

Searching the Literature and Selecting the Right References

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The ability to locate published data on a topic is a fundamental skill in the research process, and it aids in formulating and refining a research question and planning the study. Searching the literature for published studies on a topic relevant to one's question requires knowledge of databases such as MEDLINE, Cumulative Index to Nursing and Allied Health, or Hospital Literature Index. PubMed provides access to MEDLINE and over 12 million citations in the medical literature. When searching in PubMed you can apply various "limits," such as what fields the search term is in (eg, author, title, text word, journal), type of report (eg, clinical trial, review, editorial), language, patient age, gender, and human or animal study. The "Boolean operators" (AND, OR, and NOT) can further focus and refine your search. However, to be sure that you retrieve all the files of interest and don't miss any files that might be critical to your understanding of the topic, you must search all fields and be careful not to exclude potentially important files with the NOT operator. Key words: research, Internet, database, publication, writing, publishing, biomedical Research, Index Medicus. [Respir Care 2004;49(10):1242-1245. © 2004 Daedalus Enterprises]

Introduction

A review of the literature is a necessary preliminary activity for performing research and when preparing the results of a study for publication. A careful review of previously published research prevents wasteful duplication of effort and can suggest research topics, questions, and methods. This article briefly discusses the place of a

literature review in the research process, the basics of doing a literature search in common medical databases, how to search using the National Library of Medicine's PubMed Web site, and how to obtain articles identified in the search.

Place in the Research Process

Table 1 lists the key steps in the research process and highlights the literature review within that sequence. The literature review is a search for and reading of all published research on a given problem or question, usually with defined limits. Although the creative activity of research is not constrained by any list, it can be helpful to understand where a research question falls within a broad topic and that it stems from a problem identified within that topic.¹ For example, we may have a *topic*, say, aerosol delivery during mechanical ventilation. From our clinical experience we may have a *problem*, say, with different

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Table 1. Place of the Literature Review in the Research Process

1. Identify the topic and preliminary research question
2. <i>Search and review the related literature</i>
3. Devise the final formulation of the research question
4. Determine the research design, including the specific study question, hypothesis, study population, sample size, sampling method, and data collection and analysis techniques
5. Seek institutional review board (IRB) approval if human subjects are involved, and amend the study design per the IRB's feedback
6. Conduct the data collection
7. Conduct the data analysis
8. Write the preliminary report
9. Present the findings to co-workers and close colleagues
10. Revise the preliminary report based on feedback from co-workers and close colleagues
11. Write and submit an abstract to a conference
12. Present the abstract at the conference
13. Edit the report based on feedback received at the conference
14. <i>Search the literature again, looking for reports that may have been published since you first searched the literature</i>
15. Revise the report based on new reports you found in step 14
16. Submit the report to a scientific journal
17. Revise the report based on feedback from peer reviewers
18. Give final approval for the journal to publish the edited version

patients' response to aerosolized bronchodilators during mechanical ventilation. And we might therefore have a *research question*: How much aerosolized drug reaches the lung through an endotracheal tube (ETT)? Your literature review should identify all the published studies on the question of aerosol delivery through an ETT. After completing a literature review, you can usually improve the research question. For instance, our initial question was: "How much aerosolized drug reaches the lung through an ETT?" The preliminary literature review leads us to a more specific (and answerable) question: "How much metered-dose-inhaler albuterol is delivered through an ETT actuator/adaptor, compared to a reservoir device, in a lung model of a mechanically ventilated adult?" The revised question can guide each aspect of our investigation. In addition to refining our question and avoiding unnecessary duplication (which might not get published), the published studies we found will help us build a rationale for our study in the introduction of our manuscript, guide us in study design, measurements, and data analysis, and provide references for the introduction and discussion sections.

Databases and the Basics of a Literature Search

Searching the literature requires some basic resources. The investigator should identify local library resources (eg, in the hospital, university, or medical school). The Internet gives access to databases of medical literature.


Databases can be confusing to use, and reference librarians are the professionals who can help us search the databases efficiently. Consult with a librarian when setting up a search. Before becoming immersed in the details of a medical database, I strongly suggest that you manually locate a recent review article on the topic and check that article's references, as a starting place. Browse issues of *RESPIRATORY CARE*, *Chest*, *Journal of Aerosol Medicine*, or *Respiratory Care Clinics of North America*. Table 2 lists a partial selection of important journals for respiratory care topics. I recommend a review article because review articles contain numerous references, often with comprehensive coverage of the topic. Having a few articles in hand before doing a database search provides a check on whether your search is correctly identifying references on the topic. An article may also give you search terms that you might not otherwise think of. Searching with the wrong search terms or categories can prevent you from locating articles you need. Some medical databases have guides to the terms in which a topic is categorized. In the National Library of Medicine's MEDLINE database, the Medical Subject Headings shows the organization of topics and terms used for areas of study. Note, however, that the list of Medical Subject Headings is quite incomplete; for instance, it does not include the term "noninvasive ventilation."

Not all medical journals are indexed in MEDLINE. Other databases that can be useful for respiratory care research include the Cumulative Index to Nursing and Allied Health Literature, and Hospital Literature Index. However, the present article focuses on searching MEDLINE, using PubMed.


Table 2. Selected Journals That Focus on or Contain Studies Related to Respiratory Care

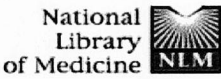
<i>American Journal of Respiratory and Critical Care Medicine</i>
<i>Annals of Allergy, Asthma, and Immunology</i>
<i>Anesthesiology</i>
<i>Chest</i>
<i>Clinical Pulmonary Medicine</i>
<i>Critical Care Medicine</i>
<i>European Respiratory Journal</i>
<i>Intensive Care Medicine</i>
<i>Journal of Aerosol Medicine</i>
<i>Journal of Allergy and Clinical Immunology</i>
<i>Journal of Asthma</i>
<i>Journal of Respiratory Diseases</i>
<i>Pediatric Pulmonology</i>
<i>Respiratory Care</i>
<i>Respiration</i>
<i>Respiratory Care Clinics of North America</i>
<i>Thorax</i>

Entrez-PubMed http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?CMD=Limits&DB=...



Term or phrase





[PubMed](#) [Nucleotide](#) [Protein](#) [Genome](#) [Structure](#) [PopSet](#) [Taxonomy](#) [OMIM](#) [Books](#)

Limits | Preview | Index | History | Clipboard | Details

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New/Noteworthy
E-Utilities

PubMed Services
Journal Browser
MeSH Browser
Single Citation Matcher
Batch Citation Matcher
Clinical Queries
LinkOut
Cubby

- Use All Fields pull-down menu to specify a field.
- Boolean operators AND, OR, NOT must be in upper case.
- If search fields tags are used enclose in square brackets, e.g., rubella [ti].
- Search limits may exclude in process and publisher supplied citations.

Limited to:

<input type="text" value="All Fields"/>	<input type="checkbox"/> only items with abstracts
<input type="text" value="Publication Types"/>	<input type="text" value="Language"/> <input type="text" value="Subsets"/>
<input type="text" value="Ages"/>	<input type="text" value="Human or Animal"/> <input type="text" value="Gender"/>
<input type="text" value="Entrez Dat"/>	
<input type="text" value="Publication Dat"/>	From <input type="text"/> To <input type="text"/>

Use the format YYYY/MM/DD; month and day are optional.

Fig. 1. An annotated image of the "Limits" search page at the PubMed Web site (reach this page from the PubMed home page by clicking "Limits").² From top to bottom, the arrows indicate: the box for entering the search terms or search phrases; the "Limits" option (which you already clicked, to reach this page); the list of other functions such as "Overview" and "Help"; and the "Limits" drop-down menus, with which to limit your search (eg, search only the titles; search only for certain types of publications; search only for reports about patients in a certain age range; search only for reports about human studies).

Searching With PubMed

MEDLINE is the National Library of Medicine's database of indexed journal citations and abstracts. This database covers nearly 4,500 journals from the United States and more than 70 other countries, and includes over 12 million citations, the dates of which range back to the mid-1960s. The PubMed Web site (<http://www.pubmed.gov>) provides access to MEDLINE. A nice feature of PubMed is that it often gives links to sites that provide full-text articles or related resources.

Figure 1 shows the PubMed Web page after clicking on "Limits." The left edge of the figure (arrow) shows the column of available features, such as "Overview" and "Tutorial," which will help you get familiar with PubMed's capabilities. Clicking on "Limits" brings up options by which to limit your search to certain fields; each limits section has a drop-down menu. For example, you can limit a search by author, journal, language, text word, or other fields. However, early in your literature search, to be sure that you retrieve all the files of interest and don't miss any files that might be critical to your understanding of the topic, you should search all fields. You can limit the types of publications retrieved (eg, clinical trial, editorial, letter,

meta-analysis, randomized clinical trial, review). Limiting the search to review articles is helpful when, prior to narrowing your research question, you want an overview of and numerous references about the topic or problem. Other limits can be set for patient age, language, subsets (eg, AIDS, bioethics, history of medicine), human or animal study, sex, and publication date.

Boolean operators are a tool for narrowing your search in an electronic database such as PubMed, so that you retrieve only the references of interest. Figure 2 illustrates the logic and use of the Boolean operators AND, OR, and NOT. If you use more than one search word, the search engine will retrieve all references that have both the search words, anywhere in the database entry (not necessarily with the words adjacent to each other). That is, the search engine assumes that you want to find references that contain all the search words you entered, so it is (by default) placing an AND between each of your search words. If you want to search for references that have a specific multi-word term such as "noninvasive ventilation" or "positive end-expiratory pressure" you must enter the term in quotation marks in the search-terms box. For example, if you enter "positive end-expiratory pressure" without typing quotation marks at both ends of the term, the search

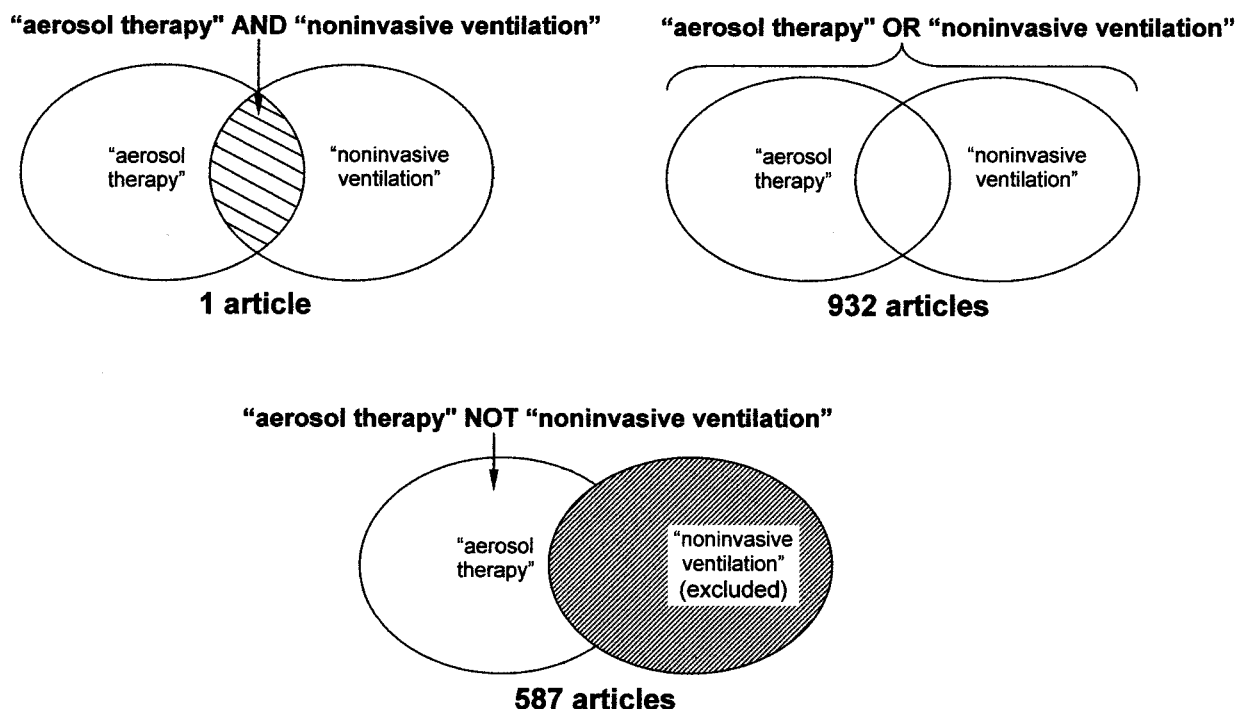


Fig. 2. Functions of the 3 Boolean operators AND, OR, and NOT in a PubMed search with the term "aerosol therapy" AND/OR/NOT "noninvasive ventilation". To retrieve database entries that include a multi-word term such as "aerosol therapy," you must type quotation marks at the beginning and end of the term. At the time this article was written, entering the search string "aerosol therapy" AND "noninvasive ventilation" (ie, with the multi-word terms in quotation marks) retrieved only 1 PubMed database entry; entering the search string "aerosol therapy" OR "noninvasive ventilation" (again, with the multi-word terms in quotation marks) retrieved 932 PubMed database entries. Entering the search string "aerosol therapy" NOT "noninvasive ventilation" (yet again, with the multi-word terms in quotation marks) retrieved 587 PubMed database entries.

engine will retrieve all database entries that contain all the words "positive," "end," "expiratory," and "pressure," which is many more files than contain the exact term "positive end-expiratory pressure."

Obtaining Articles

A final practical consideration is obtaining copies of the articles identified in the search. PubMed includes the article's abstract, if it has one (editorials, letters to the editor, and some research articles do not). Abstracts can be printed and perused for usefulness to the study. When you have identified the articles you want, you can use the electronic card catalog of the local library to see if it carries the journals you identified in the search. Many hospitals and clinical agencies have small libraries that either have or can obtain a copy of the article. An ideal source is a medical school, if one is nearby and if nonstudents or nonemployees can access it. A local college or university with health care programs, particularly a program in respiratory therapy, can be another source. Assistance in finding a library can be obtained by contacting the

National Network of Libraries of Medicine at (800) 338-7657. If the local agency or school library does not have the journal you need, there may be an interlibrary loan service, through which (usually for a small fee) you can obtain a faxed copy of the article from a remote library, with usually short turnaround times. Articles can also be ordered through PubMed, using the "Loansome Doc" service, which is a subscription (ie, fee) service.

Summary

In this age of information, skill in using databases to search for published results on a topic is essential for both research investigators and clinical practitioners, who need current information on medical techniques and for protocol development.

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