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PubMed Search: How to get Optimum Results?

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Abstract

There are many articles published regularly in the literature dealing with various aspects of "Research Methodology". Techniques of manuscript writing and various strategies for statistical analysis have been very well documented in the past. However, when it comes to conducting a thorough literature search using the most comprehensive online database i.e. PubMed, the literature is surprisingly scant. Pubmed (Medline) is the primary source of literature search for research citations in medicine. However, getting the optimum result is a difficult task. Often the search results are either too voluminous or not to the point. This article illustrates strategies using which the PubMed search engine can be used optimally to perform a thorough and exhaustive literature search, thereby yielding the desired papers published previously.

Introduction

Performing an accurate literature search is of paramount importance to keep abreast with the ever evolving ophthalmic and medical literature. This endeavour is undertaken primarily to support one's own academic research as well as enhance patient care.

Literature search essentially implies finding answers to a specific set of queries. It involves application of "*keywords*" leading to the identification and retrieval of published papers from readily available electronic databases. However, one must remember that most of the scientific databases are not as intuitive as the Google search engine and hence, do not always yield the desired search results. This can be frustrating to a novice who is unaware of the different strategies that can be applied to refine the search.

There are a number of databases that index medical literature such as PubMed, Scopus, Embase, Cochrane library to name a few. Amongst these, PubMed a web-based retrieval system developed by the National Center for Biotechnology Information (NCBI) is the most widely used. It is part of NCBI's vast retrieval system, known as Entrez. PubMed is a free source and provides links to MEDLINE citations and PubMed Central (PMC), but itself does not contain full text articles. It contains an assortment of more than 22 million scientific papers published predominantly in English language and archives medical literature from 1946. As can be determined from the magnitude of the database, finding a set of relevant papers is like finding a needle in a haystack. This review illustrates strategies using which the PubMed search engine can used optimally to perform a thorough and exhaustive literature search yielding the desired papers published previously.

Understanding the terms:

1. <u>Medline:</u> It is the National Library of Medicine® (NLM®) premier bibliographic database. It contains author abstracts from more than 20 million references archived since 1946.
2. <u>Entrez:</u> It is a Web-based retrieval system developed by the National Center for Biotechnology Information (NCBI) at the National Library of Medicine.

3. <u>PubMed:</u> It is bigger than Medline (26 million citations) and apart from links to the Medline database it also has data of; in-process citations, citations when supplied only electronically by the publisher, pre 1966 citations and citations for the majority of books available on the NCBI Bookshelf.[1] Clinicians seeking information can search PubMed on http://www.pubmed.gov.
4. <u>PubMed Central (PMC):</u> It is a digital archive of all the FREE full-text biomedical and life sciences journal literature.

Basic PubMed search:

PubMed basic search is easy, search terms/phrases are entered in the search box and the "Search" icon is clicked.[2] Automatic suggestions will display as you type your search terms. This is known as "Keyword searching". Figure 1 shows an example of this.

Figure 1: *Key word searching (Source: www.ncbi.nlm.nih.gov/pubmed)*

The homepage provides a feature that allows users to decide the number of results to be displayed, the results to be displayed as abstracts or summary (Figure 2) and sort results based on relevance, date, author, journal or title (Figure 3), so that the search gives the closest desired results. The "similar articles box" in the right hand side of the screen also displays all the closely related articles (Figure 4) and is a very helpful and simple way to find desired result.

Common guidelines to get the optimum search results are:

- Be clear about the objective of the search: The study question i.e. hypothesis along with the primary outcome measure much be clear in the researchers mind. Is it a set of original articles or review articles answering the research question, or an author or a book?

- Is a very precise (to the point) search result desired?
  OR is a more comprehensive search (yielding multiple citations) desired
  OR a combination of the above?
- Identify search keywords (Eg. Diabetic maculopathy)
- Think of other ways to spell the keywords (Eg. Diabetic macular oedema)
- Identify other words which mean the same thing <synonyms> (Eg. Clinically significant macular oedema CSME for maculopathy)
- Identify related keywords which needs to be included (Eg. central foveal thickness).

Below are the less known useful tips for an effective PubMed search

Tip Number 1: The simple clinical (guideline) query.

Although PubMed is mostly accessed for research citations i.e. original articles, review articles etc. but some clinicians might look up PubMed for a simple clinical query such as "What's the guideline for anti VEGF injections in patients with diabetic maculopathy". On the home page of PubMed, look for clinical queries under the heading 'PubMed tools'. The results under the heading 'systematic reviews' will provide the answer as shown in Figure 5.

Tip Number 2: Framing the search questions "The PICO Technique"

Searches will be successful if users put up "well-built clinical questions." Such questions are constructed by breaking down questions that arise from a clinical encounter into four components commonly referred to as the PICO technique where[3]:

1. P stands for: Patient/problem/population
2. I stands for: Intervention/Exposure
3. C stands for: Comparison intervention/control
4. O stands for: Outcome (result)

For example "In patients with diabetic maculopathy, does the treatment of anti vascular endothelial growth factors improve symptoms?" In this query the patient/problem would be "diabetic maculopathy," the intervention would be "anti vascular endothelial growth factors," the control would be "no treatment," and the outcome would be to "improve symptoms."

Tip Number 3: Using Boolean search:

PubMed searches can be refined by using multiple search terms connected by Boolean operators: AND, OR, and NOT. Boolean operators must be entered in upper (capital) case.[2] AND selects the references that contain both search terms (narrow search), OR selects the references that contain either search term (wider search), and NOT selects the references that contain the first term but not the second term. NOT should be used carefully, if at all. If you do not include Boolean operators in your search, PubMed will automatically use AND between terms. The Figure 6 depicts these concepts in a pictorial manner.
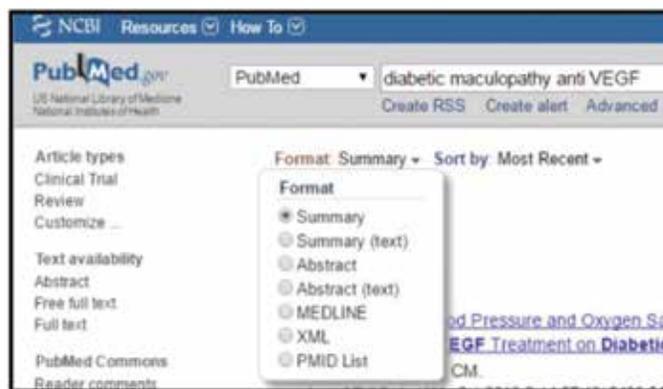
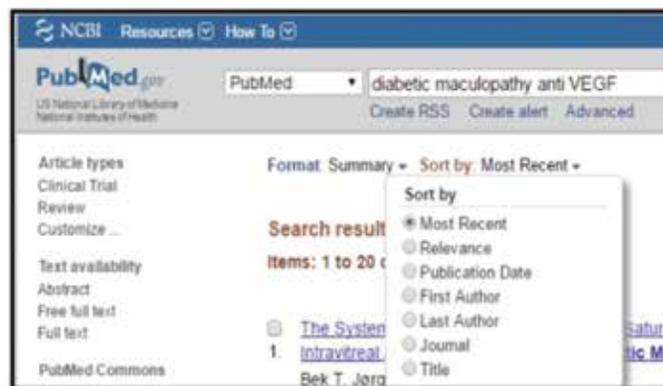**Figure 2:** *Home Page (Source: www.ncbi.nlm.nih.gov/pubmed)*

Figure 3: *Home Page (Source: www.ncbi.nlm.nih.gov/pubmed)*

Figure 4: *Similar article box (Source: www.ncbi.nlm.nih.gov/pubmed)*

Tip Number 4: Use 'Nesting"

This is actually a subset of the Boolean search but is worth a separate mention, as it can be really fruitful in many cases. When using multiple Boolean operators in PubMed, they are processed left to right. Example: Suppose we wish to study the incidence of maculopathy in diabetic patients who are getting Anti VEGF injections, we can write. "Maculopathy AND diabetes OR Anti VEGF", this will retrieve records that include both terms Maculopathy AND Diabetes as well as all records with the term Anti VEGF whether or not they contain the other two terms.

To change the order in which terms are processed, enclose the terms(s) in parentheses. The terms inside the set of parentheses will be processed as a unit and then incorporated into the overall strategy. This is called nesting.

Example: Maculopathy AND (Diabetes OR Anti VEGF). This will retrieve records that contain the term Maculopathy as well as one or both of the terms Diabetes OR Anti VEGF as shown in Figure 7.

Tip Number 5: Use Filters

PubMed allows users to refine searches further by imposing Limits. Limits include: publication type, search field (Title/abstract), age and sex, date of publication, language, human or animal, or journal subsets as shown in the Figure 8. Click the icon "Show additional filters" to display all filters. You can uncheck them or click Clear All.

You can make several custom filters if you register (free) with My NCBI.

Important note: Filters other than language or date will exclude records in process.

Filters remain active for all subsequent searches until you clear them.

Tip Number 6: Use Truncation (Wildcards)

If you do not know the correct spelling, use an asterisk (*) at the end of a word.

Example: bacter* retrieves bacteria, bacterium, bacteriophage, etc. However, this is not generally recommended as it may give erroneous results.

Advanced Searching Techniques

A. Use Advanced Search (Search Builder) (Figure 9)

The Advanced Search page includes a feature "Search builder" to search by individual fields (for example; Author, Journal, MeSH fields) in the PubMed record.

Select AND, OR or NOT similar to the Boolean search described above to combine your search with any search components already in the search box as shown in the Figure 10. When you have completed building your search, click the Search icon. You can also view and combine searches from the previous 8 hours of your search history.[4]

Searches can be also be combined or used in subsequent searches using the search number from Advanced search history using the # sign in between.

B. MeSH Database

The language of medicine is varied and often concepts are

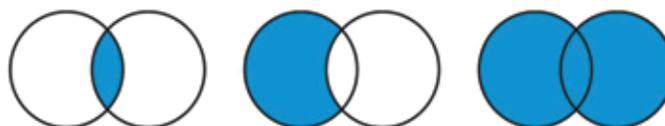**Figure 5:** *Clinical queries (Source: www.ncbi.nlm.nih.gov/pubmed)*
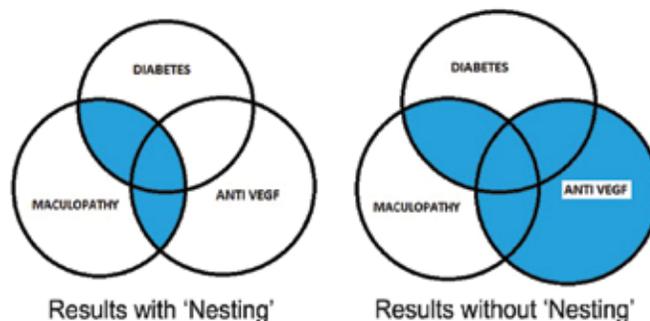

Figure 6: *Boolean search*

Results with 'Nesting'   Results without 'Nesting'

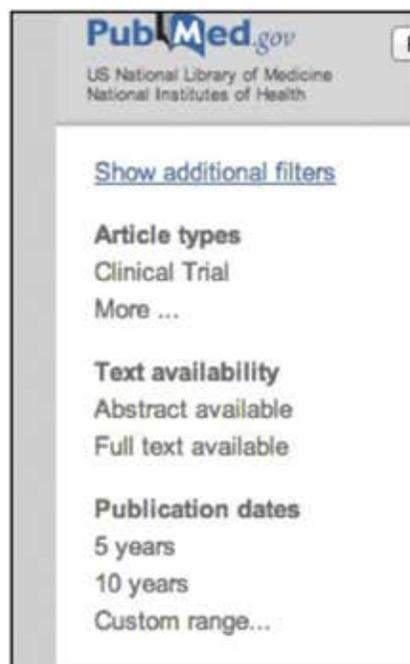**Figure 7:** *Results with and without nesting*

Figure 8: *Use of filters (Source: www.ncbi.nlm.nih.gov/pubmed)*

Figure 9: *Advance search (Source: www.ncbi.nlm.nih.gov/pubmed)*

described by using a wide range of synonymous words. The list is like a thesaurus. So PubMed calls its thesaurus MeSH (Medical Subject Headings). MeSH search is all about finding that right word. It also suggests you every possible synonym or alternate spelling of your search terms. MeSH terms help in selecting the most accurate keywords that go a long way in obtaining the desired search results.

MeSH database is accessed from the pull down menu to the left of the search box, or directly from the home page as shown in Figure 11.

What MeSH search does is to:
• Locate and select appropriate MeSH terms
• View the definition and other helpful information for a MeSH term including the MeSH hierarchy
• Attach subheadings for a search and/or limit MeSH terms to a major concept for a search
• Build PubMed search strategies. (Figure 12)

A subject heading search helps when the keyword selected has many meanings. For e.g. I need information on AIDS, the disease. The computer will pick up handicapped aids, visual aids, diabetes aids, etc.

This provides a reliable way to retrieve citations that use different terminology for the same concept because it indexes articles based on content rather than on the words of the authors.

To look up official MeSH terms, view hierarchical relationships to other subject headings and subheadings, and incorporate them in your PubMed search.

Once you find your terms, select any desired Subheadings and if the search is to be a Major Topic of the article, then click the Add to search.
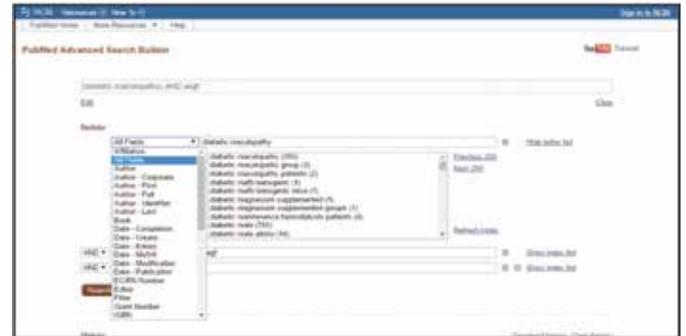

Figure 10: *Advance search builder (Source: www.ncbi.nlm.nih.gov/pubmed)*

Figure 11: *MeSH database (Source: www.ncbi.nlm.nih.gov/pubmed)*

Figure 12: *Summary of MeSH technique using the example 'Diabetic macular oedema' (Source: www.ncbi.nlm.nih.gov/pubmed)*

C. Field Tags

Tags specify the fields to search for your terms.

Example: glaucoma [mh] AND quigley [au] AND 1993[dp]] searches for glaucoma as a MeSH term [mh], Quigley as author [au], and 1993 as publication date [dp].

Common data entry mistakes that will result in an erroneous "No Documents Found" message (Table 1).

Table 1: Data Entry Mistakes that will result in an erroneous "No Documents Found" Message

Oculoplasty (mh)	• Parentheses used instead of square brackets.
Occuloplasty [mh]	• Misspelled term (one extra C)
[mh] Oculoplasty	• Pre-qualification does not work; you must post qualify.
Oculoplasty [mh] or proptosis [mh]	• Boolean OR is not capitalized. PubMed will replace "or" with AND.
Oculoplasty [mh] & eng [la]	• English is not spelled out.
Oculoplasty [mh] & 95 [yr]	• Must be used with a four-digit year.

Other useful features of PubMed

1. Finding free full text

The following are the ways of finding a free full text.

A. Use 'free-full-text' filter from the filter menu (left hand side) on pubmed search page.
B. In the Abstract display, click the "Free in PMC" icon (right hand top corner of the page) to link to the article in PubMed Central.
C. Look for 'Free from the publisher' link on the top right location of detailed abstract display. Remember most of the Full text materials are available either on subscription or Pay per view mode.

2. MyNCBI

One can register for My NCBI by creating a user Name and Password. My NCBI is a free service and stores both citations and search strategies. You may save, mail, export and print your searches too. Once a desired and fairly accurate search result is obtained, the entire search can be saved on My NCBI account. One can create email alerts (daily, weekly or monthly) when newer publications related to the same search keywords are published. Similarly, one can create "Collections" where only selected papers from a particular search are archived via the My NCBI account. Additionally, one can create his/her own "bibliography" of his/her own published papers indexed in the Medline database.

Summary

PubMed is a vast resource of medical literature and finding the right information is difficult if the right techniques of search are not known. Just by having a better understanding of the searching techniques, like Boolean terms, nesting and filters, one can find the right literature easily. The advance search techniques of Building the search and MeSH terms must be learned by a researcher and utilized for more precise results. PubMed has very informative video and text Tutorials for all its features and detailed tutorials are available at the following link https://learn.nlm.nih.gov/rest/training-packets/T0042010P.html

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