Continuing Medical Education

Searching for the evidence

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Making decisions about patient care is difficult. Sometimes there is not enough information, too often there is too much. Paradoxically, the solution to both information poverty and information overload is the same. More efficient and effective search techniques will elicit material previously unfound and will also ensure that the material that is found is more relevant. The accompanying, and equally important, skills of critical appraisal provide a means to rapidly assess the evidence and sort the wheat from the chaff.

Where do I find the evidence?

There are, of course, many answers to this question. Hand searching through journals, contacting colleagues or known researchers, searching the world-wide-web for useful home-pages, and browsing in a library, may all be effective strategies. Increasingly there are new sources of evidence available and new types of journals are being produced, such as the *ACP Journal Club* and *Evidence-Based Medicine*, which publish reviews rather than primary articles. If you have access to the Internet the SCHARR Introduction to Evidence-Based Practice (`http://www.shef.ac.uk/uni/academic/R-Z/scharr/in/metting.html`) is well worth a visit.

A good way to start your search is by looking for review articles (including overviews and meta-analyses). However, not all reviews are of equal quality. The systematic review carried out with clear objectives, a stated method and a summary of the individual and combined results of the studies, provides the best evidence for clinical decision-making. In contrast a single primary study may be small and not easily replicated. Meta-analyses provide a single statistic for many studies based on the cumulated results. The best place to look for systematic reviews is the *Cochrane Library* on disk or CD-ROM. This includes the Cochrane Database of Systematic Reviews, the Database of Abstracts of Reviews of Effectiveness, the Cochrane Review Methodology Database and the Cochrane Controlled Trials Register. For appraisals of clinical effectiveness, the *ACP Journal Club* (also on disk), the new journal *Evidence Based-Medicine*, *Effectiveness Matters* and *Bandolier* are good sources. These should all be available in your library, if not, lobby your librarian to acquire them.

More generally, for reviews or primary reports of research the most commonly used source of references is MEDLINE, which is available in all medical libraries either on CD-ROM or over a local network system. Increasingly it is available on the Internet and for members of the BMA it is also available by telephone dial-up. In the UK the two most common "versions" of MEDLINE are produced by SilverPlatter and Ovid Technologies. These commercial organisations are licensed by the US National Library of Medicine to market MEDLINE and they each add their own particular searching software for accessing MEDLINE. Whatever system or access mode you use the *content* of the database is the same, namely the National Library of Medicine database which is a database of references to articles in approximately 3700 biomedical journals (out of 20 000 to 30 000) world-wide.

It is important to remember that MEDLINE has a strong US bias and that there may often be more useful sources depending on the nature of the problem. EMBASE, for example, another electronic database, has a European focus, with good coverage of drug and pharmacology sources.

Whatever the database, the success and relevance of a search will depend heavily on the strategy and techniques used in the search. Search strategies may have to be tailored to a particular database and different questions will need different strategies; for instance in MEDLINE, the strategy for searching for a review will differ from one for a diagnostic test or a practice guideline.[1] However, the strategies and features described below can be applied to and exist in many other databases.

The question

The first and most essential step in any search, or indeed in research, is to clarify the question. Richardson[2] suggests that it is helpful to phrase the question in order to facilitate searching. For clinicians any patient encounter may elicit a question. Formulating the clinical problem in terms of the patient or condition, the intervention or exposure being considered and the clinical outcome constitutes a "well-built clinical question" and helps to identify knowledge gaps and indicate where the information need exists. For clinicians *and* information professionals, the task of analysing the question in this way enables a clearer understanding of how the component concepts relate to each other and enables a more structured search for information. Once the question has been broken down or built up, the next step is to think of related terms or synonyms that might be used in searching. For example, what are the risks (outcome) in treating/not treating (intervention) trichomoniasis (condition) during pregnancy (patient)?

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Table 1 Analysing the question: natural language

Patient/Condition	*Intervention*	*Outcome*
Pregnancy	Treatment	Pregnancy Complications
Trichomoniasis	No Treatment	Risk Factors
	Drug Therapy	Preterm Birth
	Metronidazole	Low Birth Weight
		Intrauterine Infection

These "natural language" terms or "free text" or "textwords" can be used for a preliminary search on any database. A match will be found for whatever character strings you enter—often with unpredicted, or even entertaining results! Thus by typing in pregn*ancy* you will not retrieve pregnan*t* or pregnanc*ies* (the problem of singular, plural, noun, adjectival endings). Similarly *preterm* birth will not retrieve *premature* birth (synonyms), *gonorrhoea* will not retrieve gonorr*hea* (American and English spelling). These shortfalls can be partly overcome by using the truncation symbol (* on WinSpirs, $ on Ovid) at the end of a word to include any number of further characters, or the wild card (? on WinSpirs) in the middle of a word to replace one or no letters. So, on WinSpirs: *gonorr** will retrieve gonorrhoea or gonorrhea or gonorrhoeal or gonorrheal etc, *tumo?r* will retrieve tumor or tumour.

Your prepared "natural language" terms can be combined in a search "strategy" with Boolean operators, AND and OR. The use of these operators can be illustrated with a very simple example: combining the search terms *dogs* and *cats* with OR will yield all those references that are about dogs *as well as* all the references that are about cats. Using the operator AND, on the other hand, will yield *only* those papers that happen to be about dogs and cats and will exclude those that are only about dogs or only about cats.

Thus

1 pregnan*
2 trichomoniasis
3 # 1 AND # 2
4 metronidazole
5 nitroimidazole*
6 # 4 OR # 5
7 pre?term birth
8 intrauterine infection*
9 low birth weight
10 # 7 or # 8 or # 9
11 # 3 and # 6 and # 10

This preliminary search will retrieve useful references.

However, your first concern should be to make sure that you do not miss any relevant paper. A sound search strategy begins by including *as many* references as possible (a sensitive search) and then moves on to defining the requirement more precisely (a specific search). As well as using natural language terms it is also often necessary to use Medical Subject Headings (MeSH) index terms.

What is MeSH and why is it important?

The National Library of Medicine indexes every article included in MEDLINE, using a controlled list of words (index terms) known collectively as the Thesaurus. Both electronic forms of MEDLINE (Ovid Technology and SilverPlatter) have a built-in thesaurus. When using the SilverPlatter version the system will assume that you are using "natural language" terms whereas with the Ovid Technologies version the default is to the thesaurus. Essentially a thesaurus is a list of preferred terms for any condition. For genital warts the preferred MeSH term is Condylomata-Acuminata. An article may be *about* genital warts but not include those exact words in the title or abstract. MeSH terms are assigned on the basis of the content or topic of an article. Thus a search of MEDLINE (1990–1996) reveals a significant difference in references retrieved:

genital warts (natural language)
retrieves 203
Condylomata-Acuminata (MeSH)
retrieves 825

How do I find which MeSH terms I should use?

Type in your "natural language" word(s) and having retrieved some references, browse through a few records, paying particular attention to the MeSH field, located just below the abstract, which contains the Medical Subject Headings.

For most MeSH terms there will be broader, narrower and related terms to consider for selection within the thesaurus facility in the database. As we pointed out earlier, it is important to make sure you include as many papers as possible at the beginning and do not inadvertently limit your search. You may have heard of MeSH "explosions". When you explode a MeSH term, all the articles which have been indexed as narrower (more specific) terms, and which are listed below the broader (more general) term, will automatically be included.

explode HIV-Infections will include all of the following:

HIV Infections
Acquired Immunodeficiency Syndrome
AIDS-Associated Nephropathy
AIDS Dementia Complex
AIDS-Related Complex
AIDS-Related Opportunistic Infections
HIV Enteropathy
HIV Seropositivity

If you only use the natural language term, HIV Infect* , this would retrieve HIV infection, HIV infections, HIV infected etc but would *not* include the narrower "exploded" terms. Thus searching MEDLINE 1990–96:

1 HIV Infect* 26833
2 explode HIV-Infections 44767

The explosion facility is particularly useful if you are unsure of the range of named drugs to treat a particular condition. If you explode antitrichomonal drugs, the following will automatically be included:

Antitrichomonal drugs
Furazolidone
Metronidazole
Nifuratel
Nimorazole
Ornidazole
Tinidazole

Table 2 Analysing the question: adding MeSH terms

Patient/Condition	*Intervention*	*Outcome*
explode Pregnancy	explode Nitroimidazoles	explode Pregnancy-Complications
explode Trichomonas-Infections	explode Antitrichomonal-Agents	explode Risk
Trichomonas-Vaginalis	explode Anti-infective Agents	

To these MeSH terms you can also add subheadings, chosen from a "pick-list", such as diagnosis, contraindications, adverse effects, mortality, therapy, etc.

To improve the original search strategy for the trichomoniasis question, you could now add the following MeSH terms (table 2) to your natural language terms above (table 1).

Any of these can be combined with each other, or with natural language terms,

Thus searching MEDLINE 1990–96:

(Patient/Condition)

# 1	Trichomon* in ti,ab	642
# 2	explode Trichomonas-infections	293
# 3	explode Trichomonas-Vaginalis	310

(Intervention)

# 4	Metronidazole in ti,ab	1628
# 5	explode Nitroimidazoles	2046
# 6	explode Antitrichomonal-Agents	1700
# 7	explode Anti-infective-Agents	156083

(Outcome)

# 8	explode Risk	80708
# 9	explode Pregnancy-complications	38569
# 10	(# 1 or # 2 or # 3) and (# 4 or # 5 or # 6 or # 7) and (# 8 or # 9)	

This yields **14 references**. Of these 14 articles found, one is a randomised controlled trial, one a controlled clinical trial, one a meta-analysis and seven are review articles. Each record retrieved consists of a number of set fields each prefixed by an abbreviation. Records can be viewed either in full or as a brief record. The notable fields in a full record are the title (TI), author (AU), source (SO), publication year (PY) language (LA), country of publication (CP), abstract (AB) MeSH headings (MESH), check tag (TG), publication type (PT) and named substance (NM).

Fourteen records is almost the perfect number of references to retrieve and while you can browse through 14 records relatively quickly to make your selection of the evidence, it can be a time-consuming and daunting task when you are presented with hundreds of records.

How do I sift out the quality evidence to solve my specific patient problem?

Quality filters or methodological filters are single terms or groups of terms which can be added to your search strategy and are designed to increase the effectiveness of your search by retrieving the most appropriate studies (for example cohort studies for prognosis, clinical trials for therapy) and thus provide harder evidence for solving problems of treatment, diagnosis, aetiology (causation/harm/risk-benefit) and prognosis.[3–6]

The recommended quality filter to use for articles about therapy interventions (from 1990) is CLINICAL TRIAL as a publication type (PT). Prior to 1990 the recommended term to use is RANDOM* as a natural language term. This highlights the importance of recognising that indexing practice changes over the years and that it may be necessary to check what MeSH terms might have been used previously. In order to ensure that no high quality evidence is missed, a slightly broader quality filter strategy is recommended (for literature published after 1990) which incorporates publication types, natural language and MeSH:[7]

9 randomised-controlled-trial in pt
10 drug therapy in mesh
11 therapeutic use in mesh
12 random* in ti,ab,mesh
13 # n and (# 9 or # 10 or # 11 or # 12)

where n = combined subject terms.

For publications prior to 1990 the recommended slightly broader quality filter strategy is:

14 random-allocation
15 comparative-study in tg
16 drug therapy in mesh
17 placebo* in ti,ab,mesh
18 controlled trial* in ti,ab,mesh
19 # n and (# 14 or # 15 or # 16 or # 17 or # 18)

There is also a recommended quality filter for retrieving reviews, (including overviews and meta-analyses) in MEDLINE.[8]

Conclusion

In this article we have shown you how to

- develop search strategies from clinical questions
- identify search terms (using natural language and MeSH) to describe the key elements in your question
- apply quality filters (for treatment, diagnosis, aetiology and prognosis problems) to sift out the best available evidence.

However, just as we all have different ways of learning, so too do we have individual styles in information seeking. What suits one may not suit another. You may wish to do it all on your own, colleagues may prefer someone else to do it for them. Whatever your preferred mode of operation, find out more about your local health library and see how they can help you. Librarians are trained to search for evidence and are also trained to help you to do it yourself.

1 See for example the series of User guides published in *JAMA* beginning 3 November 1993. Most recent was published 8 May 1996.
2 Richardson S, *et al* (1995). The well-built clinical question: a key to evidence-based decisions. *ACP Journal Club*, November-December:A12–13.
3 McKibbon KA, Walker CJ. Beyond ACP Journal Club: how to harness MEDLINE for diagnosis problems. *ACP Journal Club* 1994; September-October:A10.
4 Walker-Dilks CJ, McKibbon KA, Haynes RB. Beyond ACP Journal Club: how to harness MEDLINE for etiology problems. *ACP Journal Club* 1994; November-December:A10–11.
5 McKibbon KA, Walker CJ. Beyond ACP Journal Club: how to harness MEDLINE for prognosis problems. *ACP Journal Club* 1995; July-August:A12–13.
6 McKibbon KA, Walker CJ. Beyond ACP Journal Club: how to harness MEDLINE for therapy problems. *ACP Journal Club* 1994; July-August:A10.
7 Haynes RB, Wilczynski NL, McKibbon KA, Walker CJ, Sinclair JC. Developing optimal search strategies for detecting clinically sound studies in MEDLINE. *Journal of the American Medical Informatics Association* 1994;6: 447–58.
8 McKibbon KA, Walker-Dilks CJ, Wilczynski NL, Haynes RB. Beyond the ACP Journal Club: how to harness MEDLINE for review articles. *ACP Journal Club* 1996; May-June:A12–13.