Using Advanced Search Tools on PubMed for Citation Retrieval

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PubMed (www.pubmed.gov) provides health care professionals with free access to one of the largest searchable biomedical databases available. However, attempting to find relevant literature in PubMed without an understanding of basic search strategies and tools may be daunting and frustrating. In a previous issue of the *Mayo Clinic Proceedings*, we presented an overview of searching in PubMed and introduced its basic features. In this article, we build on this foundation and present advanced search tools designed to assist clinicians in performing efficient and focused literature searches.

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Efficient literature searching is becoming an indispensable skill for medical practice, education, and research. PubMed, developed by the National Library of Medicine, is the most comprehensive and up-to-date online database of biomedical literature. PubMed is available free of charge to all users and has no registration requirements. Beyond basic search techniques, PubMed offers several tools that can help the user refine a search to retrieve articles that are most relevant to the questions being asked. This should help save time and make the process of literature searching easier and more enjoyable.

In a previous issue of the *Mayo Clinic Proceedings*,[1] we discussed the importance of a well-formulated clinical question (which should be broken down into 4 components: patient/problem, intervention, comparison intervention, and outcome), Boolean operators, Limits, and Clinical Queries for retrieving citations. In the current article, we expand these concepts and introduce additional PubMed tools available to refine search strategies. Using a combination of these tools enables an efficient retrieval of citations relevant to clinical questions. The following topics are covered: Single Citation Matcher, Related Articles, Preview/Index, Clipboard, Cubby, MeSH Database, Field Tags, Journal Subsets,

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History, Details, Journals Database, Order Documents, and LinkOut.

We use clinical cases to illustrate search techniques. Readers are encouraged to log on to www.pubmed.gov and practice searches while reading this article. All actions that readers should complete are italicized. The names of features in PubMed are capitalized.

CASE 1

A 54-year-old chronic smoker with advanced emphysema is evaluated for chronic dyspnea. He is unable to walk more than half a block despite receiving maximal bronchodilator therapy. The patient has heard about lung volume reduction surgery and asks if he would be a candidate. You recall reading an abstract of a clinical trial on lung volume reduction surgery published in the *New England Journal of Medicine* in 2003 and want to retrieve this citation.

SINGLE CITATION MATCHER

Single Citation Matcher is a tool for locating a specific article of interest.

Select Single Citation Matcher in PubMed's sidebar on the left-hand side of the screen. Several fields display for entering data about the article. You can omit items, but at least 1 field must be entered to execute the search.

Type "NEJM" (Journal field), "2003" (Date field), and "lung volume reduction surgery" (Title words field).

Select the Search button. Of the 3 citations obtained, you are interested in the third one.

Single Citation Matcher also can be used to retrieve multiple citations that meet the specifications of the entered fields.

Type "Lung volume reduction surgery" in the Title words field and "2003" in the Date field. Select Search to retrieve the citations (50 with this search). To narrow your search further, use the Limits option with the search results.

RELATED ARTICLES

The Related Articles feature is a tool for quickly identifying articles related to a citation of interest. PubMed retrieves related articles for citations with use of a prespecified word-weighted algorithm incorporating the assigned Medical Subject Headings (MeSH) and words from

the title and abstract of the selected citation. Several articles are preselected and linked to the selected citation.

Select an article of interest from your previous search and click the Related Articles link on the right-hand side of the screen. Look at the citations retrieved to see if they address similar issues as the original article.

Related Articles citations are arranged from the most to the least relevant. Two words of caution: (1) Any Limits you may have specified are not in effect with the Related Articles link, even though the Limits option is checked; (2) If you use Limits within the Related Articles option to refine the search further, you lose the algorithm that is used to select and arrange the related articles.

CASE 2

A 50-year-old obese woman is admitted to the hospital with a 2-day history of abdominal pain in the right upper quadrant. The patient has a low-grade fever with mild tenderness in the right upper quadrant. Ultrasonography of the abdomen suggests a diagnosis of acute cholecystitis. You prescribe antibiotics and ask, "In patients with acute cholecystitis, does early surgical intervention decrease complications and increase survival compared with late intervention?"

PREVIEW/INDEX

The Preview option allows you to look at the number of articles retrieved in a search before displaying them. You can refine search strategies by adding 1 or more terms until an optimal number of citations are retrieved. Preview is particularly useful with slow Internet connections because you can refine your search before displaying citations.

Select Preview/Index from the features bar located just below the query box.

In the search field under Add Term(s) to Query or View Index, type "acute cholecystitis AND treatment" and select the Preview button. This search yields more than 2000 citations.

In the search field under Add Term(s) to Query or View Index, type "surgical" and select the Preview button. The search term "surgical" is added to the previous search. The number of citations retrieved is still too many. Note that the search was conducted with the term "surgical" linked to the previous terms with "AND."

In the search field under Add Term(s) to Query or View Index, type "early cholecystectomy" and select the Preview button. Now you have fewer citations. *Click the number of articles on the right to view the search results.*

The search yields several relevant citations. You can narrow your results further by applying Limits and restricting the search to Clinical Trial. If you want to retrieve

other studies that are relevant to your search, use the Related Articles link.

The Index button is to the right of the Preview button. Use the Index option to look at the number of citations associated with the search term along with specific narrower term(s). The same results can be obtained, albeit more easily, using MeSH Database (see "MeSH Database" section).

CASE 3

You are working on a review article on the complications of sleep apnea and want to retrieve relevant citations. You need to review data on the association between sleep apnea and cardiovascular disease, specifically, hypertension and coronary artery disease. You also would like to store these searches and download them into bibliographic management software (eg, Endnote, Reference Manager, Procite) at the end of your search.

CLIPBOARD

Clipboard is used to save citations temporarily (up to 8 hours) while you are working on other searches. The most common use of Clipboard is to select and save citations, allowing you to work with them together. Clipboard can hold up to 500 citations. Once citations are stored in Clipboard, you can perform all the functions that can otherwise be executed with a standard PubMed search.

Type "sleep apnea AND hypertension" in the query box. Select Go or Enter.

Select the following Limits: Review (Publication Types field), All adult: 19+ years (Ages field), English (Languages field), Publication Date 1995 to 2004, Human (Human or Animal field), and Only items with abstracts (checkbox).

Select Go or Enter.

Select the articles you are interested in by clicking the box displayed on the left-hand side of the article (Figure 1).

Choose Clipboard in the Send To drop-down menu, and then click Send To. The citations are now added to the Clipboard.

Use a similar search strategy to perform the next search for "sleep apnea AND coronary artery disease."

Once all relevant citations have been added, click Clipboard to view all the articles.

You can manage these citations in any way you like and can download, print, or order them. Articles stored in Clipboard also can be easily downloaded into reference management software.

To remove items from Clipboard, select Clipboard and choose Clip Remove from the Send To drop-down menu. Select Clipboard again and see that it is now empty.
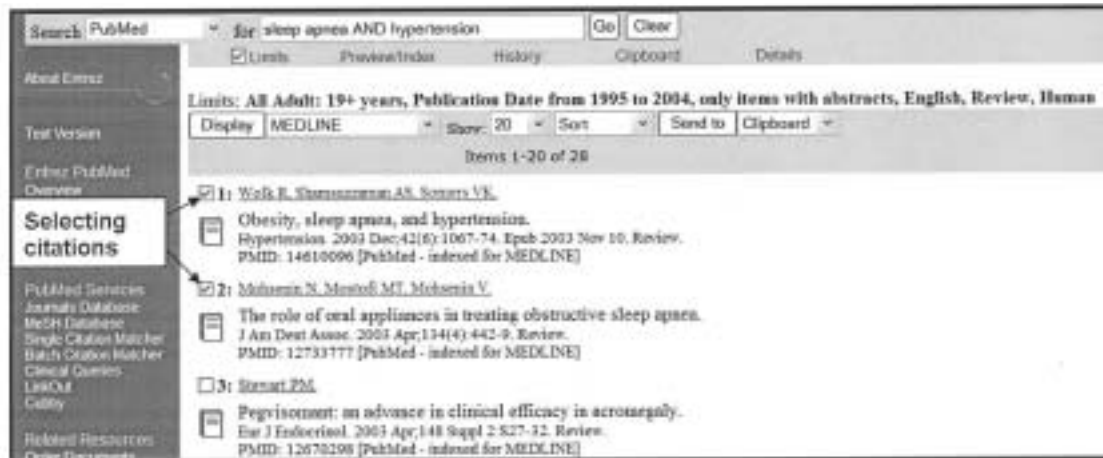
FIGURE 1. Saving multiple citations using Clipboard.

If an item is checked and Clip Remove is chosen, only that item will be deleted from Clipboard. If no items are checked and Clip Remove is chosen, all the items on Clipboard will be removed.

CASE 4

You are a national expert on asthma and want to remain updated with PubMed articles regarding asthma treatment.

CUBBY

The Cubby feature is accessed from the PubMed sidebar and is used to store search strategies for future reference. The service is free to everyone and requires setting up a user name and password. Cubby allows you to review articles published since your last search or to reexecute saved searches.

Set up your own Cubby account if you do not already have one by selecting the Cubby feature on the PubMed sidebar on the left-hand side of the screen.

Type the search term "asthma AND treatment" in the query box. Use Limits appropriate to your search.

Click Cubby on the sidebar and log on to your account. Your search term will be displayed in the window (Figure 2).

Store this search by selecting the option Store In Cubby.

The search is stored along with the date and time the search was performed. When you reaccess your Cubby account, you can select a number in the Search column and then select the option What's New for Selected. Cubby will display the number of citations on the topic added to PubMed since your last search. Click the number displayed in the What's New column to link to the articles. Note that Cubby updates the stored search with a new date and time.
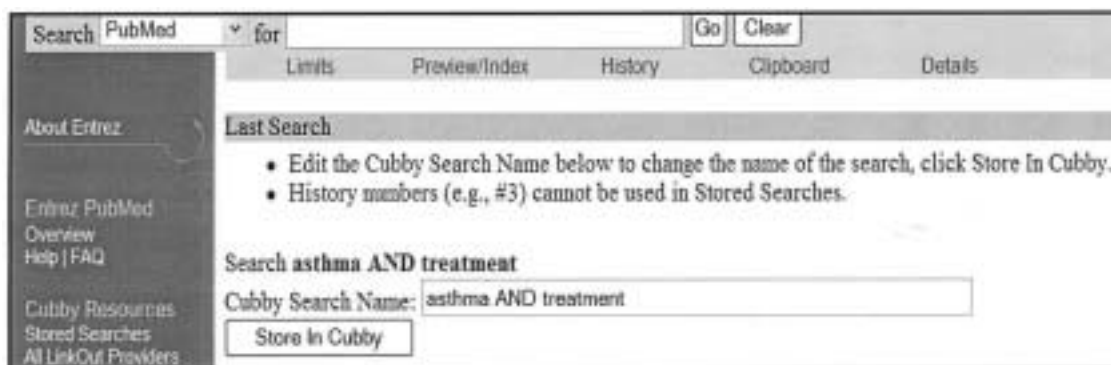

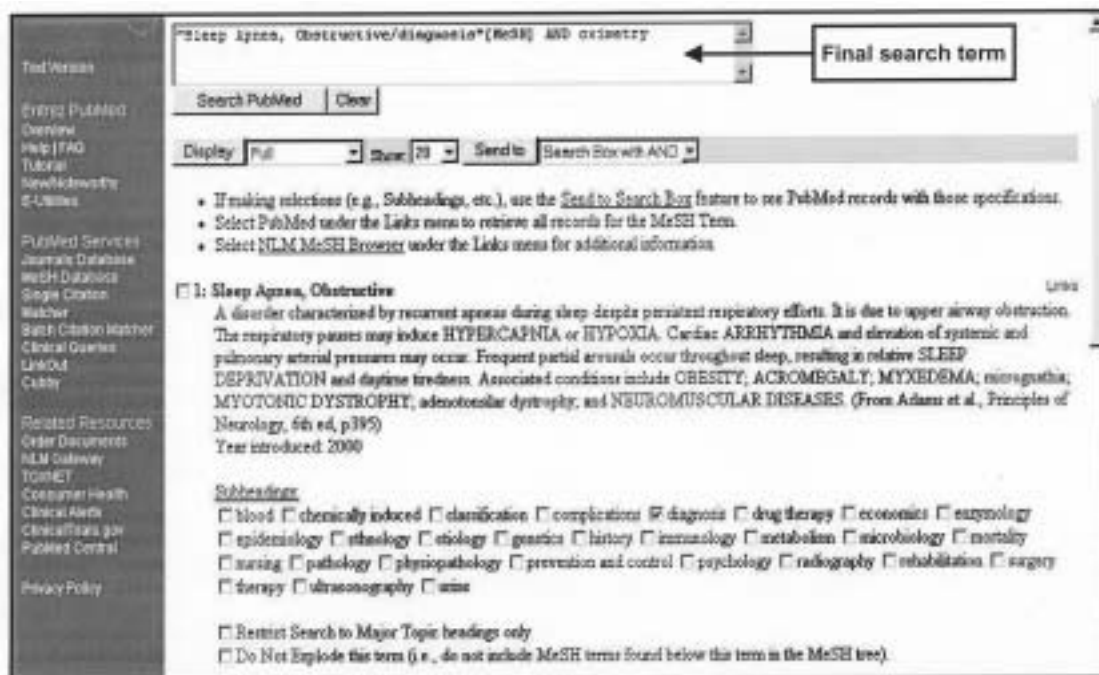
FIGURE 2. Storing searches in Cubby.

FIGURE 3. Using MeSH Database (Medical Subject Headings).

If the Cubby feature does not work, verify that your computer can accept cookies.

CASE 5

You are examining a 55-year-old patient in your office with suspected obstructive sleep apnea whom you would like to refer for nocturnal polysomnography. The earliest available appointment with the sleep specialist is 3 months from now. You would like to quickly review a few specific citations addressing the role of overnight oximetry for establishing the diagnosis of sleep apnea in this patient.

MeSH Database

MeSH is the list of vocabulary terms used for indexing journal articles. MeSH terms are arranged in a hierarchical treelike structure, with the more specific narrower terms indented under the broader terms. MeSH Database is a powerful tool to perform a focused search using MeSH headings and subheadings.

Select MeSH Database in PubMed's sidebar on the left-hand side of the screen. A single query box appears for entering the search term.

Type "sleep apnea" in the query box and select the Go button. Click Sleep Apnea, Obstructive.

Scroll down to Subheadings and select the subheading Diagnosis.

Select the Send To button with the option Search Box with AND selected (the default setting). A new query box opens, displaying the search term "Sleep Apnea, Obstructive/diagnosis"[MeSH].

Add an additional search term by typing "AND oximetry" to the right of the search term already displayed. Your final search term in the query box will show "Sleep Apnea, Obstructive/diagnosis" [MeSH] AND Oximetry (Figure 3). *Select Search PubMed to retrieve the citations.*

Try the same search without using MeSH Database and compare the outputs.

You will notice that your retrieval is more relevant and focused using MeSH Database, and you do not need to remember synonyms, acronyms, and variant spellings.

ADDITIONAL PUBMED FEATURES

Field Tags

In an unqualified search, PubMed searches each term sequentially in the MeSH translation table, Journals translation table, Phrase list, and Author index. Search field tags "force" PubMed to search terms in the specified fields instead of following the standard algorithm. Tags are enclosed in square brackets and placed at the end of the search term. Two useful field tags are title word search and author search.

Title Word Search. Use of the tag [ti] instructs PubMed to restrict the search to article titles. The tag should follow each word in the search.

Type the search term "lung [ti] volume [ti] reduction [ti] surgery [ti]" in the query box. All retrieved citations will have the term "Lung volume reduction surgery" in the title.

Author Search. PubMed recognizes the entry term using authors' last names followed by initials without any punctuation.

To search for articles authored by David Smith, type the search term "Smith D" in the query box. PubMed automatically truncates authors' initials. Thus, searching for Smith D will retrieve citations for all authors with the name Smith D, regardless of middle initials.

To avoid truncation, type author's name in double quotes followed by the [au] tag. Search for David Smith using the search term "Smith D" [au]. When using authors' last names without initials, always use the [au] tag.

A complete list of search field descriptions and tags is available on the PubMed Help/FAQ page.

Select Help in the sidebar and scroll down to References. Select the option Search Field Descriptions and Tags.

JOURNAL SUBSETS

With the Subsets option in Limits you can focus your search further and limit retrieval to specific groupings of citations. The 4 groupings are subject filter (AIDS, Bioethics, Cancer, Complementary Medicine, Space Life Science, and Toxicology); journal groupings (Core clinical journals, Dental journals, History of medicine, and Nursing journals); level of processing (MEDLINE and OLDMEDLINE for Pre1966); and PubMed Central. PubMed Central is a repository of full-text online journals. The subset Core clinical journals limits retrieval to approximately 125 principal journals most likely to be found in a health care library.

HISTORY

All your searches are automatically stored by PubMed and can be retrieved by clicking History in the features bar located just below the query box. A maximum of 100 searches are stored and are cleared after 8 hours of inactivity. Search statement numbers in the History feature can be combined to fine-tune your search. If the History feature does not work, verify that your computer can accept cookies.

DETAILS

By selecting Details in the features bar you can see how PubMed is performing searches. In the Query Translation

box, appropriate changes can be made and the search reinitiated. Clicking on the URL button brings up the link that you can save to retrieve the same search later. You can copy this link from the address box of the browser or save it with the Add Page to Favorites option from your Web browser.

JOURNALS DATABASE

The Journals Database provides a list of all the journals included in various Entrez databases. The information in the Journals Database includes details about the journals and a link to their citations.

Select Journals Database in PubMed's sidebar on the left-hand side of the screen.

Type "JAMA" in the query box.

Click the name of the journal to see details about JAMA.

Now click Links (right side of the page). Select PubMed to retrieve all the citations from JAMA that are indexed in PubMed.

ORDER DOCUMENTS

You can order full text of citations using the National Library of Medicine's ordering process with Loansome Doc. This is an automatic document-ordering system wherein articles can be ordered from a local participating library. Loansome Doc can be accessed through the Order Documents link in the PubMed sidebar.

LINKOUT

LinkOut provides users with links from PubMed to several online resources. These include full-text publications, biological databases, consumer health information, and research tools. LinkOut can be accessed by selecting Links on the right-hand side of the screen after an article is selected. Some LinkOut providers require paid membership to their services.

CONCLUSIONS

PubMed offers multiple options to enable users to conduct focused and relevant searches. Familiarity with these search tools will help users retrieve relevant citations efficiently. PubMed also provides online reference material and a tutorial that may be helpful for both new and experienced users.

REFERENCE
 1. Ebbert JO, Dupras DM, Erwin PJ. Searching the medical literature using PubMed: a tutorial. *Mayo Clin Proc.* 2003;78:87-91.

Questions About Using PubMed

1. Which *one* of the following is a *correct* statement about using PubMed tools?

   a. You must fill all fields to execute a search using the Single Citation Matcher
   b. Citations retrieved using Related Articles are arranged in chronologic order
   c. Clipboard stores citations indefinitely
   d. History and Cubby features work only if your computer accepts cookies
   e. Limits are still in effect when using Related Articles

2. Which *one* of the following is *not* an appropriate strategy to save your search?

   a. Using URL from the Details option
   b. E-mailing the search results using the Send To button
   c. Using URL from the History option
   d. Saving the search results temporarily (up to 8 hours) in the Clipboard
   e. Saving text version of the search results as a Word file

3. Which *one* of the following is a *correct* statement about using PubMed tools?

   a. You can select only a single Subheading associated with a MeSH term
   b. The Preview option is particularly helpful with a slow Internet connection
   c. For a nominal monthly fee, Cubby allows you to review articles published since your last search
   d. Using the Details option allows you to see how PubMed is interpreting your search but does not allow you to modify your search question
   e. You can sort search results by Author and Journal but not by Publication date

4. You want to retrieve articles on smoking cessation that are published between 1994 and 2004 and are authored by Hurt RD from the Mayo Clinic. Which *one* of the following will be your *search term* if you were to use field tags to perform this search?

   a. RD Hurt[au] AND Mayo[ad] AND clinic[ad] AND 1994:2004[dp] AND smoking cessation
   b. Hurt RD[au] AND Mayo[ad] AND clinic[ad] AND 1994:2004[dp] AND smoking cessation
   c. RD Hurt[au] AND Mayo[add] AND clinic[add] AND 1994-2004[dp] AND smoking cessation
   d. Hurt RD[au] AND Mayo[ad] AND clinic[ad] AND 1994-2004[dp] AND smoking cessation
   e. Hurt RD[au] AND Mayo[ad] AND clinic[ad] AND 1994 to 2004[dp] AND smoking cessation

5. You are searching for articles on the treatment of alcohol withdrawal using gabapentin. Using the search term "gabapentin AND alcohol withdrawal," you retrieve only a few citations with 1 article that is relevant to your search. Which *one* of the following PubMed tools is the *most appropriate* for retrieving additional citations that are similar to the article you found to be the most relevant?

   a. MeSH Database
   b. Cubby
   c. Related Articles
   d. Single Citation Matcher
   e. Limits

Correct answers:
   1. *d*, 2. *c*, 3. *b*, 4. *b*, 5. *c*