In any clinical setting, there are numerous information resources (e.g., journal literature, practice-based data, patient information, text books) to answer a variety of questions about how to improve patient care or clinical procedures and protocols. For example, a patient in the medical intensive care unit (ICU) is being treated for refractory atrial fibrillation without much success. After exhausting a range of treatment options, a collaborating clinician remembers hearing that clonidine, a well-known antihypertensive medication, has been used successfully elsewhere and wonders whether it would work on this patient. With the delays in treatment success, the patient has become more and more concerned as treatment after treatment fails. The patient requests some help in understanding how she can reduce her anxiety. While other members of the healthcare team seek out what the evidence says about the use of clonidine, you formulate the following PICOT question about how to address the patient’s anxiety: In adult ICU patients undergoing difficult treatment plans, how does music therapy compared to planned quiet affect anxiety during their hospitalization? Using the PICOT question as a guide, you conduct an efficient, thorough search for evidence to address the clinical question (Fineout-Overholt, Hofstetter, Shell, et al., 2005). Upon finding several recent randomized controlled trials (RCTs) that corroborate positive benefits of music therapy, you share this with the healthcare team and initiate music therapy for your patient.

Finding the right information to answer a given question often depends on the source of the information (Table 3.1). When clinicians explore only one source of information, they
### Table 3.1 Sources of External Evidence

<table>
<thead>
<tr>
<th>Resources</th>
<th>Free or Subscription Required*</th>
<th>Document Types</th>
<th>Search Method</th>
<th>Mobile Device Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACP Journal Club</td>
<td>Subscription</td>
<td>• Synopses of single studies and reviews</td>
<td>• KW</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Individual</td>
<td>• Expert clinical commentary</td>
<td>• KP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• FT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMJ Clinical Evidence</td>
<td>Subscription</td>
<td>• Summaries of evidence with recommendations</td>
<td>• KW</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Individual</td>
<td>• Clinical commentary</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• FT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CINAHL</td>
<td>Subscription</td>
<td>• Journal article citation and abstract of primary studies, reviews, and synopses</td>
<td>• KW</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Individual</td>
<td>• FT (with FT subscription)</td>
<td>• CV</td>
<td></td>
</tr>
<tr>
<td>Cochrane Databases</td>
<td>Subscription</td>
<td>• CDSR—FT systematic review</td>
<td>• KW</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Individual</td>
<td>• DARE—citation and abstract summary of systematic review not completed by Cochrane</td>
<td>• CV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Free website access with restricted content</td>
<td>• CENTRAL—citation and abstract of clinical trials</td>
<td>(i.e., MeSH if you know the heading)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pay-per-view options</td>
<td>Note: Three of the five Cochrane databases are described here</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamed</td>
<td>Subscription</td>
<td>• Summaries of evidence</td>
<td>• KW</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Individual</td>
<td>• FT</td>
<td>• Topic</td>
<td></td>
</tr>
<tr>
<td>Essential Evidence Plus</td>
<td>Subscription</td>
<td>• POEMs (Patient Oriented Evidence that Matters) synopses of evidence</td>
<td>• KW</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Individual</td>
<td>• Clinical practice guidelines and guideline summaries</td>
<td>• Topic</td>
<td></td>
</tr>
<tr>
<td>Evidence-Based Nursing</td>
<td>Subscription</td>
<td>• Synopses of single studies and reviews</td>
<td>• KW</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>(individuals or institutions)</td>
<td>• Expert clinical commentary</td>
<td>• KP</td>
<td></td>
</tr>
<tr>
<td>MEDLINE</td>
<td>Free via PubMed</td>
<td>• Journal article citation and abstract of primary studies, reviews, and synopses</td>
<td>• KW</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Available as subscription from other vendors</td>
<td>• FT (with FT subscription)</td>
<td>• CV</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Clinical practice guidelines</td>
<td>• Clinical queries</td>
<td></td>
</tr>
<tr>
<td>NGC</td>
<td>Free</td>
<td>• Syntheses of selected guidelines</td>
<td>• KW</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• FT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*(table continues on page 42)*
may conclude that there is no evidence to answer their question. For example, if clinicians are searching for RCTs to answer the sample clinical question and only search a web-based search engine (e.g., Yahoo or Google), they may not find any recent trials. Instead, they find a case study that is presented in a journal. The temptation may be to ignore the case study and conclude that there is no evidence to answer the question; however, to discard a case study would be inadvisable. While it may not be able to answer the clinical question fully and confidently indicate a practice change, a case study can inform clinical care. When searching for answers to clinical questions, all evidence should be considered; however, caution must be used when deciding about practice changes that are based solely on evidence that may contain substantial bias (e.g., case studies). Table 3.2 contains categories of clinical questions and the corresponding type of evidence that would best answer the question.

Since time is of the essence in finding answers to clinical questions, searching for evidence that has already been appraised for the quality of the study methodology and the reliability of its findings is desirable. This is called preappraised literature and can range from \textit{meta-analytic systematic reviews} to synopses of single studies. Since these golden nuggets have already been critically appraised for clinicians, the work they need to do to determine whether or not they have reliable information can be minimized. Therefore, the time from finding the evidence to application can be reduced with this type of resource. Systematic reviews are the type of preappraised synthesis of studies that is the heart of evidence-based practice (EBP; Stevens, 2001). However, there is often not enough quality research to address all clinical issues with a synthesis; there may be only a few primary studies that exist—the question is where to find them. Clinicians looking for answers to their questions can access many sources of evidence reviews, synopses, summaries, and primary studies to efficiently and effectively locate the nuggets; however, it is often like finding the proverbial needle in a haystack.

**Tools for Finding the Needle in the Haystack**

Given the consistent need for current information in healthcare, frequently updated bibliographic and/or full-text databases that hold the latest studies reported in journals are the best, most current choices for finding relevant evidence to answer compelling clinical questions (see Clinical Scenario 3.1).
The use of a standardized format, such as PICOT (see Chapter 2), to guide and clarify the important elements of the questions is an essential first step toward finding the right information to answer them. Generally, PICOT questions are expressed in everyday clinical terminology. Often, in searching for the best evidence to answer a PICOT question, clinicians encounter databases that have their own database-specific language that can help the searcher navigate a myriad of available studies and articles. This language is designed to eliminate or minimize errors that occur because of linguistic usage or spelling. Learning how to navigate through different databases is imperative for successfully retrieving relevant evidence. Novices to this type of searching are wise to consult a medical librarian who can assist them in this process.
After formulating a well-built PICOT question, the next step is to determine the source from which the best evidence is most likely available. Clinicians need peer-reviewed research to answer their questions, and most often the source of that evidence will be a database of published studies. These databases contain references to the healthcare literature, including books or journal publications, that are usually discipline specific (i.e., allied health, nursing, medicine, psychology). Choosing the right databases and being familiar with their language are essential to a successful, expedient search for answers to a clinical question.

In addition, there are resources that are available to assist busy clinicians with the best available evidence. While these resources save time, clinicians need to know how the appraisal process was conducted to ensure that the preappraised evidence is trustworthy. For example, one resource may be critically appraised topics (CATs; http://www.ebmny.org/cats.html). While some CATs are well done and reliable, others may not be. Knowledge of the PICOT question, the best type of evidence to answer it, and critical appraisal are essential for clinicians to know which of these resources (i.e., the haystack) is the best to search for the desired information.

**Tool 1: Sources of External Evidence—Description of the Haystack**

Answers to clinical questions may be found in a variety of resources, ranging from practice data found in the healthcare record (i.e., internal evidence) to research articles in journals (i.e., external evidence), all of which have been moving increasingly from print to digital formats. The transition of evidence to electronic format has been fundamental to the emergence of new external evidence resources for supporting clinical decision making at the point of care. These resources contain timely clinical topic summaries and are designed to provide both background information and the best available external evidence to improve patient care.

**Types of Evidence Resources**

**Textbooks and Journals.** Healthcare professionals can consult a good textbook to refresh their knowledge of a specific condition or physiologic mechanism (i.e., background information; see Chapter 2), particularly if it is unusual (e.g., noncompaction cardiomyopathy or the clotting cascade), whether the text is in print or electronic format. To answer a specific question over and above general knowledge, however, textbooks are insufficient, as the discussion may be either incomplete or out of date. A journal article is the typical source from which to find an answer to this kind of question (i.e., foreground question; see Chapter 2), if there is one to be found. The journal literature is generally where all new ideas first enter the healthcare knowledge base. Journals contain a number of publication types, including systematic reviews, article synopses, research articles, narrative reviews, discussion articles, news items, editorials, and letters to the editor (listed from most useful to least in answering foreground questions).

**Consolidated Resources and Beyond.** Over the past decade, we have seen that the number and range of information databases that contain clinical evidence of varying levels have grown and flourished. Far beyond bibliographic databases that contain citations and abstracts to individual research articles (e.g., MEDLINE®, CINAHL®), there has evolved this new genre of information resource that holds within it “nuggets” of evidence to help the clinician make patient care decisions without searching the primary research literature every time.

Haynes (2007) characterized and organized the growing universe of evidence-based resources using a pyramid framework. A simplified version of this pyramid is presented in Figure 3.1. In the pyramid’s base are contained original research articles. Bibliographic databases in which the original research articles are indexed (e.g., MEDLINE, CINAHL, or PsycINFO®) form the foundation of the healthcare literature. These databases contain the largest number and widest variation of articles describing clinical research. This is the original source of current research and holds the most reliable information; however, finding the evidence within these
Finding Relevant Evidence to Answer Clinical Questions

The next level of the pyramid entitled *Reviews of Evidence* contains preappraised literature, which, when done well, can be considered a “gold mine” of evidence. New consolidated resources (e.g., Clinical Evidence, Dynamed, Essential Evidence Plus, First Consult) have been designed to answer both background and foreground questions. They include comprehensive disease summaries, some as extensive as the equivalent of 40 print pages, that are formatted with sections and subcategories that are easily selected or expanded. These summaries include many hyperlinks to electronic journal articles or practice guidelines. They combine a textbook-like resource with easy access to the evidence contained in the journal literature—a format easily usable by busy clinicians. These resources can contain many types of evidence, ranging from *systematic reviews*, *clinical practice guidelines*, *health topic summaries* to *article synopses*. Reviews within these resources are written by individuals or panels of experts who have evaluated the available evidence, determined its worth to practice, and made recommendations about how to apply it to a particular clinical issue. While these sources of evidence are preappraised, it is important that the clinician understand the appraisal process used by each source of evidence to determine if the information contained within them is reliable for clinical decision making.

The pyramid’s top layer, entitled *Decision Support in Medical Record*, describes the ideal situation, a *clinical decision support system* integrated into the *electronic health record* (EHR). Here, data on a specific patient are automatically linked to the current best evidence available in the system that matches that patient’s specific circumstances. Upon matching the evidence with patient data, the clinical support system assists clinicians with evidence-based interventions for that patient. There are currently few of these decision support systems in use, and those that do exist are not always completely evidence based or current (Haynes, 2007). Effective use of these resources requires that practitioners value the use of evidence in daily practice and have the knowledge and skills to utilize the given information.

The shape of the pyramid is significant in terms of the number of resources available. Although there are millions of original research articles on the bottom layer, the number of
highly functioning computerized decision support systems is very few. The number of conditions covered by evidence reviews is somewhere in between. One reason for this disparity in resources is the time and money it takes to develop highly sophisticated EHR systems with integrated current evidence, systematic reviews, practice guidelines, summaries, and synopses—all requiring updating on a regular basis.

Table 3.1 includes the names of specific information resources that fall into the bottom two sections of the pyramid. Only three of the resources (i.e., National Guideline Clearinghouse [NGC], MEDLINE, and Cochrane Databases) are available to all healthcare providers no matter where they practice because they are government-sponsored databases. All of the others are available to individuals and/or institutions on a subscription basis. It is important to note that MEDLINE is produced by the National Library of Medicine (NLM) and is available free of charge through PubMed® (http://www.ncbi.nlm.nih.gov/pubmed) but can also be obtained for a cost via commercial vendors (e.g., Ovid®, EBSCO). Commercial vendors offer their own search interfaces, full-text articles/journals, and a variety of other databases, which can provide unique features that attract particular clients. Each healthcare institution may have a different array of database offerings, depending on the institution size, professions it serves, and library budget.

**Tool 2: Gathering the Right Evidence From the Right Source**

Healthcare professionals, faculty, librarians, and students are all very busy in their roles and desire a reliable, efficient source of evidence. The key is to know how to match the sources of evidence with the question to be answered.

**Which Resource or Database Is a Good Match?**

Evidence that is reliable, accurate, and consistent is needed to reduce the risk, uncertainty, and time involved in clinical decision making that is focused on promoting desired patient outcomes. With all of the resources potentially available to clinicians, the first step in finding the answer to their clinical questions is to search for evidence in synthesized, preappraised resources (e.g., Cochrane Database of Systematic Reviews [CDSR], Database of Reviews of Effectiveness [DARE], American College of Physicians [ACP] Journal Club, and the journal, Evidence-Based Nursing [EBN]) see Table 3.1 for more information on these resources). Finding the evidence in full text (i.e., electronic copies of articles available online) can promote timely decision making. While there are open source full-text articles available (i.e., no fee), a subscription is required to access most full-text journals (see Table 3.1). For example, in the CDSR, only an abstract of the systematic reviews can be obtained without a subscription. To obtain the full systematic review, either an individual or an institutional subscription is required.

For point-of-care decisions, clinicians may choose to consult one of the preappraised summaries or synopsized resources listed earlier. However, when making practice changes, it is important to either find a synthesis that has conducted an exhaustive search (i.e., found all that we know on the topic) or get as close to that as possible by searching multiple databases to ensure that studies are not missed. Searching authoritative, subject-specific, bibliographic databases that index scientific communities’ scholarly, peer-reviewed research provides the next resource for the best available evidence to clinicians. For example, searching MEDLINE, with its range of core journals cutting across disciplines and numbering in the thousands, enables clinicians to obtain a large chunk of the evidence that exists on a topic. However, solely searching MEDLINE would be a limitation, in that other databases index other journals not covered in MEDLINE and studies in those journals would not be known to clinicians; therefore, key knowledge that may impact outcomes could be missed. Other healthcare databases to consider include the Cumulative Index of Nursing & Allied Health Literature (CINAHL) and PsycINFO, the database of psychological literature. Healthcare covers a wide range of topics. If a question
focuses on issues that are not indexed within the mainstream healthcare databases, a healthcare librarian can recommend other databases that can provide evidence to answer a PICOT question (e.g., Educational Resources Information Center [ERIC], Business Abstracts [ABI], Computing Reviews, Social Sciences Citation Index [SSCI]).

When searches in indexed bibliographic databases do not lead to sufficient quality evidence and clinicians wish to explore what other evidence (e.g., grey literature) is available, they may choose to turn to web-based free resources, such as Google. Searching any web-based, non-indexed search engines, such as Google and Google Scholar, can provide value; however, caution should be used and careful evaluation of the evidence retrieved from these sources is required. MacColl (2006) indicates that Google’s best contribution to healthcare evidence base may be its identification of grey literature (i.e., reports, conference proceedings, and other research studies that may not have been published or indexed). Additionally, MacColl indicated that Google has a unique citation mechanism called “known item searching” in which searchers who have only bits and pieces (e.g., author’s name, a few words from an article title) can retrieve a full citation. Clinicians should keep in mind that Google is known for citing older resources, and older resources may not be relevant for answering clinical questions that may lead to practice change. Web-based search engines, such as Google and Google Scholar, are insufficient as sole sources of evidence. Shultz (2007) indicated that searching Google can involve time wasters in searching, and the evidence-based practitioner risks missing reliable evidence when searching them solely, as these resources are not indexed and have no limits that can be set to refine the search. With these resources, having the correct keywords is essential, as without them, evidence can be elusive.

For more about evaluating information on the Internet, visit:
http://www.lib.berkeley.edu/TeachingLib/Guides/Internet/EvalForm_General_Barker.pdf
http://www.lib.unc.edu/instruct/evaluate/web/checklist.html

Final Key Resource for Finding Evidence: Collaboration With Healthcare Librarians
An essential step in achieving success is knowing the extent of one’s resources. Collaboration with healthcare librarians who are savvy about EBP is essential to get efficient answers to clinical questions. While all clinicians may not be expert searchers, each one should have the skills to be able to search and find their own answers as they have time and resources to do so. However, there are occasions when time is short and system infrastructures must be in place to facilitate finding evidence to answer the clinical question. To bring in the librarian at this late date, however, will not serve the process or outcome well. Healthcare librarians are involved in the culture shift toward EBP. They are the knowledge brokers and knowledge miners of healthcare. Without their involvement in establishing an EBP culture, important pieces will be missed. Librarians can be helpful at any point in the search; however, librarians shine when clinicians have attempted to search multiple databases and other resources but do not find the evidence they seek. Often librarians work their remarkable magic and can find evidence to answer a clinical question. As you plan your approach to establishing EBP, consider some advice and “take your librarian to lunch.”

Get to know what is available in your organization to help you hone your searching skills. Get to know your healthcare librarian and share what your interests are in improving healthcare outcomes. Key concepts to the clinician–librarian collaboration are dialogue, role delineation, and purpose. Talk about how PICOT questions are the drivers of searches.
Discuss how keywords are a wonderful start to searching, but not sufficient to close the search. Explore the most effective way for clinicians to get the data now.

Currently, some healthcare professionals are finding evidence at the bedside. However, in 2030, it is hopeful that all healthcare professionals will be evidence-based clinicians, conducting rapid, efficient searches at the bedside, often in sources of evidence that will not be primary electronic databases. For this to occur, collaboration between librarians and clinicians will be instrumental in exploring how to access information rapidly and efficiently. As information experts, librarians are partners with clinicians in achieving the mission of transforming healthcare from the inside out. The desired effect of the clinician–librarian collaboration is synergy that leads to consistent best practices by clinicians to achieve optimal outcomes for healthcare consumers.

**Tool 3: Understanding Database Structure and Searching the Databases**

When searching databases for evidence, clinicians need to be aware of features common to most databases. Understanding the structure and content of a particular information resource before attempting to search it is critical. Without this background, the search terms and strategies used may not yield the desired information, or the chosen database may not contain the information sought.

**Types of Databases**

Prior to the mid-1990s, knowledge-based databases were of two types: bibliographic and full-text databases. Now, however, point-of-care resources combine these two elements in a single resource that houses evidence summaries on clinical topics along with references to supporting primary articles. Examples of both types of databases as well as hybrid databases that contain both bibliographic and full-text information will be discussed. Bibliographic databases contain article citations that point to the location of the article in the journal literature. They include information about the publication that makes it easy to find, such as author, article title, journal name and volume, publisher, and/or an abstract. Citations rarely include the full text of the published item. Box 3.1 is an example of a bibliographic record from MEDLINE, a bibliographic database, obtained through PubMed.

A bibliographic record (i.e., citation) can include many details about the item, including the terms that were used to describe the content, but it does not contain the full text of the article as part of the record. Other examples of bibliographic healthcare databases are CINAHL, which indexes citations dealing with healthcare issues across multiple healthcare disciplines, and PsycINFO, which indexes articles dealing with psychological topics.

Full-text information resources contain whole articles or books, including the text, charts, graphs, and other illustrations. These electronic versions may be enhanced by supplemental data (i.e., in spreadsheets), by multimedia content, and/or by hypertext links to other articles and supporting references. Full-text resources most often take the form of online journals or books (e.g., *Evidence-Based Nursing* journal or Harrison’s Online) but can also include the full text of practice guidelines (NGC) or systematic reviews (Cochrane Library). The hybrid database is designed for the point-of-care provider, with patient care recommendations supported by links to general patient care information, evidence-based articles, reviews, synopses, and guidelines. Some examples of hybrid databases are First Consult and Clinical Evidence.

**Content of Databases**

A clinician must be familiar with what databases and other information resources are available and what they contain before determining the value of searching it for answers to particular clinical questions. Databases can contain references to articles, the full text of the articles, entire
Example of a Bibliographic Record from the MEDLINE Database

Testing an Intervention to Promote Children’s Adherence to Asthma Self-Management
Burkhart PV, Ravens MK, Oakley MG, Abshire DA, and Zhang M
College of Nursing, University of Kentucky, Lexington, KY 40536–0232, USA
pvburk2@uky.edu

Purpose: To test the hypothesis that compared with the control group, 7- through 11-year-old children with persistent asthma who received asthma education plus a contingency management behavioral protocol would show higher adherence to peak expiratory flow (PEF) monitoring for asthma self-management and would report fewer asthma episodes. Design and methods: A randomized, controlled trial was conducted with 77 children with persistent asthma in a southeastern U.S. state. Both the intervention and the control groups received instruction on PEF monitoring. Only the intervention group received asthma education plus contingency management, based on cognitive social learning theory, including self-monitoring, a contingency contract, tailoring, cueing, and reinforcement. At-home adherence to daily PEF monitoring during the 16-week study was assessed with the AccuTrax Personal Diary Spirometer, a computerized handheld meter. Adherence was measured as a percentage of prescribed daily PED uses at Weeks 4 (baseline), 8 (postintervention), and 16 (maintenance). Results: At the end of the baseline period, the groups did not differ in adherence to daily PEF monitoring nor at Week 8. At Week 16, the intervention group’s adherence for daily electronically monitored PEF was higher than that of the control group. Children in either group who were ≥80% adherent to at least once-daily PEF monitoring during the last week of the maintenance period (Weeks 8–16) were less likely to have an asthma episode during this period compared with those who were less adherent. Conclusions: The intervention to teach children to adhere to the recommended regimen for managing their asthma at home was effective.

Publication Types:
- Randomized Controlled Trial
- Research Support, N.I.H., Extramural

MeSH Terms:
- Asthma/epidemiology
- Asthma/prevention and control
- Asthma/psychology
- Chi-square distribution
- Child
- Computers, handheld
- Female
- Health promotion
- Humans
- Male
- Nursing assessment
- Nursing education research

(box 3.1 continues on page 11)
books, dissertations, drug and pharmaceutical information, and other resources (e.g., news items, clinical calculators). To determine which databases to search, clinicians must consider the clinical question and which databases will contain relevant evidence. Evidence can come from multiple databases that primarily serve certain disciplines (e.g., nursing and allied health, medicine, biomedicine, psychology, social sciences). Searching only one database will limit clinicians in retrieving the best evidence to answer their questions.

**Searching Databases**

To effectively find an answer to questions, clinicians need to understand a few details about the databases they are searching, such as (a) is the evidence current? (b) will controlled vocabulary or keywords be more effective in getting to the best evidence quickly?

Often clinicians wonder how many years back they should search. Some have indicated that searching back 5 years is sufficient; however, this may not be adequate to discover evidence that can address the clinical issue. While there is no rule for how far back to search for evidence, clinicians may need to search until they can confidently indicate that there is little or no evidence to answer their clinical question or that they feel confident that what evidence they have found represents the body of evidence that exists. For example, Dr. Priscilla Worral of SUNY Upstate Healthcare System, in a situation in which clinicians in the ED were using salt pork to prevent rebleeding from epistaxis, indicated that she had to search for articles back to the late 1800s to find relevant evidence to her clinical question (P.S. Worral, personal communication, 2001). To accomplish the goal of finding “all that we know” about a topic, databases must have a span of years of evidence available for clinicians to search for the databases to contain the best answers to questions. Knowing that evidence is current is another consideration. Clinicians must be aware of the years covered in a bibliographic database. The Cochrane Library’s systematic reviews, for instance, always state the most recent update date. Other resources also require investigating how current they are. For example, some online textbooks and point-of-care resources are updated.
Finding Relevant Evidence to Answer Clinical Questions

daily and some only every year. If there is no known date for evidence (e.g., Internet sources of evidence), it may be outdated and not readily applicable.

**Keyword and Controlled Vocabulary Searching**

Keyword searching is searching using simple, everyday language. The inherent challenge is that all synonyms (e.g., research, evidence, studies, study, investigation) must be included in the search or items will be missed. Some search engines, databases, and other sources of evidence are searched completely by keywords (e.g., Google). If web based, these search engines retrieve information by looking strictly for the occurrence of the term(s) somewhere in the items to be searched. In databases, the keyword search yields evidence if there is a match between the word entered and what is found in the title and/or abstract. If a different term is entered, evidence may be missed. For example, in keyword searching, you get (and only get) articles that match the terms that you put into the search. This may sound like a good thing, but it is very difficult to know every synonym of a word and every spelling variation. For example, the keyword entered is behavior, which would yield any title or abstract (i.e., a record) that contained the word behavior in it. All records with the alternative spelling behaviour in the title or abstract would be missed. In addition, different spellings of singulars and plurals (e.g., mouse and mice) must be included or evidence will be missed.

Using keywords can be ambiguous and jargon-laden. Consider the following question: Are people diagnosed with AIDS more likely to acquire pneumonia in the community than the elderly? An example of a keyword search for this question might start with the word AIDS. This search would include articles on other types of aids, such as visual aids, aid to dependent children, and hearing aids. In addition, this search would retrieve only articles containing the word AIDS. Those articles that used acquired immune deficiency syndrome or acquired immunodeficiency syndrome would be potentially missed. A well-known example of a controlled vocabulary is Medical Subject Headings (MeSH), which are the set of terms used by the NLM to describe the content of articles indexed in MEDLINE. If the MeSH term acquired immunodeficiency syndrome was searched, all of these articles would contain information about acquired immunodeficiency syndrome. Searching with keywords can be helpful, especially when no controlled vocabulary term exists to adequately describe the topic searched. When a topic is so recent that there is likely to be very little available in the journal literature, using keywords may be the best way to find relevant evidence because controlled vocabulary for the topic is unlikely. For this reason, the importance of carefully formulating the PICOT question cannot be overemphasized. Using unambiguous, nonjargon terms to describe the PICOT components of the clinical question will assist in obtaining the best search in the shortest time.

Scholarly databases, which use keyword searching, also have enhanced search retrieval by assigning subject terms from a controlled vocabulary to each item. Controlled vocabulary can also be referred to as subject headings, thesaurus, or taxonomies in healthcare databases. The content of an article will determine which controlled vocabulary (i.e., category or subject heading) it falls under (e.g., fibromyalgia or fatigue). These controlled vocabulary terms are used to help the searcher find information on a particular topic, no matter what words the author may use to refer to a concept in the text. For example, cancer can be described using keywords such as tumor, neoplasm, mass, or with words with prefixes such as onco- or carcino- or suffixes such as -oma. If a database incorporates controlled vocabulary with keyword searching, regardless of what words the author used in the article, when searchers type their words into the search box of the database, the database does what is called “mapping” and finds the controlled vocabulary terms that best match the keyword. Using controlled vocabulary, searchers can broaden their searches without having to consider every synonym for the chosen keyword. For example, articles about cardiac carcinomas or heart tumors will be retrieved using the controlled vocabulary subject heading heart neoplasms.
Many controlled vocabulary systems also have a hierarchical structure that helps the searcher retrieve the more specific terms that fall under a general term. In searching a general MeSH term such as heart diseases, the PubMed search engine automatically maps keywords to controlled vocabulary and retrieves every specific term that is listed under it in the hierarchical structure (called a “tree structure”). This search retrieves articles ranging from myocardial infarction to familial hypertrophic cardiomyopathy and everything in between—all at one time. Some search engines, rather than doing it automatically, offer the user the option of including, or not including, all of the specifics under a general term (e.g., Ovid presents the option to “explode” the subject heading, which means to include all the specific terms indented under a more general heading).

Including the narrower terms in the controlled vocabulary (i.e., explode) can be advantageous for searches when broad terms are needed; however, it can be disadvantageous because the searcher may find papers that are not necessarily helpful in answering the clinical question. However, when clinicians use the explode feature and perhaps retrieve irrelevant articles, they can eliminate most of them by setting appropriate limits and combining controlled vocabulary term searches using the PICOT question as the guide. Therefore, exploding the search term when using controlled vocabulary is recommended. Some search systems enable the searcher to click on the controlled vocabulary heading and see the other narrower headings in the hierarchical thesaurus. This option helps the searcher create the most relevant search by making a decision about whether to explode terms in the search.

An example of the usefulness of the explode function is a search to find information on food poisoning. In MEDLINE, the MeSH term food poisoning is the broad subject heading that describes various types of food poisoning, including botulism, ciguatera poisoning, favism, mushroom poisoning, salmonella poisoning, and staphylococcal poisoning. Using this heading to initiate the search and then exploding it means that the name of each of those types of food poisoning is a part of the search without entering each one into the search strategy, saving clinicians’ time. In PubMed’s MeSH search, the term you enter is automatically exploded. In the search, you have to instruct PubMed to NOT explode the term.

Most large bibliographic databases, such as MEDLINE, CINAHL, and PsycINFO, use a controlled vocabulary to describe the content of the items it references. Most search engines will attempt to map the keyword entered in the search box to a controlled vocabulary subject heading. This assists the searcher in finding relevant evidence without the need to know the subject heading up front. For example, in most search engines, the term Tylenol is mapped to the generic term acetaminophen, as is the European term paracetamol, or any of the following that are acetaminophen types of pain relievers: tempra, panadol, datril, valgesic, valadol, tussapap, tralgon, tapar, tabalgin, and pyrinazine. As a system searches the controlled vocabulary heading acetaminophen, any article using the term Tylenol or any of the other words above will be retrieved because an indexer cataloged it under that heading, regardless of the term used in the article. There is a caveat to controlled vocabulary searching: This mapping process may not be efficient with very current topics that have only recently entered the literature. In these cases, a controlled vocabulary term likely is not available; therefore, keyword searching, using synonyms or variant forms of the word, may yield more relevant results. In some cases, truncation should be considered, which is using special symbols in combination with words or word parts to enhance the likelihood of finding relevant studies. Truncation is usually indicated by a word or part of a word followed by an asterisk (*). In PubMed, the asterisk is used to replace any number of letters at the end of the word. For example, in PubMed, to truncate adolescent, one would use adolescence to retrieve adolescent, adolescents, or adolescence.

Some evidence-based resources do not have controlled vocabulary, or there must be knowledge of controlled vocabulary terms that may not be commonplace to use them. For example, the Cochrane Library can be searched using MeSH or keywords. To search using the MeSH
option, you have to know the MeSH term you want to search. If you use MeSH often, you may
know the term you want to search and easily can make use of this feature. However, given that
this information resource is relatively small, searching with keywords, including synonyms, can
retrieve a reasonable number of relevant articles. Nevertheless, keyword searching requires some
creativity; the searcher must think of all the different ways that an author could have referred to a
particular concept. To maximize your search, keep in mind the caveats about keyword searching
that were described earlier in this chapter.

Combining and Limiting Searches

In a focused search for a clinical topic using the PICOT question as the framework for the search,
clinicians may choose to enter multiple concepts simultaneously into the search system. The
disadvantage to this method is that there is no way to determine which concept has the most
evidence available. To assist with knowing what evidence exists to address the terms entered into
the search box, clinicians can enter the terms from the PICOT question into the search box one
at a time. By entering them one at a time, especially in very large databases (e.g., MEDLINE,
CINAHL, PsycINFO), the number of hits (i.e., articles or studies that contain the searched word)
for each individual term searched can be known. For example, searching MEDLINE for the
keywords Tylenol and pain separately yielded 67 and 180,694 hits, respectively; however, when
searching them together, Tylenol AND pain, the yield was 32. There is clearly more evidence
about pain than Tylenol. It is important to consider that out of a possible 67 studies, only 32 were
found that addressed both terms. To enter each PICOT term individually may not be possible
with every search due to competing clinical priorities; however, it is the best method to fully
understand what evidence exists to answer the clinical question.

When combining controlled vocabulary or keywords, the Booleans AND and OR are
usually used. Using AND is appropriate when clinicians wish both of the combined terms to
appear in the final record. Since AND is a restrictive word (i.e., both words must appear), it will
reduce the size of the final yield (i.e., number of studies retrieved). If the goal of the search is to
explore what is available, using OR can be helpful, as either one or the other or both of the terms
are desired in the final record. When keyword searching using synonyms, OR is often used. Each
search system has its own unique way of combining terms. For example, one system may require
typing in the word AND or OR, while another may offer the ease of clicking on a “combine”
option and specifying the correct connector.

Consider an example that illustrates the principle of combining search terms. A clinician
began searching for articles to answer the following question: In patients with suspected schizo-
phrenia, how does magnetic resonance imaging (MRI) compared to computed tomography (CT
scan) assist in accurate diagnosis of the disorder? The search would begin with entering the key-
words MRI, CT scan, schizophrenia, and diagnosis into the search engine. If there is an option of
controlled vocabulary, it would be used. The yields from the searches of the terms MRI and CT
scan could first be combined with the outcome of the searches for the terms schizophrenia and
diagnosis using AND (i.e., [MRI AND CT scan] AND schizophrenia AND diagnosis) because
this search would theoretically yield the best answer to the question. However, if few results were
found, more exploration can be accomplished by combining the yields of the searches for MRI
and CT scan using the Boolean connector OR and then combining with the outcome using AND
(i.e., [MRI OR CT scan] AND schizophrenia AND diagnosis). This search can provide some
insight into the answer to the question; although, it won’t answer it completely.

Clinicians should consider that different search engines process terms in the search box
in different ways; therefore, use caution when searching various databases in multiple search
engines. They may not all be searched using the same search strategy. For example, PubMed
automatically puts an AND between the words, as does Google. Other search engines may look
for the words first as a phrase, while other search systems automatically put OR between the
Before combining terms in a large bibliographic database, know how the search engine treats the terms it is given.

Since bibliographic databases are very large, often there are more citations retrieved than are reasonable to address to determine relevance, even after the searcher has combined all of the main concepts of the search. The “limit” function is designed to help the searcher pare down the large results list. This is a great tool when considering how to increase the relevance of the final search cohort. Choosing the limit function leads one to a set of options for limiting the results by various parameters (e.g., language, human studies, publication year, age, gender, publication type, full text). An important limiting option in a bibliographic database with a controlled vocabulary is to designate the search terms as the main point of the article. When indexers assign subject terms for MEDLINE, CINAHL, and PsycINFO, they will index both the major and the minor concepts within the articles. In Box 3.1, the asterisk (*) beside some MeSH terms denotes the main points of the article. Many search systems permit the searcher to limit the search to articles where a particular concept is the main point, or focus, of the article. For example, Ovid provides the “focus” option to the left of its controlled vocabulary subject heading. Using this limit is aimed at increasing the relevancy of the retrieved articles.

Another option, full text, limits the search to only those articles that are available electronically. The ease of full-text retrieval can be tempting; however, clinicians can miss evidence by limiting their search to only those articles where full text is readily available. While an increasing number of journals do provide their articles in full text, all journals do not. Although limiting to full text can be a useful tool to get a rapid return on a search, clinicians must keep in mind that there may be relevant studies that are not captured in such a limited search. The quality of the full-text evidence will assist in determining whether the missing evidence is essential to safe and effective clinical decision making (see Chapters 4–8 on critical appraisal). It is important to note that full-text articles are not part of the bibliographic record and are not in the database itself. Rather, links have been created that connect the search to the free full-text article available somewhere on the web or to the article in an electronic journal for which the library in your institution has paid a subscription fee for institutional access. If neither of these conditions exists, then the link may lead you to the journal’s website and you will be asked to pay a fee to access the full text of the article. Box 3.1 is a bibliographic record from the bibliographic database MEDLINE that contains an example of buttons at the top of the citation that link the searcher from the bibliographic database to the full text of the article.

If it is preferable not to pay the publisher for this article, know that the library that you are affiliated with can get the item for you through interlibrary loan. Some libraries offer this service at no charge and others charge a fee per article. Contact your librarian to request the article. If there is no librarian to partner with regarding the evidence you need, you can register to use a document delivery service through the NLM called Loansome Doc®, using the instructions at the following link: http://www.nlm.nih.gov/pubs/factsheets/loansome_doc.html. This service requires you to establish a relationship with a nearby library and there may be a fee for each document, depending on that library’s policies.

The final limit setting is not done in the search, but in the strategy for retrieving studies to review as evidence. Once a search yields a number of potential matches, or hits, the clinician is wise to have established specific conditions beforehand that will assist in determining which hits, or articles, are “keepers” and which will be discarded. These conditions are called inclusion and exclusion criteria. Often, many of the criteria have been applied in the search strategy as limits. However, there are occasional articles/studies that are not relevant to answering the question but still slip through the best search strategy. Stating inclusion and exclusion criteria upon which to judge a study will focus the return of the search to provide the most relevant evidence.

An inclusion criterion may be that a clinician will accept only studies with samples that are equally balanced in regard to gender. An exclusion criterion may be that the clinician will not
accept studies that compare three different medications. These stipulations for acceptable studies cannot be met through the search strategy. Often, the abstract is not adequate to address all of the inclusion and exclusion criteria. The entire study may need to be obtained to determine whether it is a keeper.

**Keepers: Managing Citations of Interest**

Once a search is completed, each database will provide options for dealing with citations of interest. Most databases provide methods for printing, saving, or e-mailing citations. Each database may also provide other specialized features for dealing with selected citations: PubMed has the Clipboard, while EBSCO uses folders. Databases may also allow users to set up individual accounts that allow customization of certain features or the ability to save desired settings. Familiarizing yourself with these options can spare you frustration and may save you a great deal of time. Collaborate with a librarian to determine the easiest way to learn about these time-saving options provided by any given database. In addition, many databases provide “Help” documentation that can assist users in learning to use these helpful features of a database.

**Saving Searches: Why and How**

Saving the method of searching (i.e., how you went about the search) is imperative if you want to repeat the search or communicate the search to someone else. The only way to have the search details so that they can be replicated is to save it when you conduct the initial search. Each search engine offers different mechanisms for saving a search. Let’s take the example of updating a healthcare policy and procedure. An in-depth search is completed that yielded relevant studies upon which to base the recommendations in the now updated policy. The next review cycle comes along; however, without a saved search, the review group will have to start from scratch. With a saved search, they simply run it to determine what is new since the last revision of the policy.

**Organizing Searches**

Often there is a need to organize the evidence found, as it can become overwhelming just by the sheer volume (Fineout-Overholt et al., 2005). Practitioners need to be able to organize evidence in a variety of ways to best serve clinicians as they journey through the various steps of the EBP process and search various databases. The entire team working on a clinical change project can have quick access to necessary resources through web-based password-protected folders (i.e., bibliographic management software [BMS]), thereby supporting team communications, work distribution, turnaround of critical appraisal sessions, defense of practice changes, and other knowledge transfer initiatives.

Bibliographic management software is designed to offer options that save, search, sort, share, and continuously add, delete, and organize promising citations. Some web-based examples include RefWorks and EndNote®. Many libraries provide access to these types of software programs for their users; therefore, readers should check with their library before purchasing any BMS software. If clinicians must select a BMS product, they need to compare purchase/subscription fees, features, ease of use, and speed. Approximate annual fees for individuals can range from $100 to $300 per year, depending upon vendor/desired features.

Practitioners can work with teams in multiple sites or their own institution using a web-based BMS that is designed to import/export citations from all of the commonly searched bibliographic databases as well as sort the citations by author, journal title, and keywords. Organizing the evidence in folders such as clinical meaningfulness, specific PICOT concepts, or strength of evidence allows the teams to add to and keep track of the relevant information they have about their common clinical issue. Through sharing citations with the team or organizing them for their own initiatives, clinicians can reduce the time invested in evidence retrieval and improve access to current information for the entire team.
Tool 4: Choosing the Right Database

Of the many databases that index healthcare literature, some are available through several vendors at a cost, some are free of charge, and some are available both free of charge and through a vendor for a fee. For example, as noted previously, depending on the search options desired, MEDLINE can be accessed free of charge through the NLM’s PubMed or obtained for a cost through other providers (e.g., Ovid). Table 3.1 contains information about access to some of the available databases.

This chapter focuses primarily on the following databases:

- Cochrane Databases
- NGC
- MEDLINE
- CINAHL
- Excerpta Medica Online (EMBASE)
- PsycINFO

MEDLINE and CINAHL are among the best-known comprehensive databases and can arguably be described as representing the scientific knowledge base of healthcare. However, the amount of information in healthcare exceeds the capacity of either of these databases. In addition to MEDLINE and CINAHL, there are other databases available, some of which are highly specialized, and their numbers are growing in response to the desire for more readily available information (e.g., Up-to-Date, Clinical Evidence).

Cochrane Databases

Classified as an international not-for-profit organization, The Cochrane Collaboration represents the efforts of a global network of dedicated volunteer researchers, healthcare professionals, and consumers who prepare, maintain, and promote access to The Cochrane Library’s six databases: Cochrane Database of Systematic Reviews (CDSR), Database of Reviews of Effectiveness (DARE), Cochrane Central Register of Controlled Trials (CENTRAL), Cochrane Methodology Register, Health Technology Assessment Database, and NHS Economic Evaluation Database.

The Cochrane Library’s “gold standard” database is the CDSR. It contains Cochrane full-text systematic reviews and should be searched first to answer intervention questions. Although the CDSR is a fairly small database, in part because systematic reviews are still relatively new in the history of healthcare, the CDSR contains a large number of valuable, synthesized (i.e., critically appraised, compiled, and integrated) RCTs. Unlike MEDLINE (e.g., 16 million citations) and CINAHL (e.g., 3 million citations), the CDSR contains a few thousand citations and is limited to a single publication type—systematic reviews—including meta-analyses. A single word search in the MEDLINE or CINAHL databases can easily result in thousands of hits. Because the CDSR is a small database, the broadest search is likely to retrieve only a small, manageable number of hits. This makes the database easy to search and the results easy to review. When reading the search results, the label “Review” refers to a completed Cochrane review and the label “Protocol” applies to Cochrane reviews that are in the initial stages of gathering and appraising evidence. It is helpful to know that protocols are in the pipeline; however, it can be disappointing not to find a full review. Protocols can provide background information, the
objectives and methods for developing the review in progress, and an expected completion date for the review.

If a full Cochrane review is retrieved during a search, clinicians can save time because they do not need to conduct the critical appraisal and synthesis of primary studies, as that has already been done. However, clinicians need to critically appraise the systematic review itself. Chapter 5 contains more information on critically appraising systematic reviews. A Cochrane review can be quite lengthy, which is particularly important when printing.

Clinicians without a paid subscription to The Cochrane Library can still access almost all of its collection of six databases for free at: http://www.cochrane.org/. The Cochrane Library provides free access to the abstracts of the systematic reviews. However, without a subscription, access to the full-text Cochrane review is restricted. First check to see if your library has a subscription to the Cochrane Library. In addition, full-text reviews can be available if institutions and organizational libraries have licensing agreements with vendors who bundle the CDSR with other databases. If these options are not available, another option is to access the full-text version of a review by paying for it separately, called pay-per-view. This option is offered on each abstract summary page.

The Cochrane DARE database is produced by the Centre for Reviews and Dissemination at the University of York, UK. The DARE database complements the CDSR by quality assessment and summarizing of reviews that are not produced by The Cochrane Collaboration.

The Cochrane CENTRAL database serves as the most comprehensive source of reports of controlled trials. It includes 310,000 trial reports from MEDLINE, 50,000 additional trial reports from EMBASE, and the remaining 170,000 reports from other sources such as other databases and hand searching. It also includes citations of reports of controlled trials that are not indexed in MEDLINE, EMBASE, or other bibliographic databases; citations published in many languages; and citations that are available only in conference proceedings or other sources that are difficult to access (Dickersin et al., 2002).

The databases produced by The Cochrane Collaboration can be accessed via http://www.cochrane.org.

**National Guideline Clearinghouse**

The NGC is a comprehensive database of evidence-based clinical practice guidelines and related documents that provide physicians, nurses, and other healthcare professionals and stakeholders with detailed information on the latest management and maintenance of particular health issues, along with how the guideline was developed, tested, and should be used (e.g., an algorithm). Guidelines are systematically developed statements about a plan of care for a specific set of clinical circumstances involving a particular population. In other words, clinical practice guidelines address several PICOT questions, compiling the evidence into a set of evidence-based recommendations that can be easily applied by clinicians. The best intervention guidelines are based on rigorous scientific evidence obtained from systematic reviews or RCTs. Some guidelines that are consensus of expert opinion, while not the strongest evidence, still can assist in decision making.

The NGC is a government-supported database that was initiated by the Agency for Healthcare Research and Quality (AHRQ) within the U.S. Department of Health and Human Services. The agency has a mission to improve the quality, safety, efficiency, effectiveness, and cost effectiveness of health. The NGC provides the following benefits: (a) structured summary abstracts with links to the full-text guidelines, when available, or links to ordering information for print copies; (b) syntheses of selected guidelines that cover similar topics; (c) expert commentary on issues of interest to the guideline community; (d) a guideline comparison feature that
allows users to generate side-by-side evaluation of two or more guidelines; and (e) downloads to a mobile device.

The NGC can be found at [http://www.guideline.gov](http://www.guideline.gov).

MEDLINE
MEDLINE is one of the world’s largest searchable bibliographic databases covering medicine, health, and the biomedical sciences, and it is available 24 hours a day on any computer in the world with Internet access. The NLM also leases the MEDLINE data to vendors. These types of companies load the database into their own user interfaces with unique features and sell subscriptions to libraries and others. It is important to acknowledge that the original file of indexed citations is the same MEDLINE product in PubMed as in any of these other vendors’ versions of the file. It contains citations from more than 5,200 biomedical journals in medicine, nursing, pharmacy, dentistry, and allied health. The database is updated daily and has abstracts for over 52% of its articles, with 80% of its citations in English.

MEDLINE has worldwide coverage, including many non-English languages, though it tends to focus on North American journal articles. MEDLINE uses a controlled vocabulary, MeSH, to facilitate searches.


CINAHL
The Cumulative Index of Nursing & Allied Health Literature (CINAHL) database is produced by Cinahl Information Systems and contains article citations with abstracts, when available, from 13 nursing and allied health disciplines. Articles are retrieved from journals, books, drug monographs, dissertations, and images that are sometimes difficult to locate in other databases. The CINAHL database is usually accessed through libraries but can be accessed through a personal CINAHL direct subscription via the Cinahl Information Systems website ([http://www.ebscohost.com/cinahl](http://www.ebscohost.com/cinahl)). The CINAHL database includes more than 3 million journal articles from 1982 to present. About 70% of the citations in CINAHL also appear in the MEDLINE database. The CINAHL database also has a controlled vocabulary. It is an English language database and available through various vendors.

The CINAHL database is available at [http://www.ebscohost.com/cinahl](http://www.ebscohost.com/cinahl).

EMBASE
Excerpta Medica Online (EMBASE) is the major European biomedical and pharmaceutical database indexing in the fields of drug research, pharmacology, pharmaceutics, toxicology, clinical and experimental human medicine, health policy and management, public health, occupational health, environmental health, drug dependence and abuse, psychiatry, forensic medicine, and biomedical engineering/instrumentation. The EMBASE database is indexed using the
Finding Relevant Evidence to Answer Clinical Questions

controlled vocabulary EMTREE as well as MeSH. The EMBASE database currently has more than 19 million indexed records from more than 7,000 peer-reviewed journals. Yearly, EMBASE adds more than 600,000 articles to the database, 80% of which have full abstracts. EMBASE requires a subscription to access its indexed articles.

The EMBASE database is available at http://www.embase.com.

PsycINFO
PsycINFO is a bibliographic database that indexes publications from the late 1800s to present. This database of scholarly literature in psychology, behavioral sciences, and mental health contains more than 2 million citations, 7% of which are books and 11% dissertations. Professionals in psychology and related fields such as psychiatry, education, neuroscience, nursing, and other healthcare disciplines can find relevant evidence in this database to answer specific clinical questions.


Searching the literature can be both rewarding and challenging, primarily because the volume of healthcare literature is huge. The MEDLINE database alone provides reference to more than 17 million citations; however, it cannot cover all worldwide healthcare journals. Searching multiple databases can increase the number of relevant articles in any search. The databases discussed here and others impose organization on the chaos of the journal literature. Each database offers coverage that is broad and sometimes overlapping. Knowing which databases to search first and for what information is imperative for a successful, efficient search.

Never give up, for that is just the place and time that the tide will turn.
Harriet Beecher Stowe

Example: How to Search PubMed
PubMed is a broad database produced and maintained by the National Center for Biotechnology Information (NCBI) at the NLM. In 2009, this bibliographic database contained more than 19 million citations to articles from more than 5,200 journals published worldwide (NLM, 2009). At its web debut in 1997, the oldest citations in PubMed were from 1966, but that has changed dramatically since 2003 when the first group of older citations (1.5 million citations to journal articles dated 1953–1965) was added to the database. As of 2009, the oldest citations date back to 1945. Since NLM has been indexing the medical literature since 1879, it is highly probable that the date of the oldest citations in PubMed will continue to slowly creep backward in time while current citations continue to be added.

PubMed is freely accessible on the Internet at http://www.pubmed.gov. However, NCBI has made it possible for libraries to link their electronic and print serial holdings to citations in the database, making it easy for their clientele to access full-text articles through the
PubMed database. Such access is via a specialized URL that facilitates this linking. Therefore, it is important for anyone affiliated with a library to check with that library to learn the most efficacious way to access PubMed.

PubMed covers several subject areas, including

- Biomedical sciences
- Nursing
- Dentistry
- Veterinary medicine
- Pharmacy
- Allied health
- Preclinical sciences
- Health policy
- Bioinformatics
- Health administration
- Standards and practice guidelines
- Health-related technology

PubMed also contains access to the information that makes up the foundation and midsection of the Haynes Evidence Pyramid: original research studies and reviews of evidence. PubMed provides free online access to the MEDLINE database, which resides within the PubMed database; however, not everything in PubMed is in the MEDLINE database.

Citations in PubMed that are in MEDLINE are indexed with MeSH terms. Citations that are in PubMed but not in MEDLINE are not indexed with MeSH terms. Every citation in PubMed contains a status tag at the end of the citation. The majority of citations start out as electronically submitted by publishers to the database and have a status tag that says “[PubMed—as supplied by publisher].” In general, these are the newest citations in PubMed. During the indexing process, the status tag will change to “[PubMed—in process].” When indexing is complete, the citation’s status tag changes to “[PubMed—indexed for MEDLINE].” It is then that the citation becomes part of MEDLINE.

Approximately 8% of the PubMed database is not indexed with MeSH terms. This has implications for searchers. Since only the citations marked “[PubMed—indexed for MEDLINE]” are indexed with MeSH terms, only MEDLINE citations can be retrieved by using MeSH terms to search the database. Constructing a search in PubMed using only MeSH terms will exclude all the nonindexed citations in PubMed. In reality, this means that the newest citations in the database may not be retrieved. In healthcare, it is crucial to retrieve the most current information. Nonindexed citations in the PubMed database can only be retrieved by using keyword searching. Effective searching in PubMed requires the use of both MeSH terms and keywords. In PubMed, the NLM developed automatic term mapping, which takes the terms typed into the search box, maps them to any appropriate MeSH terms, and uses keywords in the search. It effectively searches both indexed and nonindexed citations (i.e., PubMed and MEDLINE).

For example, consider the following question: In children with otitis media (P), how does waiting (I) compared to immediate antibiotic treatment (C) affect time for infection resolution (O)? To answer this question, you could begin by entering otitis into the search box in PubMed as one search term and run the search. On the right-hand side of the search results page is a box that says “Search Details” and there you will see how PubMed used automatic term mapping to process the search, shown in Box 3.2.

In another example, consider the following PICOT question: How do women (P) diagnosed with breast cancer (I) perceive their own mortality (O)? As an initial step to answer this question, you could type breast cancer as one of the search terms in the search box in PubMed.
Details of PubMed Automatic Term Mapping for Otitis

“otitis”[MeSH Terms] OR “otitis”[All Fields]

- The “otitis”[MeSH Terms] portion of the search will retrieve relevant information from the MEDLINE database.
- The “otitis”[All Fields] portion of the search will retrieve information from the nonindexed portion of the database.

and run the search. Click on “Details” to see how PubMed used automatic term mapping to process the search, as shown in Box 3.3.

Automatic term mapping makes sure that both the indexed and the nonindexed portions of the database are searched. In addition, a particular logic has been built into automatic term mapping to make it even more effective. There are three steps to this process:

1. **MeSH term:** Automatic term mapping first looks for a match between what is typed into the search box and a table of MeSH terms. If there is a match with a MeSH term, the MeSH term plus the keyword will be used to run the search.

2. **Journal title:** If there is no match with a MeSH term, what has been typed in the search box is next compared to a table of journal titles. If there is a match, the journal title is used to run the search.

3. **Author name:** If there is no match with either a MeSH term or a journal title, the words in the search box are then compared to a table of author names. If there is a match, that author name is used to run the search.

Automatic term mapping begins with the words entered into the search box as a single unit. If it cannot find a match in any of the three tables, it will drop the word that is furthest to the right in the search string, look at the remaining words, and run through the three steps of automatic term mapping.

Details of PubMed Automatic Term Mapping for Breast Cancer


- The “breast neoplasms”[MeSH Terms] portion of the search will retrieve relevant information from the indexed portion of the MEDLINE database, since breast cancer is not a MeSH term.
- The (“breast”[All Fields] AND “neoplasms”[All Fields]) OR “breast neoplasms”[All Fields] OR (“breast”[All Fields] AND “cancer”[All Fields]) OR “breast cancer”[All Fields] portion of the search will retrieve information from the nonindexed portion of the database.
Steps Zero, One, Two: Getting Started

mapping, looking for a match. If a match is found, then automatic term mapping will use the match (MeSH term, journal title, or author name) plus the keyword as part of the search and return to process the term that was previously dropped. An example of this process can be found in Box 3.4.

Once a search has been run, PubMed provides the option to further refine retrieval by using limits. Simply click on the Advanced Search link located just above the search box in PubMed. Limiting to certain dates of publication, certain languages, human or animal studies, and types of publications (e.g., clinical trial, meta-analysis) is also one of the options. Figure 3.2 shows some examples of the many limits that can be applied.

When reviewing search results in PubMed, it may appear that the citations are listed in chronological order with the most recent citation appearing first, but that is not the case. Search results appear in the order in which they were added to the database. This means that the citation that sits in the no. 1 spot is the citation that meets the search criteria and was most recently added.

**Box 3.4**

An Example of PubMed Automatic Term Mapping

**PICOT question:** In children with head lice (P), how does shampoo (I) compared to mayonnaise (C) affect lice demise (O)? As a beginning step, you type head lice shampoo into the search box in PubMed and run the search. This is what will appear in the “Details”:

("pediculus"[MeSH Terms] OR "pediculus"[All Fields] OR (“head”[All Fields] AND “lice”[All Fields]) OR “head lice”[All Fields]) AND shampoo[All Fields]

And here is how Automatic Term Mapping did the processing:

1. Look at head lice shampoo as a single unit and it will find
   - No match to a MeSH term
   - No match to a journal title
   - No match to an author name

2. Drop shampoo, the word on the far right of the search string.

3. Process the remaining words head lice to find
   - Head lice maps to the MeSH term pediculus
   - Use “pediculus”[MeSH Terms] as the first part of the search
   - OR in “pediculus”[All Fields] OR (“head”[All Fields] AND “lice”[All Fields]) OR “head lice”[All Fields] to capture information from the non-indexed part of the database

4. Go back and look at the term that was previously dropped, shampoo, and find
   - No match to a MeSH term
   - No match to a journal title
   - No match to an author name

5. Look for the term shampoo in [All Fields]; **AND** it into the search

**Final result:**

("pediculus”[MeSH Terms] OR “pediculus”[All Fields] OR (“head”[All Fields] AND “lice”[All Fields]) OR “head lice”[All Fields]) AND shampoo[All Fields]

This method can facilitate busy clinicians finding relevant evidence quickly since PubMed automatically maps keywords to controlled vocabulary behind the scenes. Terms can be typed into the search box in PubMed and automatic term mapping can do its work to retrieve relevant studies.
to the database. To find the most recently published article, use the “Sort by Pub Date” option that can be found in the Display Settings dropdown menu (Figure 3.3).

The search strategy carefully designed using PICOT as a guide is entered into the search box in PubMed and run. The appropriate limits have been applied. The results have been sorted as desired. The most useful of these are found in Figure 3.3. To further separate the citations of interest from others, PubMed provides the “Send To” options (e.g., e-mail, clipboard; Figure 3.4).

This has been a brief introduction to PubMed. Additional information on searching PubMed can be found from

- Tutorials provided by NLM and available via the “Tutorials” link on the blue sidebar of the PubMed homepage or directly from http://www.nlm.nih.gov/bsd/disted/pubmed.html
Steps Zero, One, Two: Getting Started

**Figure 3.3** Tip on sorting citations in PubMed

Table showing display settings for sorting citations in PubMed:
- **Format**: Summary, Abstract, Abstract (text), MEDLINE, XML, PMID List
- **Items per page**: 5, 10, 20, 50, 100, 200
- **Sort by**: Recently Added, Pub Date, First Author, Last Author, Journal, Title


**Figure 3.4** The most useful “Send To” options in PubMed; a mechanism to manage citations of interest

- **File**: Save citations as a file on your computer
- **Clipboard**: Cyberspace holding area for citations of interest. The Clipboard will hold citations while you continue searching. When you’re done searching, access the Clipboard and retrieve the citations.
- **E-mail**: Use this to e-mail citations

Tool 4: Help Finding the Needle: Specialized Search Functions

Many database providers have designed specialized search functions to help busy healthcare practitioners find evidence as quickly as possible. This section discusses the specific search functions available in PubMed, Ovid, and EBSCO that can assist in finding relevant evidence quickly.

PubMed Clinical Queries and Health Services Research Queries
PubMed provides several options for busy clinicians: Clinical Queries and Health Services Research Queries. Both are freely available to all users and are easily accessed via the “Special Queries” link on the blue sidebar of the PubMed home page.

The Clinical Queries section provides two very useful search options: Clinical Study Category and Systematic Reviews. Search by Clinical Study Category provides a quick way to pull evidence from the PubMed database. When using this feature, search terms must be entered in the query box, the type of clinical question being asked must be indicated (etiology, diagnosis, therapy, prognosis, or clinical prediction guide), and the scope of the search must be indicated (broad or narrow), as shown in Figure 3.5.

When a search is run, PubMed applies specific search filters to limit retrieval to the desired evidence. This means that PubMed automatically adds terms to the search in order to hone in on just the evidence needed. A quick look at the “Details” box after running a search will show what terms were added. PubMed also provides a link to the filter table that shows the different search filters and the terms associated with them.

Find Systematic Reviews is located on the Search by Clinical Study Category page (Figure 3.6) and works somewhat like the Search by Clinical Study Category, in that PubMed automatically enhances the search by restricting retrieval to Systematic Reviews. Run a search using this feature and then check the “Details” box to see that PubMed automatically adds “AND
systematic[sb]” to the search. Systematic Reviews in the PubMed database are coded as such so that little addition to the search easily locates those citations.

**Health Services Research (HSR) Queries** have been developed by the National Information Center on Health Services Research and Health Care Technology (NICHSR). As noted before, this function is available via the “Topic Specific” link on the Advanced Search page or on the bottom of the PubMed home page, as displayed in Figure 3.7. These HSR Queries may be of special interest to nurses who are often looking for evidence that is cross disciplinary or qualitative in nature. These function very much like the Search by Clinical Study Category in that a search is enhanced using special search filters. However, the HSR Queries address different types and areas of research, including

- Appropriateness
- Process assessment
- Outcomes assessment
- Costs
- Economics
- Qualitative research

Once search terms have been entered, a category chosen, and the scope of the search selected, simply click “Go” and the search will be run with appropriate filters applied. Check the “Details” box to see what terms were added to the search. Links are provided to both the filters and the definitions of the categories.
Clinical Queries in Ovid

Ovid Clinical Queries (OCQ) is an innovation designed to be used in the EBP searching process to limit retrieval to best evidence and what Ovid refers to as “clinically sound studies.” To access OCQ, a searcher enters search statements in the main search box. A number of retrieved journal citations display as “Results” on Ovid’s main search page within “Search History.” To limit retrieved results, select “Additional Limits” to view Ovid’s menu of limits. Find the Clinical Queries’ dropdown menu and select the clinical query that best serves the purposes of your PICOT question.

The OCQ dropdown menu offers limits that retrieve clinically sound studies. Searchers select a query based on what the PICOT question is targeting (e.g., therapy, diagnosis, prognosis, reviews, clinical prediction guides, qualitative studies, etiology, costs, economics). Additionally, within each query, there are options to further refine the search. This refinement is described as restricting retrieval to clinically sound studies. The refinement options include “Sensitive” (i.e., most relevant articles but probably some less relevant ones), “Specific” (i.e., mostly relevant articles but probably omitting a few), and “Optimized” (i.e., the combination of terms that optimizes the trade-off between sensitivity and specificity). The use of these queries requires a level of searching expertise that can be perfected through practice.

Evidence-Based Practice “Limiter” in EBSCO

Journal databases typically offer options for limiting search results to allow quick retrieval of the most relevant and focused citations. “Limiters” that are commonly offered allow you to narrow your citation search by options such as publication type, age groups, gender, clinical queries, language, peer reviewed, and full text. EBSCO CINAHL provides an additional option within its “Special Interest” category of limits called “Evidence-Based Practice.” Selecting the EBP limiter allows you to narrow your results to articles from EBP journals, about EBP, research articles (including systematic reviews, clinical trials, meta-analyses, and so forth), and commentaries on research studies.

A Final Tool: Time and Money

Producing, maintaining, and making databases available is financially costly and time-consuming. Although computer technology has revolutionized the print industry and made it easier to transfer documents and information any time around the world in seconds, the task of producing databases still relies on people to make decisions about what to include and how to index it. Databases produced by government agencies, such as MEDLINE, are produced with public money and are either very inexpensive or without cost to the searcher. The MEDLINE database is available to anyone in the world who has access to the Internet through PubMed. The data in MEDLINE can be leased at no cost by vendors and then placed on a variety of search engines to be accessed by healthcare providers, librarians, and others. Private organizations that produce biomedical databases, such as CINAHL or the CDSR, license their product, usually to libraries but also by subscription to individuals. If there is no in-house library, it is worth the time and effort to locate libraries in the area and find out their access policies for these databases.

For clinicians to practice based on evidence, access to databases is necessary. Cost for access to databases includes subscriptions, licensing fees for users of the database, hardware, software, Internet access, and library staff to facilitate its use (if available). Institutions must make decisions about what databases to subscribe to, and these decisions may be based...
Steps Zero, One, Two: Getting Started

on the resources available. Not all healthcare providers have libraries in their facilities. In these situations, clinicians or departments can consult with partnering librarians about securing access to databases that they consider critical to evidence-based care.

Although there is a cost associated with searching databases for relevant evidence, regular searching for answers to clinical questions has been shown to save money. Researchers conducted an outcome-based, prospective study to measure the economic impact of MEDLINE searches on the cost both to the patient and to the participating hospitals (Klein, Ross, Adams, et al., 1994). They found that searches conducted early (i.e., in the first half) in patients’ hospital stays resulted in significantly lower cost to the patients and to the hospitals, as well as shorter lengths of stay.

Computerized retrieval of medical information is a fairly complex activity. It begins by considering the kind of information needed, creating an answerable question, planning and executing the search in an appropriate database, and analyzing the retrieved results. Clinicians must remember the costs of both searching and obtaining relevant evidence, as well as the costs of not searching for and applying relevant evidence.

Do not go where the path may lead, go instead where there is no path and leave a trail.
Ralph Waldo Emerson

How to Know You Have Found the Needle

Successfully searching for relevant evidence is as important as asking a well-built PICOT question. For clinicians to get the answers they need to provide the best care to their patients, they must determine the appropriate database, use controlled vocabulary, use limits, and meet specified criteria to navigate the database maze. In addition, clinicians must consider the cost of not searching for the best evidence. Commitment to finding valid, reliable evidence is the foundation for developing the skills that foster a sound strategy, which, in turn, helps in reducing frustration and time. Box 3.5 contains the steps of an efficient search.

The key to knowing whether the needle has been found is in further evaluation of the selected studies from a successfully executed search. This evaluation method is called critical appraisal, the next step in the EBP process. Some journals are dedicated to the preappraisal of existing literature. Most of these articles are not syntheses (e.g., systematic reviews), but rather critical appraisals of current single studies. For example, the journal Evidence-Based Nursing reviews 140 general medical, specialist, and nursing journals to identify research that would be clinically meaningful to nurses. Appraisals of 24 studies (both quantitative and qualitative) are published quarterly. The ACP Journal Club is another publication dedicated to preappraised literature. More than 100 journals are scanned for evidence relevant to clinicians. Specific criteria are applied to the appraised articles, and the appraisals are published bimonthly in the journal. These types of journals assist the clinician in reducing the time it takes from asking the question to applying valid evidence in decision making.

Do what you can, with what you have, where you are.
Theodore Roosevelt
**Steps to an Efficient Search to Answer a Clinical Question**

- Begin with PICOT question–generated keywords.
- Establish inclusion/exclusion criteria before searching so that the studies that answer the question are easily identifiable.
- Use controlled vocabulary headings, when available.
- Expand the search using the explode option, if not automatic.
- Use available mechanisms to focus the search so that the topic of interest is the main point of the article.
- Combine the searches generated from the PICOT keywords that mapped onto controlled vocabulary, if the database does not automatically do this for you.
- Limit the final cohort of studies with meaningful limits, such as year, type of study, age, gender, and language.
- Organize studies in a meaningful way using BMS.

**Next Steps**

There needs to be some discussion about when a thorough search to answer a compelling clinical question yields either too little valid evidence to support confident practice change (i.e., inconclusive evidence) or no evidence. In most cases, clinicians are not in positions to do full-scale, multisite clinical trials to determine the answer to a clinical question, and the science may not be at the point to support such an investigation. However, determining what is effective in the clinician’s own practice by implementing the best evidence available can generate internal evidence. In addition, generating external evidence by conducting smaller scale studies, either individually or with a team of researchers, is an option. Chapters 4–8 address how to generate evidence to answer clinical questions. However, the starting place for addressing any clinical issue is to gather and evaluate the existing evidence using strategies and methods described in this chapter.

**references**


Steps Zero, One, Two: Getting Started

