How to Find Evidence When You Need It, Part 1: Databases, Search Programs, and Strategies

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Does the addition of a glycoprotein IIb/IIIa receptor antagonist to heparin and β blockade decrease mortality in emergency department patients with chest pain and nondiagnostic ECGs?

Does a negative troponin I at 6 hours after onset of chest pain rule out myocardial infarction?

When should I suspect myocardial infarction in patients presenting to the ED who have previously received heart transplants?

Is "zero tolerance" for missed myocardial infarction a cost-effective policy for an urban ED?

Are clinically stable patients with cocaine-related chest pain at risk for near term life-threatening events?

These questions are only a few among those potentially relevant to the evaluation and management of patients presenting to EDs with possible myocardial ischemia. They are formulated with varying degrees of specificity and pertain to different aspects of clinical decisionmaking for such patients. A similar set of questions could be generated in relationship to almost every patient that we encounter. Physicians have a professional obligation to base their clinical decisions on the best evidence available.[1] This assumption is the cornerstone of the concept of evidence-based medicine. Given the density and variety of questions that emergency physicians routinely face in the course of everyday practice, as well as the time constraints characteristic of emergency care, the challenge posed by the cited assertion calls for considerable resources and skills to address. In this and in future installments of this skills series, we will introduce the reader to

some of the resources most useful to an emergency practitioner and to the essential skills required to use them. In this article, we will focus on the knowledge required to match questions to appropriate databases and approaches to searching. This requires knowledge of databases, search engines, and strategies and of how these components can be used to locate the best and most relevant evidence.[2-4]

WHAT IS A FOREGROUND QUESTION?

Emergency physicians cannot maintain subspecialty expertise in the care of all the varied problems they face. The care of complex and unusual patients requires knowledge that is often not inherent in emergency medicine residency training. Among the questions given at the outset of this article, a heart transplant patient presenting with chest symptoms is an example of such a situation. In such a case, the practitioner might well feel the need for additional knowledge of the relevant disease process or might seek specific information regarding how a previous heart transplant is likely to effect the differential diagnosis of acute chest pain.

When adequate knowledge of disease is present, the practitioner is more likely to pursue answers to focused questions involving the performance of specific diagnostic tests or the choice of therapeutic agents and management strategies. Most of the other example questions involving patients with possible myocardial ischemia conform to this latter description. When specific clinical questions productively lead to a quest for information from primary reports of clinical research or from rigorous syntheses of them, known as systematic reviews,[5] they are often characterized as pertaining to "foreground knowledge," in contrast with more general, "background" knowledge of diseases and disease processes.[6,7] Matching foreground questions to appropriate resources and efficiently using those resources to find clinically useful answers define skill sets within the domain of evidence-based care.[3,4] We will be concerned exclusively with foreground questions in this series. We will begin by introducing terms that will be used throughout the series, "database," "search engine," and "search strategy."

WHAT IS A DATABASE?

A database is an organized collection of data or information. It can be as complex as MEDLINE, which now has more than 11 million biomedical citations, or as simple as a small collection of citations developed by a practitioner for personal use. A collection of favorite recipes might also qualify as a database. A database is composed of records; records are composed of fields; fields are composed of data. Using the recipe set analogy, each card in the recipe box represents a record. Each record is composed of fields such as ingredients, mixing instructions, and baking or presentation suggestions. The specific ingredients and directions for each recipe (the data) are entered into the appropriate fields within each record. The recipe database may be arranged alphabetically, by year of acquisition, or by main ingredient. An index can be created that cross-references the fields in the recipe records at the convenience of the user.

A database can consist of a single file such as the recipe file. This is called a "flat" database. An example of a flat database used by a clinician is a set of names and addresses of professional contacts. A database can also be a set of multiple, linked files; this is called a "relational" database. A relational database consists of files that share fields and, therefore, data. For example, a library's online catalog pulls book titles from one file, patron names from another, and due dates from yet another. This modular, shared data approach avoids the need to make the same update to many files; for example, if a library user's address changes, all related files in the catalog system can access that change, so that the change is made only once in one file. An example of a relational database familiar to many physicians is an electronic medical record, which pulls data from many files (eg, the patient identifier number comes from one file, the radiology record from another, the billing information from yet another). Data-rich relational databases are useful when, for example, reports for outcomes research need to be pulled from a set of electronic patient records based on very specific criteria such as age range, geographic location, and medical condition.

To manage large databases such as MEDLINE, creators often use a controlled indexing language. An indexer assigns key words to articles from a standardized set of terms. This set of terms is designed to alleviate the confusion and imprecision of numerous synonyms and variations in medical description of disease. In MEDLINE, this standardized indexing language uses what are called Medical Subject Headings or MeSH terms. For instance, the authors of different articles may refer to the concept "pulmonary embolism" using varying terminology such as "pulmonary emboli," "pulmonary thromboembolism," and "thromboembolic disease." MeSH terms will be discussed further in subsequent articles in this series. Applying a standardized, highly structured organization to a large database allows the database to be searched relatively efficiently and thoroughly, using a minimum number of phrases and avoiding unusual descriptions of disease processes or drugs. MEDLINE is only one example of a data-

base. Other examples will be listed at the end of this installment.

WHAT IS A SEARCH ENGINE?

Separate from the data in a database—figuratively, lying on top of the data—is a software program called a search engine. The search engine is the workhorse that performs the task of matching the content of the database to the specifics of a search strategy; it is what actually performs the "searching." Search engines differ enormously in terms of power and user-friendliness of interfaces. Some may allow users to do complicated, exacting searches, others can process only the simplest of search commands. Producers of databases usually construct search engines that are specific to their unique needs. However, many commercial organizations obtain the MEDLINE database and build their own proprietary search engines to access it. This may result in differing results when using different MEDLINE access programs (ie, the database is the same, but the search process is unique to the vendor). The differences between MEDLINE search engines will be explored in later installments in this series.

One important principle governing the relationship between databases and the search engines used to access them is important for clinicians: When a database is relatively small, sophisticated tools for searching it are much less necessary. Citations that it may contain that are relevant to a particular question are much easier to find. As a database increases in size, its corresponding search engine must increase in power.

WHAT IS A SEARCH STRATEGY?

A search strategy is, simply, the representation of the clinical question in a format that is understandable by the search engine. More broadly, it might be conceived of as encompassing the process of matching the practitioner's question to the appropriate target resource. Most foreground searches are composed of the following steps: clarification of the information need and formatting or "mapping" the question; choosing the best database(s); forming a search strategy; and inputting the terms and refining the strategy as needed.

Clarify the Information Need

Once the practitioner has determined that a specific foreground question is important to the care of an individual patient, a structured approach to formatting the question is useful in guiding the search process and formulating a search strategy. The question must be categorized in a fashion that links it to preferred study designs and to appropriate resources and databases, a process that is sometimes referred to as "mapping." After initially identifying the type of question at hand (eg, therapy, diagnosis, prognosis),[8] it is useful to specify the patients, interventions, comparison or cointerventions, and outcomes of interest.[6,7] The resulting "PICO" formula (Figure) can assist in identifying potential search terms and in assessing the applicability and relevance of citations found in the course of a search. Among the sample questions provided at the outset of this article, the reader might have selected a prognosis question: "Are clinically stable patients with cocaine-related chest pain at risk for near term life-threatening events?" This question is addressed in PICO form in the Figure.

Choose Databases to Search

The second step is choosing the database(s) to search. This requires familiarity with and availability of appropriate options. A sample of databases relevant to emergency physicians is provided later in this article.

The selection of a medical database by a clinician depends on multiple factors, including the type of question, immediate availability, the ease of use for a particular problem, and the need to limit the search to the highest quality studies. Some databases, such as those included in the Cochrane Library, only pertain to questions regarding therapy or prevention.[9] Point-of-care Internet access and an institution's or department's subscription choices affect availability. We will explore the interplay of factors affecting the choice of databases in detail in the final article in this series.

Formulate the Search Strategy

Once a relevant database has been selected, formulating the search strategy involves the choice of search terms

Figure.
A 4-part format facilitates turning clinical questions into searchable queries. This example illustrates its use with a prognosis question pertaining to patients with chest pain.

PATIENTS:	Patients with chest pain and exposure to cocaine
INTERVENTIONS:	Assessment over time
COMPARISON:	None
OUTCOMES:	Near term mortality

and limits for the purpose of creating an appropriate interface between the clinical question, the database, and its search engine. Formatting the question using PICO may facilitate the choice of search terms. The decision regarding how many terms to use and whether to use terms from the database's standardized vocabulary will vary and will be influenced by factors such as the size of the database being used, the clinician's estimate of the extent to which the question has been studied, and how comprehensive a search is desired at a particular time. The next installments in this series will acquaint the reader with the process of formulating a specific strategy for searching a very large database, MEDLINE, taking these factors into account.

Perform Search, Examine Results, and Refine Strategy

The final search step is to input the selected search terms and limits and then to examine the results and refine the strategy as needed. The searcher will then use his or her clinical knowledge to make sense of the results and then apply the results to the specific clinical situation. In many cases, access to the skills of a medical librarian trained in evidence-based search techniques will be invaluable. These information professionals can frequently provide assistance with all aspects of the search process.

DATABASES USEFUL TO THE EMERGENCY PHYSICIAN FOR FOREGROUND QUESTIONS

MEDLINE

Created from Index Medicus and maintained by the US National Library of Medicine, MEDLINE consists of articles from more than 4,000 biomedical journals and contains more than 11 million citations from the mid-1960s to the present.

Subsequent installments in this series will explore the many different search engines available for MEDLINE access, as well as the nature of the differences between them. The National Library of Medicine maintains 2 free access engines for MEDLINE users on the Internet:

PubMed: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi

National Library of Medicine Gateway: http://gateway.nlm.nih.gov/gw/Cmd

Cochrane Library

The Cochrane Library (http://www.cochrane.org) and the included databases are a useful resource when the clinical question involves a matter of therapy or prevention. It was described in detail in an earlier article in the *Annals* Evidence-Based Emergency Medicine series[9] and is available commercially from Update Software Inc. (http://www.update-software.com/cochrane; Santa Fe, NM). Parts of the Cochrane Library are also available from other sources.

ACP Journal Club

ACP Journal Club (http://www.acpjc.org) consists of article reviews and abstracts drawn from a target set of about 125 journals from 1991. It also encompasses what was initiated as a separate journal called "Evidence-Based Medicine" from 1995 through December 1999. This resource is not specific to emergency medicine and does not include all important emergency medicine journals in its target set. It is a useful resource for finding summaries of high quality studies in areas overlapping emergency medicine practice, particularly internal medicine.

The National Guideline Clearinghouse (NGC)

The National Guideline Clearinghouse (http://www.guidelines.gov) is a database of clinical practice guidelines sponsored by the Agency for Healthcare Research and Quality, in partnership with the American Medical Association and the American Association of Health Plans. The database does not systematically include emergency medicine guidelines or provide a uniform definition of "evidence-based guidelines."

Emergency Medical Abstracts

Known for years to many emergency practitioners as a means of "keeping up with the literature," Emergency Medical Abstracts (http://ccme.org/EMA/index.html) is a private subscription, emergency medicine database dating from 1977. It currently includes approximately 150,000 citations assembled by means of a structured hand search of the Science Citation set of English-language journals. It is frequently the most efficient pathway for locating articles relevant to questions arising from emergency care.

Other resources that may be considered in the course of searching for information regarding foreground questions include electronic textbooks such as *Up to Date* (http://www.uptodate.com) and *Clinical Evidence* (http://www.clinicalevidence.org), both available in CD-ROM editions and many Web-based sites and links. Finally, the reader may ultimately choose to develop his or her own database of citations and summaries corresponding to questions encountered with particular frequency in his or her practice.[10]

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