fig. 3). The Cochrane Library emphasizes interventions, whereas the ACP Journal Club includes studies and reviews in the areas of etiology, prognosis, therapy, diagnosis, quality improvement and economics. Some authors are now suggesting that these resources of preappraised reviews may serve as the best place to begin a search of the literature.[5]

The advantages of searching preappraised sources include more manageable search results containing high-quality studies or reviews. Clearly, if your clinical problem has been reviewed by a group of experts, and the literature has been appraised, you may have all the information you need. However, if your question has not been reviewed you will need to continue and complete a full MEDLINE search. Presently, more medical topics are addressed than surgical, but this situation is improving.

If we choose to review the preappraised evidence at "Cochrane Reviews," we click on The Cochrane Library Web site, then "Abstracts of Cochrane Reviews," and enter our text words in the "Search for" window. This identifies a recent review that proves extremely helpful (Fig. 4).[6] The Cochrane review not only provides insight into the effectiveness of DVT prophylaxis with heparin but also specifically addresses the scenario of colorectal surgery. The reviewers conclude that combining heparin and mechanical methods (graded compression stockings) is the most effective means for reducing perioperative DVT and pulmonary embolism. Although some of the statistical terms may be unfamiliar to you, you understand the power of the conclusions.

You remain concerned about the potential for increased hemorrhagic complications with the use of heparin and you wish to review the studies independently to clarify this issue. However, the thoroughness of this appraisal has done much to convince you to consider a change in your practice.

Executing a MEDLINE search

We have provided a simple worksheet to guide you through the process of developing and executing


Table 2

Characteristics of "Four Star" MEDLINE Search Engines

Search engine	Internet address	Features
No fee		
NLM PubMed	www.ncbi.nlm.nih.gov/PubMed	No registration required. PREMEDLINE, Boolean searches, saved searches. Clinical queries
BioMedNet	http://research.bmn.com/medline	Registration required. Includes other NLM databases. Boolean searches, natural language
Fee based		
BioMedNet evaluated MEDLINE	http://research.bmn.com/medline	Free registration. Boolean searches
Knowledge Finder	http://kfinder.com/newweb	Free trial. Natural language, Boolean searches
Ovid On Call	http://preview.ovid.com	Offline registration. Natural language searches
NLM = National Library of Medicine.		
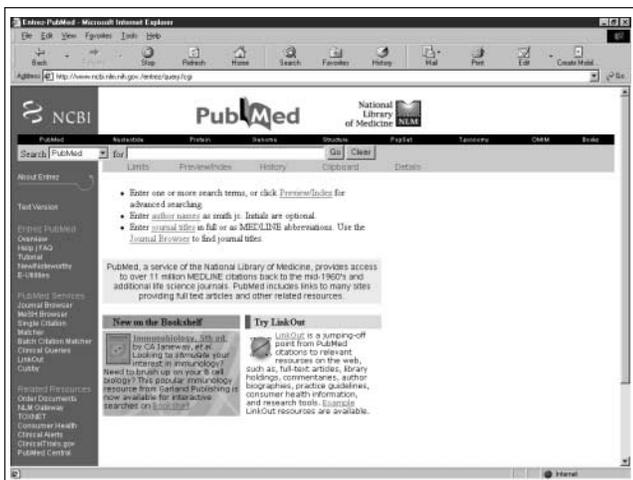
FIG. 3. The Cochrane database of systematic reviews. Prepared and published by Update Software, Oxford, UK.
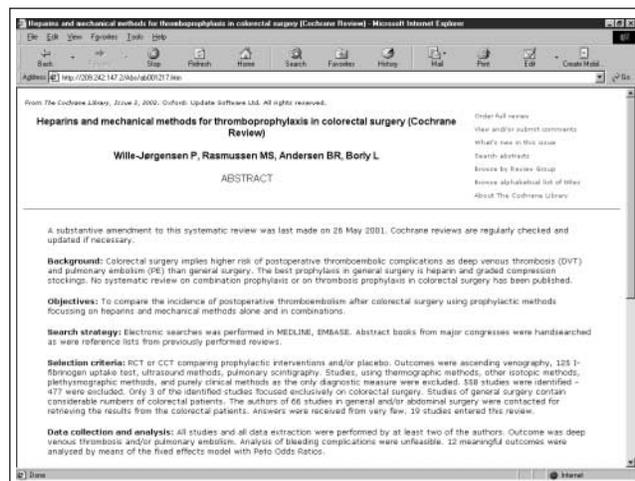
FIG. 4. Abstract of an article on thromboprophylaxis in colorectal surgery obtained from the Cochrane Library. Prepared and published by Update Software, Oxford, UK.[6]

a literature search (Fig. 5). A simple method to search the literature is to use PubMed by accessing the PubMed home page **www.ncbi.nlm.nih.gov/PubMed**. You can enter your search terms in the search window directly or by using the "Preview/Index" feature. The search terms that you have selected from your clinical question are "text terms." PubMed will search for each of these terms in the index fields (title, abstract) unless otherwise specified. PubMed will automatically combine these terms with the Boolean operator* "and," which implies that all terms entered must be found in each record retrieved (which will restrict the focus of the search, whereas the Boolean operator "or" will expand the search).

Another method of searching is to use medical subject headings (MeSH terms). Every article in the MEDLINE database is indexed according to its content with specific MeSH terms. As compared to a text word search, MeSH terms may increase the relevance of your search results. However, most surgeons will be unfamiliar the appropriate MeSH terms to apply to a search strategy. For certain topics, the consistency and accuracy of indexed MeSH terms may not be satisfactory and therefore you may not retrieve all relevant articles. To gain familiarity with MeSH terms, review specific terms associated with an abstract and conduct a new search using these terms. A librarian will also be extremely helpful if you choose to improve your knowledge of MeSH terminology, as will the NCBI MeSH Browser (**www.ncbi.nlm.nih.gov/entrez/meshbrowser.cgi**).

Setting search limits

Text-word searching may result in large numbers of irrelevant references because of the various ways in which a particular word may be used in an abstract or title. If you are searching for a topic that is described in different ways, you may need to use synonyms for the disease or intervention. In these cases you would combine the terms with the Boolean operator "or." Therefore, each record will include at least one of the synonyms chosen.

If your search leads to an unmanageable number of references, you should try to restrict or limit the search. This is a way of refining the search and increasing the relevance of each of the retrieved articles. For example, you may limit your search by specifying a certain publication type (i.e., randomized controlled trials), a specific interval of publication dates or by limiting the language of the publication to English. Other criteria that are helpful in eliminating less relevant articles include human or animal research articles, subsets of journals (e.g., nursing journals, dental journals), gender and availability of abstracts.

Choosing which limits to use will depend on your question. For therapy questions, limiting results by publication type is helpful (i.e., clinical trial, randomized controlled trial, multicentre study, review, meta-analysis or practice guideline). PubMed only allows you to apply one publication type at a time on the Limit page. To apply more than one publication type, you may use the Preview/Index page.

Worksheet for Literature Searches

1. Write a short, detailed description of the specific clinical problem:
   _____
   _____
   _____

2. Write the problem as a question, including the key issues (PICO):

Population:	
Intervention:	
Comparison: (optional)	
Outcome:	

3. Underline each of the key words in your question.

4. These key words will become your initial search terms:
   _____/ _____/ _____.

5. Execute the initial literature search (PubMed).

6. Consider carefully initial limits or restrictions on your search:
   Author(s)
   Publication date
   Language
   Publication type.

7. Execute a second search and review the references you have found.

8. Consider further restrictions on your search or choose new search terms based on your review of the references obtained.

FIG. 5. A sample worksheet for literature searches.

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*Although PubMed states that the Boolean operators must be capitalized, this is not necessary.

On the Preview/Index page you can select publication type in the drop-down box and type: clinical trial "or" randomized controlled trial "or" multicenter study "or" meta-analysis. This page is also useful to enter search terms for any field (all fields or limit to title, author, and so on) and have PubMed add the search criteria automatically to your search window (Fig. 6).

Limiting the search by publication type is not as helpful with questions about etiology, diagnosis or prognosis. Search limits for age and gender will depend on the question. Limiting by language runs the risk of excluding an important piece of evidence. However, practical constraints may make it difficult to obtain or translate an article in another language. Keep in mind that MEDLINE usually provides an abstract in English for many studies published in other languages.

Clinical query filters

PubMed also provides clinical query filters, which use methodologic terms to limit search results to the ar-

eas of therapy, diagnosis, etiology, and prognosis. Click on "Clinical queries" at the PubMed home page to access these filters. You can choose to emphasize sensitivity (greater catch) or specificity (smaller catch) when selecting which filter to use. These filters are based on the work of Haynes and associates.[7] Further study is underway to update these filters.

Sample search

In our example algorithm (Fig. 1) we have stated our clinical question as clearly as possible. After selecting key words to act as our initial search terms, we consider how we may choose to limit our search. For illustration, we ran a search with no limits on our key text words "deep vein thrombosis," "prophylaxis" and "heparin." This generated a list of 2184 articles. If we limit our search to only those articles describing randomized controlled trials published in English since 1990, we will reduce our list to 232 studies. It is reasonable at this point to review the titles and abstracts for some of the articles we have found by clicking on the title as displayed. This links us to

the online written abstract. Scanning through several articles may help us to understand how to limit our search further without jeopardizing final content. After reviewing some of the abstracts we realize there is a wealth of knowledge and studies addressing the issue of DVT prophylaxis in all surgical specialties. Therefore, we choose to "raise the bar" on the publication type. We change the publication type from randomized controlled trial to meta-analysis and retrieve 29 articles.

We review these abstracts and find that the majority of references relate to orthopedic patients. However, a recent meta-analysis compares the use of various forms of heparin as DVT prophylaxis in general surgery (low molecular weight heparin v. unfractionated heparin and v. placebo).[8] We review the abstract to find an impressive reduction in the risk for DVT following either form of prophylaxis. There may also be a slight increase in the risk of hemorrhagic complications; however, specific details are not provided in the abstract. We can record the reference to obtain the article for further review by either saving the abstract on our personal computer or printing the abstract directly from the browser window.

If we then change the publication type to practice guidelines, we retrieve 3 articles. One of these references is the guidelines from the American Society of Colorectal Surgeons.[9] This reference is also recorded for review as little detail is given or recommendations provided in the abstract.

Summary

The Maintenance of Competence initiative (MOCOMP 2000) by the Royal College of Physicians and Surgeons of Canada provides a template for lifelong learning for all physicians and surgeons. The objectives include "… ensuring that fellows are engaged in professional development endeavours that are directed at enhancing the quality of specialty care."[10] The American College of Surgeons lists a
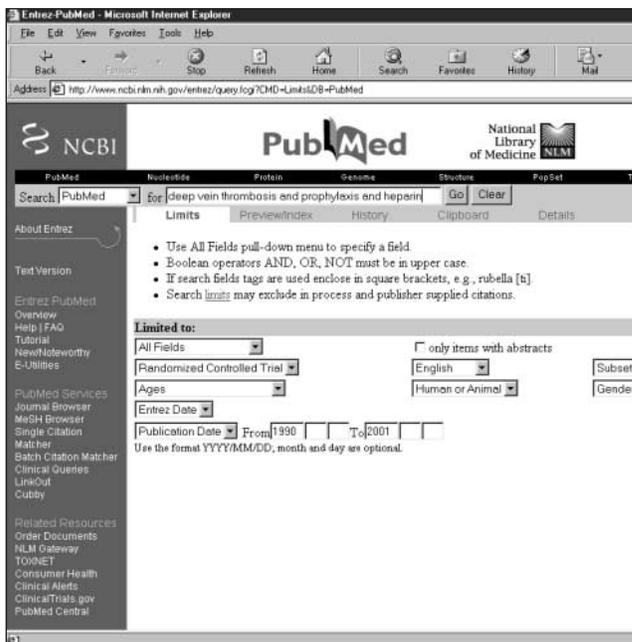

FIG. 6. Setting search limits in the PubMed search engine. Copyright of the National Center for Biotechnology Information (NCBI), National Library of Medicine, Bethesda, Md.

commitment to lifelong learning as 1 of the 4 required elements for maintenance of certification.[11] Professional development includes the ability to conduct a literature search to answer a clinical question or problem.

Having access to a personal computer and the Internet allows a surgeon to complete a literature search at the office or home. It is not difficult to perform a literature search, the challenge is to recognize when it is necessary and to find the time to complete it. It is no longer acceptable for a surgeon to be estranged from the current literature — the demands of colleagues, licensing bodies and patients necessitate satisfactory knowledge of the best available evidence for surgical care.

Now with your literature search complete and relevant articles reviewed, you make a decision to change your practice and provide heparin prophylaxis to prevent DVT in patients undergoing colorectal surgery. You make a further decision to explore future questions in clinical care with a literature review to decide upon possible changes in practice.

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Update in general surgery

Update in General Surgery 2003, the 43rd annual course for practising surgeons, sponsored by the Faculty of Medicine, University of Toronto, will be held from Apr. 24–26, 2003 at the Westin Harbour Castle, Toronto. Credits: Royal College of Physicians and Surgeons of Canada, AMA Category 1. For registration information contact Continuing Education, Faculty of Medicine, University of Toronto, 500 University Ave., Ste. 650, Toronto ON M5G 1V7; tel 416 978-2719; fax 416 971-2200; ce.med@utoronto.ca; www.cme.utoronto.ca

Advances in breast cancer

Continuing Education, Faculty of Medicine, University of Toronto is sponsoring a course entitled "Advances in Breast Cancer: From Molecular Pathology and Imaging to Therapeutics." The course will be held at the Sutton Place Hotel, Toronto, on June 20 and 21, 2003. Credits: Royal College of Physicians and Surgeons of Canada, AMA Category 1. For registration and call for papers information contact Continuing Education, Faculty of Medicine, University of Toronto, 500 University Ave., Ste. 650, Toronto ON M5G 1V7; tel 416 978-2719; fax 416 971-2200; ce.med@utoronto.ca; www.cme.utoronto.ca