# How to Find Evidence When You Need It, Part 4: Matching Clinical Questions to Appropriate Databases

**Peter C. Wyer, MD**
**Tracy Y. Allen, MLS**
**C. James Corrall, MD**

*From the Augustus Long Health Sciences Library of Columbia University (Allen) and the Columbia University College of Physicians and Surgeons (Wyer), New York City, NY, and the Children's Center at Mercy, Des Moines, IA, and the Mayo Clinic, Rochester, MN (Corrall).*

Practitioners seeking enhancement of clinical care through consideration of research require rapid and efficient point-of-care access to current studies and summaries pertaining to specific clinical queries. MEDLINE and other large databases usually contain the citations relevant to such questions but frequently fall short of the practical requirements of busy clinicians. We present a summary of the knowledge and skills required for physicians to select and use smaller databases appropriate to particular types of questions arising from emergency care. We outline a step-by-step approach that begins at the bedside with the sorting of questions into appropriate categories of knowledge and research design. We identify commonly encountered pitfalls in the process of connecting a particular question to an appropriate database. We illustrate the approach through a set of demonstration questions pertaining to patients presenting to emergency departments with chest pain consistent with acute coronary ischemia. We describe a selection of resources and databases and summarize their performance in locating articles relevant to the demonstration questions.

[*Ann Emerg Med.* 2003;42:136-149.]



*0196-0644/2003/$30.00 + 0*
*doi:10.1067/mem.2003.255*

## INTRODUCTION

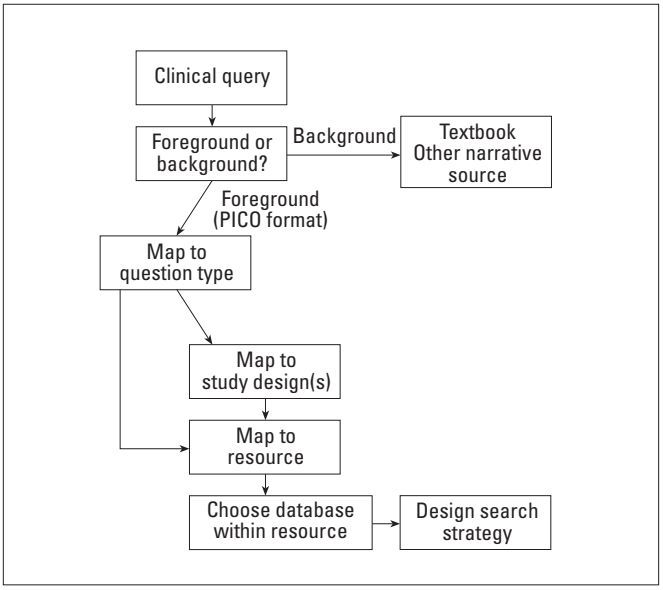
Earlier articles in this series introduced the reader to the use of resources, databases, and search engines[1] and presented a tutorial in searching skills derived from the use of the MEDLINE database.[2,3] Clinicians desiring to routinely locate literature relevant to clinical questions need the latter skills to do MEDLINE searches themselves and to effectively use the services of resource consultants, such as librarians. The principles underlying effective MEDLINE searching are common to the use of all search engines and resources. The preceding 2 installments in this series might therefore be taken as an effective primer with respect to searching any biomedical database.

MEDLINE is a database of more than 11 million citations, the vast majority of which are irrelevant to the needs of practitioners making decisions about individual patients. Searches of MEDLINE for such purposes tend to yield many irrelevant citations and frequently fail to identify important studies that are relevant.[4] The use of validated search strategies developed for the purpose of increasing the efficiency of MEDLINE searches by clinicians only partially ameliorates these drawbacks.[5,6] Many experts currently advise clinicians to use smaller, appropriately selective, or filtered databases whenever feasible and to reserve the use of MEDLINE and other large databases for situations in which such secondary databases either do not exist or have failed.[5,6]

Filtered databases are ones in which one or more criteria have been used to select articles for inclusion. As a result of this filtering, such databases are relatively small, and the need for advanced searching skills is minimized. However, efficient use of filtered databases requires a skill set that is independent of knowledge of the search terms and indexing techniques used to create large databases. The practitioner considering a specific clinical question must possess a thorough knowledge of how the databases to be considered are created and structured to be able to reliably match or map the question to a database likely to contain relevant evidence. To do this, the clinician must also be able to identify key characteristics of the question being asked, including the study designs most likely to yield a reliable answer.

In this installment, we will introduce you to several representative databases that might be useful to emergency medicine practitioners, and we will provide a systematic approach to selecting and using them. The Figure outlines the stepwise approach we will describe, and we suggest that the reader refer to it at this time. For simplicity, we have condensed the discussion into 4 essential steps. Readers who are somewhat familiar with the process of formatting questions and linking them to preferred study designs or who are otherwise inclined to concentrate on the description of resources during their initial reading of this article may initially choose to skip directly to step 3 and to then review steps 1 and 2. Ultimately, an adequate knowledge of specific databases and the ability to format and characterize

**Figure.**
*An algorithmic approach to the sorting and seeking clinical evidence on questions arising at the bedside from the care of individual patients. The question must be formatted and characterized before a resource is selected and a search is attempted. In some cases, characterization of the question type might constitute an adequate basis for choosing an appropriate resource.* ***PICO,*** *Patients-interventions-comparisons-outcomes.*



clinical questions form part of a single skill set that allows a busy practitioner to find the most helpful clinical evidence in the shortest period of time.

## STEP 1: DISTINGUISH BETWEEN BACKGROUND AND FOREGROUND QUESTIONS

The first installment in this series identified 5 possible questions pertaining to a patient presenting to an ED with chest pain.[1] One of these involved the need for criteria for suspecting myocardial infarction or ischemia in patients who have received a heart transplant. Although clinical research might be brought to bear on this issue, we believe that most emergency physicians concerned whether a particular patient undergoing heart transplantation needs to be entered into an extended protocol to rule out myocardial infarction would be more inclined to contact a consultant than to attempt a primary literature search. Such questions, for which textbooks, state-of-the-art review articles, or the opinions of consultants constitute the most appropriate sources of information, usually involve knowledge of clinical circumstances or disease processes. They are frequently referred to as background questions. In contrast, foreground questions are questions for which a search for primary clinical evidence is appropriate.[1,7] Only the second of these 2 categories falls within the domain of evidence-based searching and appraisal. Therefore, we will restrict this article to consideration of the 4 foreground questions identified in the first installment.[1] We will retain their numbering throughout this article.

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

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

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

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

## STEP 2: DETERMINE THE QUESTION TYPE AND PREFERRED STUDY DESIGN

We have moved down the algorithm of the Figure and are ready to undertake a process of mapping the question before selecting an appropriate limited resource. By mapping, we mean matching a question to one of several preexisting categories. Putting the question into a predefined format facilitates this process. The first installment in this series introduced the reader to the Patients-Interventions-Comparisons-Outcomes format.[1] Use of Patients-Interventions-Comparisons-Outcomes prepares the practitioner to recognize articles that are relevant and applicable to the issues and circumstances presented by individual patients. It also sets the stage for all subsequent phases in the inquiry, including identifying appropriate sources of evidence, defining the criteria that will be used to select individual studies from those sources, and selecting the criteria to be used to assess their methodologic strength. Table 1 presents each of our 4 demonstration questions in the Patients-Interventions-Comparisons-Outcomes format. It includes 2 additional categories that go beyond Patients-Interventions-Comparisons-Outcomes (ie, the identification of the question type and the preferred study design to be sought for in a subsequent search).

Putting the question into the Patients-Interventions-Comparisons-Outcomes format avoids potential pitfalls in identifying the question type. For example, a practitioner asking a question regarding a diagnostic test might actually be interested in whether using the test results in better patient outcomes, such as decreased hospital stay or surgical complications. In this case, the comparison of interest would be not using the test, rather than the comparison of the test performance with that of a criterion standard. A careful consideration of the comparisons and outcomes of interest in such a case would lead the clinician to regard the diagnostic test as analogous to a therapeutic intervention, and the approach to the search for evidence would be dictated accordingly.

Use of the Patients-Interventions-Comparisons-Outcomes format also allows complex questions to be rapidly identified. For example, if we apply the Patients-Interventions-Comparisons-Outcomes scheme to question number 3, we soon recognize that the intervention in question is neither a simple therapy nor a diagnostic test. The question "How low does the probability of myocardial infarction have to be for out-patient management to be reasonably considered?" leads to a search for a probabilistic decision or cost-effectiveness analysis. We have included question 3, among other reasons, to demonstrate that not all foreground questions fall into simple categories of therapy, harm, diagnosis, and prognosis.

For most clinical questions, categorization of the question type as therapy, harm, diagnosis, or prognosis simplifies what could otherwise be a daunting task for a practitioner (ie, identifying in advance the kind of studies that should be selected from the results of a search). Earlier installments in this series introduced the concept of the hierarchy of study designs in relationship to specific question types.[2,3] The "Users' Guides to the Medical Literature," originally published in *JAMA*[8] and recently revised and published electronically and in print as a book,[9] provides clinicians with criteria for the appraisal of the quality of studies corresponding to those designs. Table 2 maps clinical question types to the study designs that usually correspond to their highest level of related evidence. A clinician might not always find a study corresponding to the highest level of evidence for a question. In such a situation, the clinician must move down the question-specific hierarchy and consider study designs that are potentially more subject to bias. For example, if no randomized trial has been performed on a therapy question, a well-designed observational study with a clearly definable control group will constitute the next best source of clinical evidence.

The systematic progression from Patients-Interventions-Comparisons-Outcomes formatting through the identification of question type and the consequent preferred study design allows the practitioner to steer through murky waters with a steady hand. As an example, we return to the pitfalls frequently encoun-

**Table 1.**
*Patients-Interventions-Comparisons-Outcomes (PICO) Plus.*[*]

| Question | Patients | Interventions | Comparisons | Outcomes | Type | Ideal Study |
|---|---|---|---|---|---|---|
| 1 | ED patients with chest pain and nondiagnostic ECGs | Glycoprotein IIb/IIIa receptor antagonist AND heparin and β-blockade | Heparin and β-blockade alone | Decreased mortality over specified time period | Therapy | Randomized trial or systematic review |
| 2 | Patients with chest pain for ≥6 h duration | Troponin I | Acceptable criterion standard for diagnosis of myocardial infarction | Sensitivity and specificity | Diagnosis | Systematic comparison of test results to criterion standard |
| 3 | Adult patients presenting to the ED with chest pain | Decision modeling of management strategies | Not applicable | Cost-effectiveness thresholds/utilities | Not applicable | Decision analysis |
| 4 | Stable patients with cocaine-related chest pain | Assessment over time | Not applicable | Dysrhythmia/myocardial infarction/mortality | Prognosis | Longitudinal cohort study |

[*]A complete map of foreground questions for the purpose of efficient location of clinical evidence includes the use of the Patients-Interventions-Comparisons-Outcomes format, the identification of the question type, and consideration of the study designs corresponding to the highest level of evidence likely to exist. This is shown by using 4 questions pertaining to patients presenting to an ED with chest pain:
1. Does the addition of a glycoprotein IIb/IIIa receptor antagonist to heparin and β-blockade decrease mortality in ED patients with chest pain and nondiagnostic ECGs?
2. Does a negative troponin I level at 6 hours after onset of chest pain rule out myocardial infarction?
3. Is "zero tolerance" for missed myocardial infarction a cost-effective policy for an urban ED?
4. Are clinically stable patients with cocaine-related chest pain at risk for near-term life-threatening events?

tered with questions concerning diagnostic tests.[10] When the question involves the usefulness of a test in making a correct diagnosis among patients being considered for the possibility of a target disease, condition, or injury, the outcome of interest of a selected study is a measure of the performance of the test, such as sensitivity, specificity, or the likelihood ratios associated with the possible test results.[11,12] In this case, the preferred study design is a cross-sectional study that systematically compares the results of the test of interest with those of an accepted criterion standard, with both tests performed on ED patients with presentations clinically suggestive of the target disorder in question.

When clinicians wonder whether using a test, as opposed to not using it, will result in improved patient outcomes, such as decreased morbidity or shorter hospital stays, their query is akin to a therapy question, and they should first seek a trial that randomly assigned patients to either having the test or to not having the test performed and that compared the outcomes of interest in the 2 groups. Although not related to emergency practice, randomized trials of the use of screening tests, such as mammography or prostate-specific antigen as means of lowering mortality attributable to breast or prostate cancer, are examples that might help the reader to recognize the concept of a diagnostic test as a therapeutic intervention.

**Table 2.**
*Specific types of clinical question correspond to a hierarchy of study designs suitable for investigating it.*[*]

| Question Type | Best Feasible Study Designs | Suitable Filtered Databases |
|---|---|---|
| Therapy | RCT or systematic review of RCTs | *ACP Journal Club*, Best Evidence Topics, *Clinical Evidence*, Cochrane Library, EMA |
| Diagnosis[†] | Systematic comparison of test results with criterion standard in symptomatic patient | *ACP Journal Club*, Best Evidence Topics, EMA |
| Harm | RCT, cohort study, population-based case-control study | *ACP Journal Club*, Cochrane Library, EMA |
| Prognosis | Cohort study, placebo arm of RCT | *ACP Journal Club*, EMA |

**RCT,** Randomized controlled trial; **EMA,** Emergency Medical Abstracts.
[*]Specific resources and databases might be appropriate to specific question types, specific study designs, or both.
[†]"Diagnosis questions" refers here to questions regarding the performance of diagnostic tests, as measured by sensitivity, specificity, or likelihood ratios.

## STEP 3: IDENTIFY THE BEST SOURCE OF CLINICAL EVIDENCE

We have moved further down the algorithm of the Figure and are ready to consider the properties and attributes of specific filtered resources and databases. To use such tools effectively, a clinician needs a good grasp of how specific databases are generated and structured to conform to different kinds of filters. Databases can be filtered by quality, by question type, by study design, or by practice specialty. There can be significant overlap between such filters. For example, a database limited to randomized trials will necessarily be largely limited in relevance to questions of therapy and prevention. However, it might also have been designed primarily for the needs of internists or gynecologists, rather than for emergency physicians. Hence, several independent considerations apply to the process of selecting the most appropriate initial database to use in the pursuit of a particular question. As a result, we have not attempted to present a simple formula for connecting specific questions to the filtered resource most likely to yield relevant evidence. We hope that the discussion and demonstration that follows will allow the reader to grasp the principles involved in making efficient choices among the available resources.

There are many filtered or limited resources. Those included in Tables 2 and 3 are representative examples of particular usefulness to emergency practitioners. Individual clinicians will be familiar with options that we have not addressed, and indeed, familiarity is a key ingredient of effective searching. We invite readers to make use of the "Feedback" component of the *Annals* Evidence-Based Emergency Medicine section to inform us of the use they have made of resources not listed here.[13]

A few general considerations might guide users' selection and appraisal of information resources. "Evidence-based" is a frequently encountered marketing label used by the promoters of information prod-

ucts. To fully merit the term, a resource needs to be explicit with respect to the criteria and methods used to search for and select the content that it includes, as well as the criteria used to critically appraise the strength of the evidence. A preappraised or quality-filtered database is one in which the included or cited studies or summaries have been systematically evaluated for the validity and importance of the findings and found to meet defined minimum methodologic standards. One might also define a further category of presynthesized resources, of which the Cochrane Database of Systematic Reviews is perhaps the prototype example. Each review systematically uses a rigorous approach to combining the results of the included trials.

Information resources that do not define in detail how the decisions are made regarding what is included or that fail to identify the criteria used to appraise the contents of the database should not be considered preappraised or evidence based. It is not necessary that a resource meet all of these criteria for it to be useful to a clinician. However, when the designers of resources make explicit their means of finding the evidence, their criteria for defining relevancy, and their criteria for assessment of methodologic strength, clinicians can better judge the products' usefulness and reliability.

We consider the 5 resources included in the discussion that follows to be well defined from the aforementioned standpoint and to be useful for illustrating the kind of knowledge that emergency practitioners need to develop mastery of efficient and clinically directed searching. Two of them, the Cochrane Library and Emergency Medical Abstracts, include more than one database. When this occurs, the user needs a clear understanding of the relationship of the component databases with each other to be able to use the resource efficiently.

Table 2 lists the study designs and databases most appropriate to specific question types. Table 3 presents a grid of the relevant properties of the 5 resources we will describe. These breakdowns illustrate why characterizing the question type and considering whether the topic overlaps internal medicine practice help the emergency practitioner to narrow down the choice of potential information sources among those we have considered. The demonstration that concludes this article should make this even clearer.

### *ACP Journal Club*

*ACP Journal Club* (http://www.acpjc.org) began in 1991 as a supplement to the *Annals of Internal Medicine* and is currently published independently on a monthly basis. It is available by subscription from the American College of Physicians and is also available to institutions as part of a package of evidence-based medicine resources marketed by Ovid. A closely related journal, *Evidence-Based Medicine*, was initiated in 1995 and is currently published by *BMJ*. Both journals are available electronically, and much of the content of the 2 journals

**Table 3.**
*Showing the characteristics of specific databases in a fashion that facilitates their use by emergency physicians.**

| Resource | Preappraised | Presynthesized | Question | Primary Specialty |
|---|---|---|---|---|
| **Cochrane Library** | | | Therapy | All |
| Cochrane Database of Systematic Reviews | ✓ | ✓ | | |
| Database of Abstracts of Reviews of Effectiveness | ✓ | ✓ | | |
| Cochrane Controlled Trials Register | | | | |
| ***ACP Journal Club* (1991-present)** | ✓ | | All | Internal medicine |
| ***Clinical Evidence*** | ✓ | | Therapy | Internal medicine |
| **Best Evidence Topics** | ✓ | | Therapy, diagnosis, prognosis | Emergency medicine |
| **Emergency Medical Abstracts (1977-present)** | | | All | Emergency medicine |

*Resources limited to evidence published more recently than 1966 are identified by the relevant dates of inclusion in parentheses under the first column.

was issued as a compendium on CD-ROM called *Best Evidence*.[14] Approximately half of the entries in *ACP Journal Club* are common to the 2 journals, with *Evidence-Based Medicine* maintaining a somewhat broader clinical focus.

*ACP Journal Club* may be considered the prototype of a preappraised source of clinical evidence. All issues of a defined set of about 125 target journals are periodically searched, and primary research reports conforming to specific types of clinical questions and meeting a predefined set of minimum quality criteria are selected for inclusion. *ACP Journal Club* largely reflects an internal medicine focus in its selection of studies for abstracting and commentary, despite the fact that its target journals reflect a broad array of medical specialties, including surgery and pediatrics. An expanded abstract drafted by the *ACP Journal Club* editors for each included article encompasses a rigorous critical appraisal of the quality of the study, a digested form of the results aimed at clinicians' needs and perspectives, and a brief commentary written by an individual familiar with the relevant area of clinical practice. The result is an abbreviated database that is quality filtered and calculated to provide clinicians who are skilled in the application of results of research to clinical practice with an accelerated access to the most important clinical evidence in a defined area of clinical practice.

*ACP Journal Club* and *Evidence-Based Medicine* have limitations as databases for application to emergency care. Their clinical focus is heavily weighted toward internal medicine practice. Furthermore, the methodologic standards for inclusion of some study types of particularly key significance to emergency physicians, such as studies of performance of diagnostic tests, might be so high as to exclude studies of clinical importance to our specialty. Studies published before 1991 will not be found in *ACP Journal Club*. Nonetheless, emergency clinicians seeking evidence on issues of therapy pertaining to questions overlapping internal medicine and emergency medicine practice will frequently find *ACP Journal Club* useful. When relevant citations are found, busy clinicians will appreciate the fact that the online summaries obviate the need to consult the full text of the original articles.

### Best Evidence Topics

Best Evidence Topics (http://www.bestbets.org/) is a Web site maintained by members of the Department of Emergency Medicine at the Manchester Royal Infirmary in the United Kingdom. It constitutes a free-access online database of shortcut reviews[15] pertaining to well-defined clinical questions, and is designed for point-of-care use by emergency physicians. The Best Evidence Topics Web site constitutes an online compendium of reviews initially published in the *Emergency Medicine Journal* and its predecessor, the *Journal of Accident and Emergency Medicine*. Currently several hundred entries are available and can be located either by way of a search or through an easy-to-use index of titles.

Best Evidence Topics summaries follow a defined and structured format that includes an identified search strategy, a hierarchical approach to the selection of articles, broadly identified critical appraisal criteria, and a proctoring protocol for quality control. The search protocol uses, principally, a MEDLINE search from 1966 forward. The Cochrane Library and Best Evidence are also considered for some topics. The summaries are indexed by means of formatted clinical questions of interest to emergency clinicians at the bedside. Appealing and distinctive features of this resource include the relatively explicit methodology used to create it and the consideration of questions commonly encountered in emergency practice for which rigorous systematic reviews are unlikely to have been performed. Best Evidence Topics includes in its catalog reviews of questions for which the search protocol revealed no strong evidence. The evidence, or absence thereof, as summarized on these questions in Best Evidence Topics, should not be taken as definitive. Only a single database (MEDLINE) is cited for most of the searches, and the estimation of the methodologic strength of the studies and the magnitude of observed results is frequently only qualitatively reported.

Most of the questions addressed in Best Evidence Topics pertain to issues of therapy and the clinical utility of diagnostic tests. An example of the latter type of question is the following: "Do follow-up x rays after an initial period of immobilization in patients with elbow injuries, no obvious fracture, and positive fat pad signs result in the identification of fractures that mandate new interventions?" Issues of prognosis are also occasionally addressed. Best Evidence Topics almost certainly constitutes the fastest route available to the onsite emergency practitioner to the evidence that the reviewers have identified on the questions they have considered.

### *Clinical Evidence*

*Clinical Evidence* (http://www.clinicalevidence.com/) is primarily useful for issues of therapy that intersect the practice of internal medicine. It is available online by subscription through BMJ publishers and is also an optional component of the Ovid institutional package of evidence-based resources. It is different from *ACP Journal Club* by virtue of presenting systematically assembled qualitative syntheses of evidence pertaining to specific clinical questions within defined topic areas. Many advisors and contributors to *Clinical Evidence* are also involved with the Cochrane Collaboration.

The syntheses in *Clinical Evidence* stop short of rigorous systematic reviews and meta-analyses. However, the methodology used by the authors of *Clinical Evidence* is structured, explicit, and involves a systematic search for randomized trials and systematic reviews in multiple databases and a methodologic appraisal of the included studies. The organization of the resource around focused clinical questions within clinical topic areas lends a further appeal of the resource to the busy clinician.

*Clinical Evidence* might be particularly useful to emergency physicians in connection with questions involving therapy or harm in areas related to internal medicine practice when multiple studies render impractical a primary critical appraisal by the practitioner at the point of care. In such a situation, a search by an emergency physician of the Cochrane Database of Systematic Reviews, if unsuccessful, might be followed by a search of *Clinical Evidence*.

### The Cochrane Library

A previous article in the *Annals of Emergency Medicine* Skills for Evidence-Based Emergency Care series described the 3 component databases of the Cochrane Library (http://www.cochranelibrary.com/cochrane/) and their usefulness to emergency physicians.[16] The Library is available by subscription, either through CD-ROM or online, to individuals and to institutions and is also a component of the evidence-based medicine resources package offered to institutions by Ovid. It is a useful source of systematic reviews and randomized trials on issues of therapy and prevention.

The Cochrane Database of Systematic Reviews currently includes more than 1,500 reviews constituting rigorous syntheses of evidence on questions of therapy and prevention. Abstracts, but not the full text, of the reviews included in the Cochrane Database of Systematic Reviews are available for free access. Among the databases we considered in this article, only the Cochrane Database of Systematic Reviews and the Database of Abstracts of Reviews of Effectiveness within the Cochrane Library encompass fully rigorous syntheses of the evidence included in the component reviews.

The databases of the Cochrane Library pertain to all medical specialities, although to varying degrees. A structured review of the Cochrane Database of Systematic Reviews in April 2000 found that up to 18% of the reviews were at least indirectly relevant to emergency practice.[17] The Cochrane Controlled Trials Register currently includes almost 350,000 citations and is the largest such registry in existence. This, together with the Cochrane Database of Systematic Reviews and the Database of Abstracts of Reviews of Effectiveness database, make the Cochrane Library a reasonable first choice for the emergency clinician seeking evidence regarding a question pertaining to therapy, prevention, or to any issue for which a randomized trial would constitute a preferred and likely study design.

### Emergency Medical Abstracts

Emergency Medical Abstracts (http://www.ccme.org/EMA/EMA_about_set.html) is a product developed and marketed by subscription for use by both emergency clinicians and academics for the purpose of keeping up to date with literature in this specialty. Emergency Medical Abstracts is available both in a CD-ROM version and online. The search engines of the 2 versions differ, and users must become familiar with the idiosyncrasies of their own preferred mode of access.

Emergency Medical Abstracts comprises a combined database of more than 180,000 citations extending back to 1977. The database is drawn from the English-language journals indexed in Current Contents (http://www.isinet.com/isi/products/cc/editions/cccm/index.html), corresponding to a target set of up to 1,120 peer-reviewed medical journals. Current Contents allows the titles of all issues of this journal set to be periodically screened. Citations of articles perceived to be relevant to emergency medicine are identified and included in the Emergency Medical Abstracts database. Forty articles per month are selected from the parent set and are included in a separate database of abstracted citations. The 2 databases are substantially exclusive of each other, with the nonabstracted database of Emergency Medical Abstracts encompassing most of the total resource. In practice, an effective search of Emergency Medical Abstracts for articles relevant to a particular topic or question might require separate searches of both the abstracted and nonabstracted databases. In most cases, it is efficient to begin with the abstracted database and to use the "indexed search" option. The latter is the equivalent within Emergency Medical Abstracts of a medical subject heading (MeSH) search on MEDLINE, the nonindexed search of Emergency Medical Abstracts corresponding to a MEDLINE text word search.[2] If nothing is found in the Emergency Medical Abstracts abstracted database, the user may, depending on the circumstances, elect a search of the nonabstracted database or consider a search of a large, comprehensive database, such as MEDLINE. The authors' original abstracts can be recovered quickly by way of an author or title search on MEDLINE. The user should be aware that there is up to a 7-month lag between an article's publication and its appearance in the Emergency Medical Abstracts database.

Although sometimes requiring several steps to complete, a search of Emergency Medical Abstracts frequently constitutes the fastest and most efficient way of locating primary studies relevant to clinical questions arising from emergency care. This is because it is both relatively small and filtered for relevance to emergency medicine. Emergency Medical Abstracts does not, however, constitute a quality-filtered database. Included articles have not passed a screening on the basis of study design or methodologic strength. Users must therefore be prepared to undertake a critical appraisal of the results of a search on their own. Systematic reviews included in the Cochrane Database of Reviews of Effectiveness are not included in Emergency Medical Abstracts.

Emergency Medical Abstracts is a particularly suitable choice when the user is searching for evidence on a question relevant to emergency medicine not involving an issue of therapy or prevention. For example, as mentioned previously, *ACP Journal Club* imposes a relatively high quality standard for inclusion of studies of diagnostic test performance and clinical decision rules. Failure to find a relevant study pertaining to such questions in *ACP Journal Club*, even if relevant to both emergency medicine and internal medicine, should prompt a search of Emergency Medical Abstracts before diving into the huge MEDLINE database or to giving up the effort.

### Homegrown Databases

An important principle of evidence-based clinical practice is "once you have found the evidence, never let it go." The work of Sackett and Straus[18] suggests that, for clinical evidence to be used consistently in a busy care setting, it must be available to clinicians with a time delay of not much more than 11 seconds. Few if any of the aforementioned resources and databases can consistently satisfy this time constraint. Practitioners are therefore encouraged to develop point-of-care electronic repositories of summaries of evidence found in the course of previous searches, formatted in whatever fashion they find to be convenient for clinical applica-

tion. One approach to formatting the summaries that make up such a repository has been previously demonstrated in the *Annals of Emergency Medicine* Skills for Evidence-Based Emergency Care series.[19] Such repositories are not themselves reviews but rather tools designed to facilitate the clinical use of information independently identified as valid and applicable. Many individuals and EDs are equipped to provide such a repository for themselves. A free-access online resource aimed at emergency practitioners and developed for this purpose, the "journal club bank," is maintained by the Evidence-Based Emergency Medicine Working Group at the New York Academy of Medicine (http://www.ebem.org).[20]

## STEP 4: SEARCH THE SELECTED RESOURCES AND DATABASES

Clinicians who have digested the content of the earlier installments in this series[2,3] will find the task of searching smaller filtered databases to be the least challenging of the 4 tasks we have identified. Simple single-term search strategies are frequently adequate to locate the relevant citations and entries, and it is rare that a clinician needs a search strategy more elaborate than 2 or 3 subject terms linked by "AND." Use of special limits conforming to specific study types, year of publication, or age groups is virtually never required to limit the hits to a manageable number. Use of validated search strategies for specific question types, crucial for efficient use of the huge MEDLINE database,[4] is similarly unnecessary when relevant filtered databases are available. In effect, the careful use of the Patients-Interventions-Comparisons-Outcomes formatting scheme, characterization of the question type, and identification of preferred study design has, through facilitating the judicious selection of an appropriate small database, made unnecessary a complicated search strategy or refined searching skills. The demonstration that follows illustrates this latter point.

Idiosyncrasies of response to specific search strategies are inevitable when independently generated databases are involved. The user of filtered databases should become familiar with the particularities of their response to specific search entries to maximize efficiency. The search programs available through different modes of access to the same resource might perform differently in response to the same search strategy. As an example, borrowed from the demonstration searches reported in the following paragraphs, the CD-ROM version of Emergency Medical Abstracts accepts "IIb/IIIa" as an indexed search entry in the abstracted database but rejects the term "glycoprotein." The online version of the same abstracted database requires the first term to be entered as "IIb AND IIIa" and also accepts the term "glycoprotein." Large databases, such as MEDLINE, incorporate features that allow experienced searchers to query the details of how MeSH terms are indexed and assigned to specific articles.[2] In the case of smaller databases, the user generally has to fiddle until a productive match is achieved.

To demonstrate how the resources we have just described perform in practice, we provide the results of their use in relationship to our 4 foreground questions regarding a patient with chest pain. For each question, the authors were aware in advance of the existence of specific relevant studies. We defined these as "target articles" for the respective questions, and we arbitrarily selected them before any of the databases discussed here were searched. We then took the target articles as a point of departure for demonstrating the performance of the different resources. In doing so, the only measures of performance that we consistently evaluated were the presence or absence of the target articles in the database and the number of total citations included in the searches that found them. We made no systematic attempt to evaluate the relevance of additional citations. When we did not find a target article in an initial search of a database, we did multiple searches, including author searches, to verify its absence. All of the target articles are either in MEDLINE or in the Cochrane Database of Systematic Reviews.

Because the choice of questions and of target articles was arbitrary and the evaluation was limited, the summary presented here and in Table 4 should be viewed as a qualitative illustration of the principles discussed in this article and not as an objective assessment of the relative merits of the resources in question. Notably, the

clinical topic area we have chosen, patients presenting acutely with chest pain consistent with myocardial ischemia, constitutes a common concern of both internists and emergency physicians. The pattern of hits observed in the different databases we have searched reflects this commonality and would likely be different for clinical queries of emergency practitioners that are not as relevant to internal medicine practice.

### Question 1: Does the addition of a glycoprotein IIb/IIIa receptor antagonist to heparin and β-blockade decrease mortality in ED patients with chest pain and nondiagnostic ECGs?

This is a therapy issue involving a relatively new product under active clinical research investigation. Multiple randomized trials and systematic reviews are relevant.[21-24] All of the resources yielded relevant hits. When the clinician is aware that a question on therapy has been the subject of multiple studies, the most efficient choice is frequently a source of an updated definitive review or synthesis of evidence, such as the Cochrane Database of Systematic Reviews, *ACP Journal Club*, or *Clinical Evidence*. The latter is particularly relevant when the question involves a therapy relevant to internal medicine practice. The Cochrane Library and *ACP Journal Club* each include all 4 of the target articles, together with numerous other relevant trials and reviews. The Cochrane Database of Systematic Reviews contains a systematic review relevant to the question.[22] Notably, the Cochrane Controlled Trials Registry, although containing the 2 individual trials, yielded more than 600 citations by using the simple search strategy. A clinician might be less inclined to use this database when many individual trials have been done on a question. *Clinical Evidence* based its summary on a somewhat less up-to-date systematic review[25] than those located in the *ACP Journal Club*.[21,22] The system-

**Table 4.**
*Results of searches performed on 4 questions pertaining to a patient presenting to an ED with chest pain consistent with myocardial ischemia.*[*]

| | Question 1 | | Question 2 | | Question 3 | | Question 4 | |
|---|---|---|---|---|---|---|---|---|
| **Database** | **Search Terms**[†] | **Target Articles/Hits** | **Search Terms**[†] | **Target Articles/Hits** | **Search Terms**[†] | **Target Articles/Hits** | **Search Terms**[†] | **Target Articles/Hits** |
| Cochrane Library | Glycoprotein | 4/[‡] | NA | NA | NA | NA | NA | NA |
| *Clinical Evidence* | Unstable angina | 2/1[§] | NA | NA | NA | NA | NA | NA |
| *ACP Journal Club* | Glycoprotein, eptifibatide | 4/48 | Troponin | 0/17 | NA | NA | Cocaine | 0/6 |
| Best Evidence Topics[‖] | Myocardial infarction | 2/22 | Myocardial infarction | 0/22 | Myocardial infarction | 0/22 | Myocardial infarction | 2/22 |
| Emergency Medical Abstracts[¶] | IIb/IIIa, glycoprotein | 3/27 | Troponin | 1/54 | Infarct, myocardial, rule | 1/77 | Cocaine, cardiac, chest | 4/185 |

**NA,** Not applicable to question or to target article or articles.
[*]When appropriate, the resources were searched for any of several specified target articles. The table presents 5 resources in the order of increasing applicability to the 4 demonstration questions. The number of target articles found and the total number of hits are recorded. Searches were updated September–November 2002.
1. Does the addition of a glycoprotein IIb/IIIa receptor antagonist to heparin and β-blockade decrease mortality in ED patients with chest pain and nondiagnostic ECGs?
2. Does a negative troponin I level at 6 hours after onset of chest pain rule out myocardial infarction?
3. Is "zero tolerance" for missed myocardial infarction a cost-effective policy for an urban ED?
4. Are clinically stable patients with cocaine-related chest pain at risk for near-term life-threatening events?
Target articles: question 1, references 21 to 24; question 2, reference 26; question 3, reference 30; question 4, references 31 to 34.
[†]No attempt has been made to notate the combinations of terms used in the individual searches.
[‡]The Cochrane Database of Systematic Reviews, the Database of Abstracts of Reviews of Effectiveness, and the Cochrane Controlled Trials Registry yielded 12, 7, and 624 hits, respectively.
[§]A single topic entry, "unstable angina," found one entry that referenced 2 target articles.
[‖]A single search of Best Evidence Topics using the term "myocardial infarction" yielded 22 hits that included all of the shortcut summaries that included any of the 10 target articles for the 4 questions.
[¶]The nonabstracted database was only searched if the abstracted database failed to identify the target articles.

atic review cited by *Clinical Evidence* does, however, include the 2 individual trials of the target set of articles.[23,24] Emergency Medical Abstracts identified all of the target articles except for the Cochrane review[22] and also relevant articles not included in the target set. Best Evidence Topics identified the 2 randomized trials but not the 2 systematic reviews included in the target set.

#### Question 2: Does a negative troponin I at 6 hours after onset of chest pain rule out myocardial infarction?

Because this is a question pertaining to the performance of a diagnostic test, the Cochrane Library and *Clinical Evidence* are inapplicable. Only Emergency Medical Abstracts directly identified the target article.[26] Two additional relevant studies were also identified in the abstracted database of Emergency Medical Abstracts.[27,28] The *ACP Journal Club*, although not containing the target article, does include a citation and summary of a relevant systematic review, also included in the nonabstracted database of Emergency Medical Abstracts.[29] Best Evidence Topics listed a shortcut review in progress but no specific citations.

#### Question 3: Is "zero tolerance" for missed myocardial infarction a cost-effective policy for an urban ED?

The third question seeks a study that would identify a decision or action threshold, in this case a likelihood of myocardial infarction below which a patient presenting to an ED with chest pain could reasonably be considered for discharge. This is a question type for which a study design, such as a randomized trial or simple cohort study, is unlikely to be feasible. As a result, resources restricted to issues of therapy are inappropriate. In addition, the target article was published before 1991,[30] rendering the *ACP Journal Club* inapplicable. Under these circumstances, many users would turn to MEDLINE and might need to do an extensive search to find the one target article. A specialty-filtered database constitutes an alternative. The citation was found in the nonabstracted database of Emergency Medical Abstracts by using a simple search strategy. The same strategy used in Ovid MEDLINE from 1966 to the present yielded only 39 citations but did not locate the target article.

#### Question 4: Are clinically stable patients with cocaine-related chest pain at risk for near term life-threatening events?

The fourth question involves a prognosis issue pertaining to patients with cocaine-related chest pain. The 4 target articles comprise research done by Hollander et al[31-33] and Weber et al.[34] Once again, only the specialty-filtered resources, Best Evidence Topics and Emergency Medical Abstracts, yielded citations of these studies, and only the latter included all 4. We required a total of 3 searches of Emergency Medical Abstracts, 2 using the nonabstracted database.

Table 4 illustrates the simplicity of search strategies required to efficiently identify citations in small databases. Most of the searches involved 1 or 2 terms; occasionally, an alternative search term was required. The entire database was searched in all cases, with no need for limits, such as year of publication. In almost all cases, only a small number of citations needed to be screened to find the target articles.

A comparison of Emergency Medical Abstracts with MEDLINE illustrates the ease and efficiency of using a limited database. All but 1 of the 10 target articles for the 4 questions, together with a number of other relevant articles, were located in Emergency Medical Abstracts by means of a total of 7 searches using 1 to 3 terms each. These 7 searches yielded a mean of 49, a median of 53, and a range of 14 to 102 citations per search. The same subject heading searches run on Ovid MEDLINE from 1966 to the present yielded a mean of 17,252, a median of 1,854, and a range of 39 to 93,867 citations per search. No clinician would find a search yielding thousands of citations to be useful. Therefore, to use MEDLINE as the source of clinical evidence on our demonstration questions, a clinician would have to use more complex search strategies to limit the number of citations and might ultimately exclude our target articles in the process.

Best Evidence Topics only included 4 of the 10 target articles. However, all those that were included were rapidly identified by means of a simple generic search

term, "myocardial infarction." The results obtained by using Emergency Medical Abstracts and Best Evidence Topics illustrate the potential power of small, specialty-filtered databases for facilitating emergency practitioners' streamlined access to primary clinical evidence on focused clinical questions.

In summary, small filtered databases are capable of facilitating rapid point-of-care access to clinical evidence and might make a crucial difference in rendering evidence-based emergency care achievable. Emergency practitioners must combine a thorough knowledge of several such databases with the ability to rapidly analyze clinical questions and to match them to the database most likely to contain the best evidence to maximize this potential.

In this article, we have presented a systematic approach to analyzing clinical questions and have described several resources and databases of different types potentially relevant to emergency care. Of those we have considered, some are limited to specific study designs, some to specific types of clinical question, and some to specific areas of clinical practice. In some but not all cases, the contents reflect minimum quality standards for the included study designs. In addition to question type, preferred study design, and practice area, the emergency clinician needs to consider the year of publication and to estimate of the amount of clinical research that is likely to have been done on a question to decide which database is likely to be most useful.

We advise the reader to select a relatively small group of options and to become intimately familiar over time with how they perform in relationship to specific types of questions. As is true of the development of clinical skills, the development of information skills involves an initial grasp of principles and requires a fair amount of practice to become proficient.

Received for publication October 7, 2002. Revision received January 20, 2003. Accepted for publication January 31, 2003.

The authors report this study did not receive any outside funding or support.

**Address for reprints:** Peter C. Wyer, MD, 446 Pelhamdale Avenue, Pelham, NY 10803; E-mail pwyer@att.net.

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