Evidence-Based Medicine

EBM NOTEBOOK

Searching for evidence: principles and practice

"Debate simmers in our practice over the efficacy of paracetamol (Tylenol) as an antipyretic in children. Is it just an accepted fact that it works, is there an evidence base, or is it a myth that has its roots in the drug companies?" Primary and secondary care clinicians address such issues—in this case, 1 captured from an e-mail discussion list—every day. How can a busy clinician harness both technology and expertise to answer questions arising from clinical practice by drawing on research-derived evidence?

As proponents of evidence-based medicine recommend (1), clinicians should, when possible, use distilled literature-based products, which are the result of formal searching and appraisal processes and are accessible either in print or increasingly on the Internet. Some are topic based, where 1 or more articles answer a specific patient-focused question (e.g., critically appraised topics [CATs] [2]). Others are based on articles contained in evidence-based compilations (e.g., Journal Club on the Web [3]) or highlighted in evidence-based journals (e.g., *Evidence-Based Medicine* [4] and *Evidence-Based Health Care* [5]).

Such ready-made answers, although increasingly plentiful, usually address only the most common conditions and even then only a minority of health care interventions for each condition. For most of the remaining clinical questions, 3 main evidence-seeking routes exist. First, there are such traditional bibliographic databases as MEDLINE. Second, there are such quality-filtered resources as Best Evidence and the Cochrane Library. Third, there is the Internet, which defies simplistic classification, being not only an access point for traditional and new products alike but also a complex (although uneven) resource in its own right. Irrespective of the preferred route, 3 information management principles are prerequisite to retrieval of clinically relevant, rigorous, up-to-date evidence: focusing the question, constructing the search strategy, and filtering the literature.

Principles of effective information retrieval

Focusing the question

A focused question uses a structure or "anatomy" to define the essential components of a clinical information need, according to a patient, intervention or exposure, outcome(s), and comparison(s) (6). This technique is being used increasingly to optimise retrieval for clinical queries (Figure); the British Library AuRACLE Project (Automated Retrieval Assistant for Clinically Relevant Evidence) showed that the technique reduced the number of MEDLINE references retrieved without adversely affecting the relevance of results (7, 8). In our opening scenario, the patient would be a child with a temperature; the intervention would be paracetamol; the outcome(s) might be either surrogate end points, such as reduction of body temperature, or clinical end points, such as relief of discomfort; and the comparison(s) might be medications, physical interventions (such as tepid sponging), or complementary therapies.

Constructing the search strategy

Use of a focused question, structured according to the above "anatomy," facilitates subsequent construction of a search strategy. Instead of entering a word, such as "paracetamol" and retrieving several thousand results, one links a patient component to the intervention using the AND operator (e.g., "fever" AND "paracetamol") to obtain more meaningful results. Synonyms or related terms from within 1 component of the anatomy can be linked using the OR operator (e.g., the patient components "temperature" OR "fever"). Spelling variants and truncation can be handled using database-specific wild-card characters (e.g., asterisk, dollar sign, colon, and question mark). So "child OR children" can both be retrieved using "child*." The further addition of either outcome terms (e.g., "discomfort") or a comparison (e.g., "sponging") narrows results even further. Such features are standard on such databases as MEDLINE or the Cochrane Library. The facility to use Boolean operators (AND, OR) is not available for all Internet search engines, but the Alta Vista advanced query option (9) allows such advanced searching techniques. The accompanying Table records availability of such features.

Filtering the literature

Having defined the subject content of a clinical query and constructed an appropriate search strategy, the final stage is to apply a quality filter. Methodological filters, as devised and tested by researchers at McMaster University (10), retrieve those articles that are most rigorous and most likely to answer the type of question posed by the enquirer. In some cases, these filters are self-evident: The answer to a therapy question can best be provided by a clinical, preferably randomised, trial (11). In other cases, the filters rely on the quality of reporting: For example, a good diagnosis study will document the sensitivity and specificity of a candidate test (12). In each case, the searcher combines concepts from the subject search before adding the filter to further restrict the final results. These filters can either be prestored on a hard disk for future use or incorporated in a customised interface, as in the case of PubMed Clinical Queries (13), an Internet version of MEDLINE, and Medical SmartSearch (14). Such databases as the Cochrane

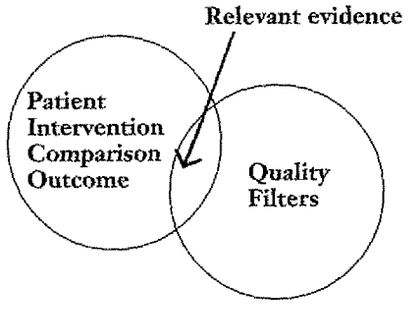

Figure. Combining a focused question with quality filters to retrieve relevant high-quality studies.

Library and Best Evidence are the products of prefiltering using similar filters. Filtering can be achieved on the Internet, though still an inexact science, by adding methodological or document-type terms to a subject query to act as a quasi-filter. For example, a search on "paracetamol AND fever" might be further refined by the addition of such terms as "clinical trial" or "guideline."

Bibliographic databases

The virtues of traditional databases, such as MEDLINE and EMBASE/Excerpta Medica, lie in their comprehensiveness and longevity and in the sophistication of their search facilities. Both of these resources provide access to over 20 years of literature from several thousand journal titles covering a vast variety of biomedical topics. Facilities to enhance retrieval include mapping of terms entered by the user to approved equivalents selected by the database producers, an "explode" feature that permits searching of multiple subordinate terms from a single parent term (e.g., exploding "lipids" avoids the need to enter all types of lipids separately), and a weighting feature that allows the searcher to restrict retrieval to a concept that is a major term or focus. The sheer size of these databases requires that the searcher define and then refine search terms to prevent the retrieval of too many results.

Quality-filtered resources

Use of quality-filtered resources, such as the Cochrane Library and Best Evidence, is presently constrained either by limited awareness of their potential or by limited local availability. The Cochrane Library, a composite CD-ROM containing about 600 full-text reviews and over 250 000 bibliographic references to controlled clinical trials, is now the single most comprehensive source of trials, surpassing the more established coverage of MEDLINE. The Cochrane Library has recently been offered through subscription on the Internet, significantly improving its availability. Best Evidence, a database of structured and appraised summaries from the major clinical journals as reproduced from its printed counterparts *Evidence-Based Medicine* and *ACP Journal Club*, is another CD-ROM–based product that is rapidly gaining in popularity. Both the Cochrane Database of Systematic Reviews and Best Evidence are offered by Ovid as a new product titled Evidence Based Medicine Reviews (EBMR) (15). These products recognise an increasing need for access to "answers" rather than to intermediate results from bibliographic records. In all of these instances except EBMR, however, access to higher-quality, value-added materials is achieved at the expense of the breadth of coverage afforded by such established databases as MEDLINE.

The Internet

For clinicians, particularly practitioners working in professional isolation in a primary care setting, the Internet offers the greatest improvements in access and availability of clinically relevant materials. However, the motto here is *caveat surfer* (16) (surfer beware) because there are widespread concerns about the quality and currency of some of the materials identified on the Web. This concern has been ably shown by a recent study that, propitiously, is very close to our clinical scenario: guidelines for the management of feverish children (17). In this study, the authors surveyed Web pages located using the Excite and Yahoo search engines and found that only 4 corresponded to recommendations in published guidelines. Clearly no substitute exists for doing your own critical appraisal, regardless of whether material is predigested in an evidence-based compilation, filtered from

Comparison of search formulations available in different sources

Database	Combining terms (Boolean logic)	Subject keywords?	Wild cards	Built-in filters
PubMed (MEDLINE*)	AND, OR, NEAR, NOT, ADJACENT	Yes	*, ?	In: Clinical Queries
Cochrane Library	AND, OR, NEAR, NEXT, NOT	Yes	* (end of word only†)	Contains RCTs and systematic reviews only
Best Evidence	AND, OR, NEAR, NOT	Yes	*	All articles selected for methodological quality
Internet OMNI	— AND, OR, NOT	— Yes	— Stems allowed†	Site dependent Sites prefiltered via a quality checklist
Excite	AND, OR, NOT	No	No	None
AltaVista	(In Advanced search only) AND, OR, NOT, NEAR	No	* (end of word only)	None but "clinical trial," etc., could be added

Other versions of MEDLINE, such as OVID, Silverplatter, and DIALOG, may use slightly different combining terms and wild cards, e.g., "$" instead of "". †Must be specifically requested to obtain all variants, e.g., "child" will not include "children" or "child's"; some systems, such as PubMed and Best Evidence automatically add a "*".

MEDLINE, synthesised in a Cochrane review, or simply made available in "raw" form on the Internet.

Nevertheless, several precautionary measures can minimise the risks posed by inappropriate or inaccurate information. The first is to use an evidence-seeking protocol that predefines high-quality, high-yield sources to be used in the quest for evidence. With the recent addition of subscription access to the Cochrane Library and to Best Evidence (via EBMR), it is now possible to follow all the evidence-seeking steps from such a protocol (e.g., the 10-step Seeking the Evidence protocol used in Sheffield [18]) without straying from an Internet-linked computer. A second, more pragmatic approach is to use a specialist search engine that retrieves only high-quality evidence, such as Medical SmartSearch (14) or the Turning Research into Practice (TRIP) database (19). A third Internet-based searching strategy is to use medicine-specific search engines in which the quality of sites is managed at a resource level rather than by validating specific pages. A leading example of this is the OMNI gateway (20), designed for the U.K. academic community but increasingly used by general practitioners. It provides hypertext links, accompanying subject indexing, and brief descriptions for many biomedical resources as well as indexing such publication types as clinical trial or guideline. Similarly, the proposed U.K. National Electronic Library for Health will seek to deliver bite-sized, user-friendly items of information within 15 seconds to the clinician's desktop. Other useful resources of preselected and categorised materials include Cliniweb International (21) and Netmedicine's Medfinder facility (22).

Finally, the least structured approach is to use a general search engine to retrieve subject-specific materials, often of varying quality. The first thing to bear in mind is that even the most comprehensive search engine (HotBot) covers no more than about 34% of the estimated 320 million pages of the "publicly indexable Web" (23). The absence of editorial control or standardisation of subject indexing requires an imaginative range of variants and permutations to maximise retrieval. Demand for more sophisticated or more comprehensive search facilities has led to the development of such products as Copernic 99 (24) and of meta-search engines that search several engines simultaneously (25).

What types of useful material do we find on the Web to add to the ready-made critical appraisal products mentioned earlier? A veritable library of health technology assessment reports and summaries, particularly strong on new technologies (e.g., stents) or new drugs (e.g., statins, donepezil, and riluzole), is reviewed more fully elsewhere (26). Abstracts of Cochrane reviews are provided in a free and instant archive as a next-best alternative to the subscription-only full-text reviews (27). Such databases as DARE, the NHS Economic Evaluations Database, and the Health Technology Assessment Database (all from the NHS Centre for Reviews and Dissemination site [28]) improve awareness of high-quality reviews, economic evaluations, and technology assessments. Full-text guidelines from government agencies or professional organisations are increasingly becoming available. Such support materials as checklists, clinical calculators, and user guides make the process of do-it-yourself critical appraisal easier. An Internet resource guide to all the above types of material is available on the Web (29) and is also included as a "chapter" of the Cochrane Library.

Addressing the scenario

Returning to our clinical scenario, what success might we have from selecting 1 example from each of these routes? Searching MEDLINE, we "explode" the Medical Subject Heading "acetaminophen" (in preference to "paracetamol") to pick up all variants, combine this intervention with 2 patient-related concepts—"fever" and "child"—to focus the question, and then add the publication type "clinical trial" to restrict the search to higher-quality studies. Further restricting this result set by language (English only) and by date (1992 onward) produces a nicely relevant set of 22 studies. Alternatively, using the Cochrane Library, again employing the approved Medical Subject Headings "acetaminophen," "fever," and "child" retrieves a comparable number of references and also establishes the significant fact that there is not yet a Cochrane systematic review on the topic. Finally, a search of Medical SmartSearch not only confirms the dearth of systematic reviews on this topic but also reveals a very recent article recording this fact (30).

Evaluation

Each route has at least 1 important advantage over its rivals: the sophistication of commercial MEDLINE software; the prefiltered quality of the Cochrane Library; and the unrivalled currency of the Internet. Each requires that the searcher complement skills in information retrieval with those of reading, appraising, and applying research literature, irrespective of how much previous processing of the evidence has taken place. Most important, a convincing argument can be made for a "cascade" approach to clinical queries that moves from filtered evidence, through MEDLINE, to the Internet. A more comprehensive approach using all three routes ("triangulation") can thus be reserved for such areas as guideline production or where the objective is the minimisation of risk. All three routes will also be required if our clinical scenario is drawn from a very topical issue, such as sildenafil for the treatment of impotence or celecoxib for arthritis.

Accessing the evidence has never been easier. Searching for evidence, however,

requires a greater awareness of both the advantages and the limitations of increasing numbers of resources. Practical information management techniques, such as focused questions and methodological filters, are becoming increasingly important, in addition to such established techniques as search-strategy construction. Clinical end users doing their own searching and information intermediaries, such as librarians, will need to work together ever more closely to develop the lifelong information skills required to support and, indeed, enhance clinical decision making.

Andrew Booth, MSc, Dip Lib
Alan J. O'Rourke, MBChB, MSc
School of Health and Related Research
University of Sheffield
Sheffield, England, UK

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Journals Reviewed for This Issue*

Core Journals

Am J Med
Am J Obstet Gynecol
Am J Psychiatry
Am J Surg
Ann Intern Med
Ann Surg
Arch Dis Child
Arch Gen Psychiatry
Arch Intern Med
Arch Pediatr Adolesc Med
Arch Surg
Arthritis Rheum
BMJ
Br J Gen Pract
Br J Obstet Gynaecol
Br J Surg
Circulation
Clin Pediatr
Cochrane Library
Diabetes Care
Hypertension
JAMA
J Am Board Fam Pract
J Am Coll Surg
J Gen Intern Med
J Intern Med
J Neurol Neurosurg Psychiatry
J Pediatr
J Vasc Surg
Lancet
N Engl J Med
Obstet Gynecol
Pediatrics
Surgery

Journals for Continuing Review

Acta Obstet Gynecol Scand
Age Ageing
Am J Cardiol
Am J Public Health
Am J Respir Crit Care Med
Ann Emerg Med
Ann Med
Arch Fam Med
Arch Neurol
Br J Psychiatry
Can Med Assoc J
Chest
Clin Invest Med
Crit Care Med
Fertil Steril
Gastroenterology
Gut
Heart
J Am Coll Cardiol
J Am Geriatr Soc
J Clin Epidemiol
J Fam Pract
J Infect Dis
Med Care
Med J Aust
Neurology
Pain
Rheumatology
Spine
Stroke
Thorax

*Approximately 60 additional journals are reviewed. This list is available on request.