Book chapter:

Strategies for searching the Internet for Orthopedic Surgeons: Tips and Tricks

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Table of contents

Abstract

Internet provides access to large amounts of information quickly, provides a flexible learning platform, and is easily accessible from anywhere, especially with new technologies.

Web-based search engines and bibliographic databases, have already become part of a doctor's everyday life.

However, even well-published researchers often fail to appreciate the background knowledge required to conduct a good literature search on the internet.

Using the right techniques can improve the ability to search for relevant information

This chapter briefly outlines the internet for information resources such as Google, Google Scholar, PubMed, Cochrane for orthopedic surgeons. Also the subsequent sections of the chapter offers combining search engines tips and tricks for a best search that orthopedic surgeons can use to improve their use of web-based information and learning resources.

Introduction

The impact of the internet on orthopedics and traumatology has been revolutionary. Compared with traditional education instruments, the Internet offers numerous advantages. It provides access to large amounts of information quickly, provides a flexible learning platform, and is easily accessible from anywhere, especially with new technologies. Furthermore, instruction is enhanced with audiovisual material and easily updated and modified to suit changing learning needs.

Web-based search engines and bibliographic databases, such as Google, Google Scholar and PubMed, have already become part of a doctor's everyday life. However, many doctors do not know the best ways to maximize their efficacy, and some doctors are still not using them at all. Sinkov et al. reported that a majority of orthopedic surgeons (79%) use the internet for at least some of their continuing learning(Sinkov et al. 2004), but the study also reported that attending orthopedic surgeons do not use the internet as often as orthopedic residents do, suggesting a learning gap.

Surprisingly even well-published researchers often fail to appreciate the background knowledge required to conduct a good literature search on the internet. Using the right techniques can improve the ability to search for relevant information; without them, however, internet literature searches can become time-consuming and even misleading. A study that examined how using PubMed and Google contributed to physicians' diagnostic skill showed that some physicians actually made the correct diagnosis earlier in the investigation and then incorrectly changed their diagnoses after conducting an internet search about their decision.(Falagas et al. 2009) (Fig.1)

This chapter briefly outlines the internet as an information resource for orthopedic surgeons and offers some simple techniques that orthopedic surgeons can use to improve their use of web-based information and learning resources.

Databases & search engines

Electronic databases provide an index of multiple journals, and include citations, abstracts, and sometimes a link to the full text. They are updated with newly published articles. Many are useful in the practice of orthopedic surgery. For instance, they can help surgeons keep track of new findings in the field or search for specific information on specific techniques or outcomes.

The databases can be classified based on their field (medicine, nursing, etc.) and can be searched via specialized search engines (Table 1).

Pubmed (National Library of Medicine Database)

The National Center for Biotechnology Information (NCBI) at the National Library of Medicine (NLM) developed PubMed as part of the Entrez retrieval system.(National Center for Biotechnology Information) At time of publication, PubMed provides access to approximately 23 million citations. This includes the content in the NLM's database of biomedical journals listed in MEDLINE, life science journals, and relevant online books. Most material includes indexed citations and abstracts, with some full-text available. Pubmed is updated Tuesday through Saturday and is freely available to anyone with an internet connection. Academic institutions can link their electronic subscriptions to PubMed offering their users enhanced access to full-text articles.

Pubmed provides a free NCBI account, "My NCBI" allows users to store keyword and MESH searches. When new results match the keyword and/or MESH search specifications, users are emailed automatically. Researchers can specific how often they wish to receive search alerts. (Fig.2)

My NCBI » Saved Search Settings

✅ Save Search successful.

Your PubMed search

Name of saved search: "Anterior Cruciate Ligament Reconstruction/t ⊗

Search terms:

    "Anterior Cruciate Ligament
    Reconstruction/therapy"[Mesh]

Test search terms

E-mail: dan.kipnis@jefferson.edu (change)

Would you like e-mail updates of new search results?
  ○ No, thanks.
  ⦿ Yes, please.
    Frequency: [Monthly ▾]
    Which day? [the first Saturday ▾]

Formats:
  Report format: [Abstract ▾]

Number of items:
  Send at most: [5 items ▾] ☐ Send even when there aren't any new results

Any text you want to be added at the top of your e-mail (optional):

[Save]   [Cancel]   [Delete]

"My NCBI" also allows storing and managing bibliographies, creating customized collections of PubMed citations, activating search filters, creating a CV and viewing recent searches.

Articles can be searched in two ways: by search terms including words in the title, abstract, authors' names, and institution or by controlled subject headings, known as medical subject headings (MeSH).("No Title") The best searches in PubMed combine both techniques, keywords

and MeSH, when building search strategies. For example, researchers can view programmed searches created by RB Hayes in PubMed. (Fig.3)

Category	Optimized For	Sensitive/ Specific	PubMed Equivalent
therapy	sensitive/broad	99%/70%	((clinical[Title/Abstract] AND trial[Title/Abstract]) OR clinical trials[MeSH Terms] OR clinical trial[Publication Type] OR random*[Title/Abstract] OR random allocation[MeSH Terms] OR therapeutic use[MeSH Subheading])
	specific/narrow	93%/97%	(randomized controlled trial[Publication Type] OR (randomized[Title/Abstract] AND controlled[Title/Abstract] AND trial[Title/Abstract]))
diagnosis	sensitive/broad	98%/74%	(sensitiv*[Title/Abstract] OR sensitivity and specificity[MeSH Terms] OR diagnose[Title/Abstract] OR diagnosed[Title/Abstract] OR diagnoses[Title/Abstract] OR diagnosing[Title/Abstract] OR diagnosis[Title/Abstract] OR diagnostic[Title/Abstract] OR diagnosis[MeSH:noexp] OR diagnostic * [MeSH:noexp] OR diagnosis,differential[MeSH:noexp] OR diagnosis[Subheading:noexp])
	specific/narrow	64%/98%	(specificity[Title/Abstract])
etiology	sensitive/broad	93%/63%	(risk*[Title/Abstract] OR risk*[MeSH:noexp] OR risk *[MeSH:noexp] OR cohort studies[MeSH Terms] OR group[Text Word] OR groups[Text Word] OR grouped [Text Word])
	specific/narrow	51%/95%	((relative[Title/Abstract] AND risk*[Title/Abstract]) OR (relative risk[Text Word]) OR risks[Text Word] OR cohort studies[MeSH:noexp] OR (cohort[Title/Abstract] AND study[Title/Abstract]) OR (cohort[Title/Abstract] AND studies[Title/Abstract]))

Under PubMed Tools from the homepage click on 'Clinical Queries' and then click on filter information to view clinical queries using research methodology filters.

Note how the searches combine the use of search tags (i.e., title, abstract) and MeSH terms when available. Using both search techniques results in more comprehensive search results. In addition, the truncation symbol is used. The truncation symbol is used to look for variants of a root word so "random*" will retrieve random, randomizing, randomization, etc.

Another method to search PubMed is to create a set of only Orthoepadic journals and then combine search terms. From the PubMed homepage click on 'Journals in NCBI Databases' and enter ortho* to retrieve all journals with variations of orthopedics in the title indexed by PubMed. (Fig.4)

In addition PubMed also allows search results to be narrowed using several limiters including: article type, text availability, publication dates, journal categories, ages etc.

EMBASE

Excerpta Medica database (EMBASE) is the electronic database of biomedical journals published by Elsevier. It contains about 25 million records with a coverage of over 7,600 journals from 90 countries from 1974 to the present.("For Answers to Your Biomedical Research Questions, Look to Embase") Think of EMBASE as the European version of MEDLINE. There is about a 40% overlap in coverage between EMBASE and MEDLINE.("Electronic Bibliographical Databases and Their Limitations" 2009) EMBASE contains many European publications that are not included in MEDLINE and it is more comprehensive in the areas of pharmacology, psychiatry and biomedical engineering. EMBASE features deep drug indexing that allows for unique tracking and precise retrieval of drug adverse events in the published literature.

EMBASE requires a subscription.(Elsevier Life Science Solutions) Embase pricing is based on the number of biomedical users and currently offers only institutional access. At the time of publication there is no individual access.("No Title") It should be noted that EMBASE records are indexed in Scopus, although in Scopus you cannot search with EMTREE subject headings, which are the proprietary subject headings used by EMBASE. (Fig.5)

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Evaluating the source and content of orthopaedic information on the Internet: The case of carpal tunnel syndrome

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▾ View references (6)

Abstract

Background: The Internet has become a popular source of medical information for patients. Authors of health-related web pages are not required to adhere to any standard for medical content or accuracy. The goal of the present study was to assess the type, quality, and reliability of information about carpal tunnel syndrome that is available on the Internet. Methods: The search phrase 'carpal tunnel syndrome' was entered into five commonly used World Wide Web search engines. The search results then were given as an ordered list of universal resource locators, or web-site addresses. The top (first) fifty web sites from each of the five searches were combined to create a master roster of 250 web-site addresses. These web sites then were evaluated for authorship and content, and an informational value score ranging from 0 to 100 points was assigned to each. Results: Thirty-three percent of the sites sold commercial products for the evaluation or treatment of carpal tunnel syndrome. An additional 30 percent were commercial web sites that did not sell products. Only 23 percent of the sites were authored by a physician or an academic organization. Fewer than half of the sites offered conventional information. Twenty-three percent of the sites offered unconventional or misleading information. The mean informational value of the web sites was 28.4 of a possible 100 points. Conclusions: The information about carpal tunnel syndrome on the Internet is of limited quality and poor informational value. The public and the medical communities need to be aware of these limitations so that the quality of medical information available on the World Wide Web can be improved.

Indexed keywords

EMTREE medical terms: accuracy; article; carpal tunnel syndrome; computer system; evaluation; image quality; information service; Internet; medical information; **orthopedic** surgery; priority journal; reliability

MeSH: Carpal Tunnel Syndrome; Humans; Information Services; Internet; Orthopedics; Patient Education
Medline is the source for the MeSH terms of this document.

Cochrane Library

The Cochrane Library is a collection of six databases that contain different types of high-quality, independent evidence to inform healthcare decision-making, and a seventh database that provides information about groups in The Cochrane Collaboration. (The Cochrane Collaboration)

- Cochrane Database of Systematic Review
- Cochrane Central Register of Controlled Trials (CENTRAL)
- Cochrane Methodology Register
- Database of Abstracts of Reviews of Effects (DARE)
- Health Technology Assessment Database
- NHS Economic Evaluation Database
- About The Cochrane Collaboration

As of January Issue 1, 2014, Cochrane Database of Systematic Reviews included around 6000 reviews and 2500 protocols.

CENTRAL includes details of published articles taken from bibliographic databases (notably MEDLINE and EMBASE), and other published and unpublished sources. CENTRAL records include the title of the article, information on where it was published (bibliographic details) and, a summary of the article, in many cases, but no full-text articles. CENTRAL merges records from MEDLINE and with relevant records from EMBASE.(The Cochrane Collabaration)

DARE covers abstracts of reviews in fields of diagnostic tests, public health, health promotion, pharmacology, surgery, psychology, and the organization and delivery of health care. It is a helpful resource for health care decision-makers who are seeking answers to questions about the effects of specific interventions.

As of publication, there are 397 Orthopaedics and Trauma Cochrane Groups. For example, one group has reviews on 'Overuse Injuries' and one topic investigates the use of Foot Orthoses for patellofemoral pain in adults. Each Cochrane Systematic Review is comprehensive. Each review includes background, objectives, methods used, all results, data and analyses, history, declaration of interest, sources of support and index terms. In vernacular terms, each review will show their work. In addition, each review includes a Plain Language Summary to help answer a clinical question. In summary, researchers should start their research in Cochrane to see if they have examined and answered a clinical question being investigated. It should be noted that Cochrane systematic reviews take time to write and are rare.

CINAHL

Cumulative Index to Nursing and Allied Health Literature (CINAHL) is a research tool for nursing and allied health professionals. It provides full-text access to more than 1,300 journals and indexing for more than 4,000 journals. The database contains more than 1,000,000 records back to 1982. Offering complete coverage of English-language nursing journals and publications from the National League for Nursing and the American Nurses' Association, *CINAHL* covers nursing, biomedicine, health sciences librarianship, alternative/complementary medicine, consumer health and 17 allied health disciplines. CINAHL offers access to health care books, nursing dissertations, selected conference proceedings, standards of practice, educational software, audiovisuals and book chapters. It also provides additional nursing and allied health research material including health care books, select conference proceedings, an evidence-based care sheet, and quick lesson disease overviews.(EBSCOhost) The index was first published in 1961 and went online in 1984. CINAHL has been published by EBSCO Publishing since 2003 and available exclusively on the EBSCOhost platform since 2006. (Wikipedia)

Web of Science (WoS)

Web of Science (WoS) provides access to three multidisciplinary databases of bibliographic information. It is indexed so that specific articles can be searched by subject, author, journal, and/or author address. Each WoS database includes the article's cited reference list (often called its bibliography). This unique feature allows searching for articles that cite a known author or work.(Thomson Reuters)

Scopus

Scopus is an abstracts database covering articles from peer-reviewed titles, including international publishers. It is a cross-disciplinary database indexing subjects including: chemistry, physics, mathematics and engineering; life and health sciences; social sciences, psychology and economics; biological, agricultural and environmental sciences; and general sciences.(Elsevier Life Science Solutions) It should be noted that MEDLINE citations are indexed in Scopus, so many of the citations that are indexed in PubMed will be indexed in Scopus. So the question becomes why search Scopus if MEDLINE citations found in PubMed are indexed in Scopus?

There are several reasons to search a bibliographic database such as Scopus.

First, it indexes 21,915 journal titles from over 5,000 publishers and over 52 million records. Compared to PubMed, Scopus is larger in scope, with 21,915 versus 5,096 journals.("Number of Titles Currently Indexed for Index Medicus® and MEDLINE® on PubMed®" 2014) And at time of publication, 23 millions citations indexed in PubMed versus 52 million records indexed in Scopus.
Second, Scopus provides cited by analysis to help determine how often works have been cited in the scientific literature. Cited by analysis has its critics, but when pressed for time cited by analysis helps to filter out which journal articles are being read and cited by other authors. (Sarli 2010)

Third, most of the citations from the mid-90s include complete bibliographies within the record without accessing full-text, which allows researchers to work backwards to locate related and relevant research.

Fourth, the ability to search for conference and meeting abstracts and patents as a secondary source.

Google and Google Scholar

Google is the most widely used search engine in the world and it is often used for health-related information by patients as well as medical professionals. Many studies have assessed the information reliability on Google searches not only in English but also in many other languages.(Küçükdurmaz et al. 2013) Almost all of them demonstrated that the quality of information provided by Google was low and that there was no correlation between the search engine rating and the reliability of the provided information. This poses an important problem, especially for patients who may retrieve inaccurate medical information using Google. The low reliability of highly ranked webpages is considered to have a high impact on public health, but it goes beyond the scope of this chapter.

However Google Scholar, which Google launched November 2004 to provide a simple way to broadly search for scholarly literature, appears to be a valuable resource. In particular, studies

have demonstrated that Google Scholar has value for initial literature searches, although for more comprehensive searches, bibliographic databases are more effective. (Dapra 2012)

Google Scholar indexes the following:

- Scholarly journal articles
- Article preprints, postprints
- Working papers
- Dissertations
- Theses
- Technical Reports
- Scholarly books
- Abstract collections
- US legal opinions

Google Scholar does not index:

- News articles
- Magazine articles
- Press releases and announcements
- Images
- Editorials
- Books Reviews
- Trip Reports

Shariff et al. compared PubMed with Google Scholar and found that Google Scholar retrieved twice as many relevant articles (PubMed: 11%; Google Scholar: 22%; *P < 0.001*) and with a similar precision. According to the study, Google Scholar also provided significantly greater access to free full-text publications (PubMed: 5%; Google Scholar: 14%; *P < 0.001*).(Shariff et al. 2013) Furthermore, Nourbakhsh et al. found that PubMed searches and Google Scholar searches often identify different articles. In their study, Google Scholar articles were more likely to be classified as relevant, had higher numbers of citations, and were published in higher impact factor journals. (Nourbakhsh et al. 2012)

Search techniques can be combined for specific searches. For example, in Google:

("anterior cruciate ligament reconstruction" OR "ACL reconstruction") site:edu filetype:ppt

will retrieve web results that mention "ACL reconstruction" from education domains and are PowerPoint slides.

To further reduce search results researchers can add intitle: prior to keywords to search for terms in the title of the web page.

(intitle:"anterior cruciate ligament reconstruction" OR intitle:"ACL reconstruction") site:edu filetype:ppt

Another technique is adjacency, where search terms can be searched near each other.

("anterior cruciate ligament AROUND(4) reconstruction" OR "ACL AROUND(4) reconstruction") site:edu filetype:ppt

This search strategy will look for the terms "ACL" and "reconstruction" within 4 words or less of each other.

Grey literature and its impact on evidence

Grey literature is defined as the literature produced by government, academics, business, and industry that is available in print and electronic formats but that is not controlled by commercial publishers.("Grey Literature" 1999) Examples of grey literature would include white papers, preprints, technical reports etc. In short, grey literature is defined as literature that is not formally published in sources such as books or journal articles.(Higgins and Green 2008)

Evidence suggests that grey literature may differ in important ways from the more easily retrieved studies.(Conn et al. 2003) Well documented differences have fueled a debate about whether grey literature should be included in literature searches or not.(Conn et al. 2003) For example, conference abstracts and other grey literature have been shown to be sources of approximately 10% of the studies referenced in Cochrane Reviews. (Mallett, Hopewell, and Clarke)

The most noteworthy difference between published and unpublished research is that published research is more likely to report findings that are statistically significant, commonly referred to as bias against the null hypothesis.(Dickersin, Min, and Meinert 1992; Easterbrook et al. 1991; Rosenbaum, Sterling, and Weinkam 1995) Research reports with statistically significant findings are more likely to be published in English and in widely distributed journals that are indexed in computerized databases and have high citation impact factors. (Begg and Berlin 1989)

Conn et al. found that the meta-analyses that exclude grey literature likely (a) over-represent studies with statistically significant findings, (b) inflate effect size estimates, and (c) provide less precise effect-size estimates than meta-analyses including grey literature.(Conn et al. 2003) In this sense, Dickersin et al. found that failure to include unpublished studies compromises the validity and reliability of meta-analysis when unpublished findings differ in some systematic way from published findings. (Dickersin, Min, and Meinert 1992)

Combining search engines

Some databases, such as PubMed and EMBASE, are more likely to contain literature that is relevant to the practice of orthopedic surgery. Furthermore, differences in programming and algorithms between search engines often results in the delivery of different results in response to the same keyword search. For the most complete results, searching at least two databases is recommended when performing a comprehensive review of the literature.

The combined use of Pubmed, EMBASE, and Cochrane identifies a very high percentage of primary research included in orthopedic surgery meta-analyses. There are certain limitations of databases (Table 2), but Slobogean et al. found that a combined search of MEDLINE and EMBASE retrieved 91% of the primary studies. The addition of Cochrane improved retrieval to 97%. The additional use of the Cochrane databases is important because it increases the search yield of conference proceedings and abstracts.

Additional searches of databases such as WoS, SCOPUS, and CINAHL did not increase the recall rate; however, conference proceedings and journal supplements should still be searched to ensure that relevant remaining reports are identified. (Slobogean et al. 2009)

A tip when searching Google: Google search results are different based on where the searches are conducted. So a search you run in your office will differ from a search you run at work, unless of course you work from home. Google attempts to automatically detect a user's location and provide customized results. Results are based on IP address. Obviously this become important when searching for local dining establishments, but your results will change if you search US Google versus UK Google (www.google.co.uk), versus Google Turkey (www.google.tr) To improve results try changing your location setting("Change Your Location on Google")and turn off search history personalization("Search and Browse Privately"). Also keep a record of your search strategy including time, date and relevant search results found, since recreating the search isn't consistent.

Tips and tricks for a best search in a bibliographic database

A reproducible, efficient, time-saving search is not a talent but rather a learnable skill. And if time is not a luxury, make sure to seek out a librarian who can help to find relevant terminology, help structure a search strategy, recommend databases and manage bibliographic

citations.(Sollenberger and Holloway 2013) The key to successful and time-efficient information identification is to use easily accessible, complete, and up-to-date information. The search should aim to exclude the irrelevant evidence while catching the necessary evidence.

Basic suggestions for a literature search:

1. Define the scope the search.
    a. Design the question. Use PICO(T) template to help structure your question. (Riva et al. 2012)
    b. Select valid inclusion and exclusion criteria.

2. Choose the right search engines or bibliographic database(s) for the type of evidence you want to retrieve.

3. Choose the right search terms. This is particularly important. Using Medical Subject Headings (MeSH) terms helps retrieve more accurate results and is particularly useful if different terminology was used for the same concepts. MeSH uses a hierarchical terminology categorization systems (Table 3) that is based on subject analysis of biomedical literature at NLM. This feature can be accessed via Pubmed main webpage (Fig. 6).
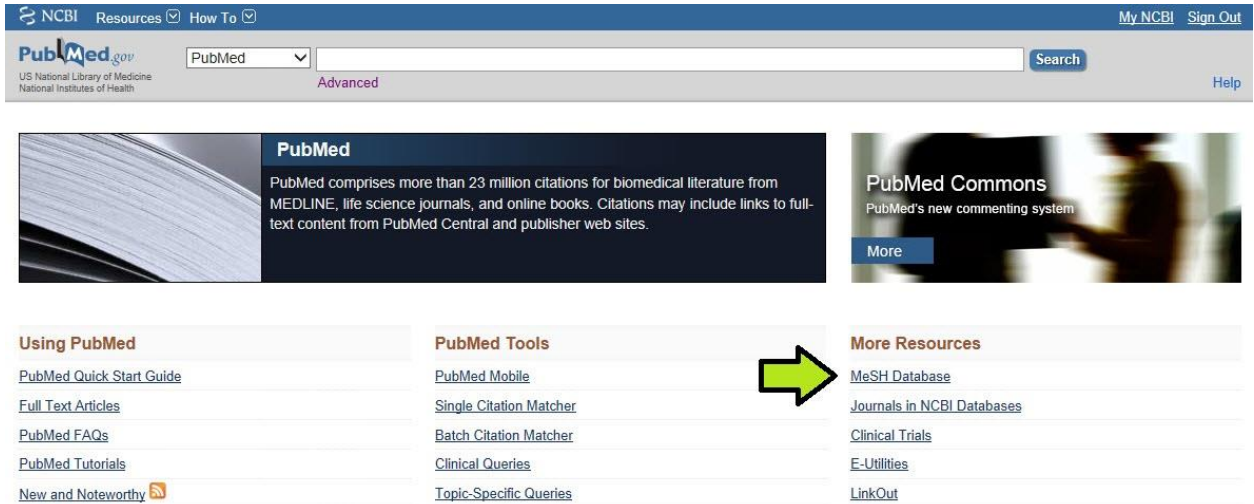
Multiple terms can be added (AND), excluded (NOT), or searched together (OR) at the same time with using search builder function for a specific field in a particular topic. (Fig.7 a, b)("PubMed® Online Training")

4. Use Boolean logic to include, exclude, or combine the keywords and queries (Fig.8 a, b, c).
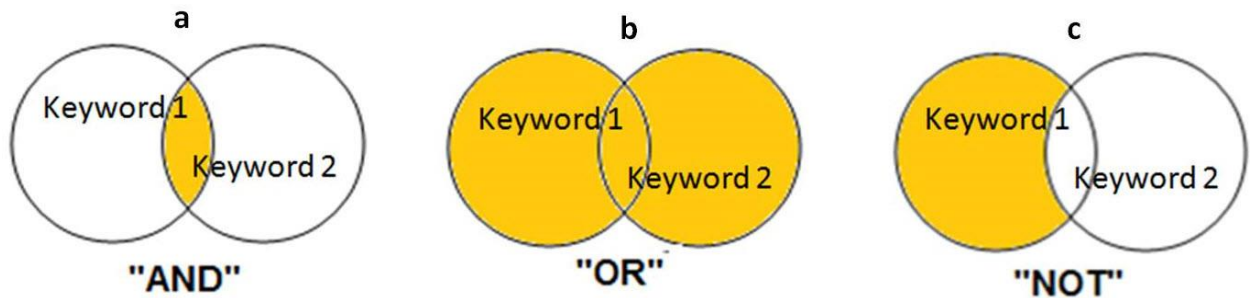
5. Use truncation when searching keywords to look for variations of the root word.
6. Almost all search engines of bibliographic databases have an "advanced search" option. This offers many ways to prefilter the search queries (Fig.9 a, b).

A search can include the name of an author, journal, publishing date, language MeSH terms (see below), among many other options. Also the advanced search makes it possible to combine more than one search. These searches can then be merged or excluded after making them separately by using Boolean logic (Fig.10).

Search #1
Keyword(s) #1 **AND** Keyword(s) #3
OR Keyword(s) #3

Search #2
Keyword(s) #4 **OR** Keyword(s) #5 **NOT**
Keyword(s) #4

Search #1
$\begin{bmatrix} \text{"AND"} \\ \text{"OR"} \\ \text{"NOT"} \end{bmatrix}$
Search #2

Final results
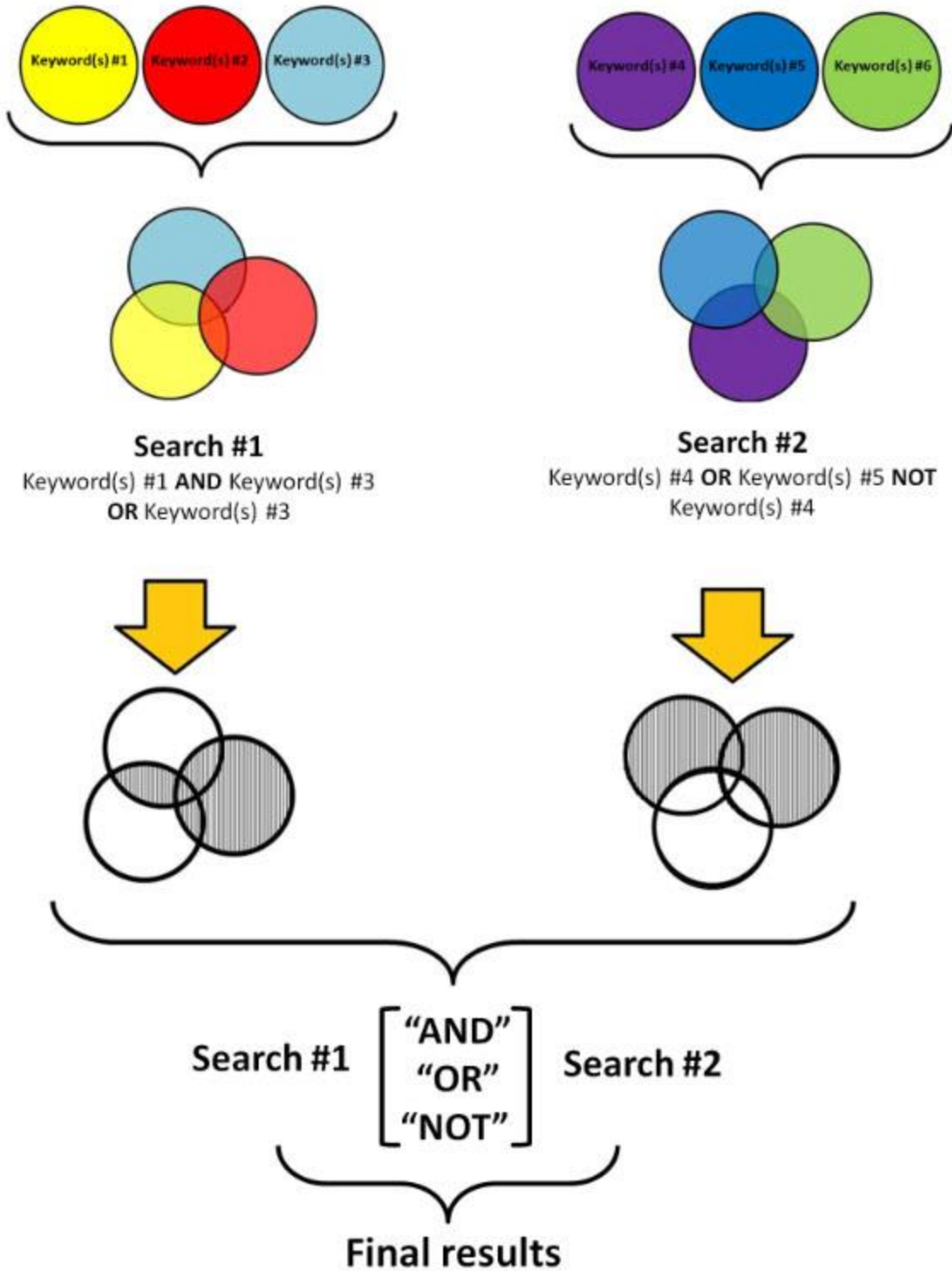
These brief but basic principles are valid for every search engine or bibliographic database. For additional information on searching techniques, all search engines have links to tutorials explaining the most effective way to carry out a search using that particular search engine. Use

of these free tutorials is strongly suggested prior to use. Other guides can be found online at YouTube. And don't forget to consult with a librarian.

Conclusion

In summary, the researchers should be trained for making an efficient and effective search. Because there are different search engines and databases with spesific features. In order to make a comprehensive search, it is recommended that searching multiple bibliographic databases and search engines is optimal for finding relevant citations. There will be overlap in results, but it behooves researchers to search multiple resources to be sure that the best available research is used to answer clinical questions.

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Figure Legends:

Figure 1: Reliability of Google is a concern for patients and medical professionals

Figure 2: Saving search strategies in PubMed

Figure 3: Clinical Queries using research methodology filters built by RB Haynes.

Figure 4: Creating a search where variations of the word orthopeadic appear in the journal title

Figure 5: EMTREE medical terms indexed in Scopus

Figure 6: MeSH can be accessed from the main page of Pubmed

Figure 7: MeSH database allows to specify your search subtopic (a) and to build a search with using Boolean operators at the same time (b)
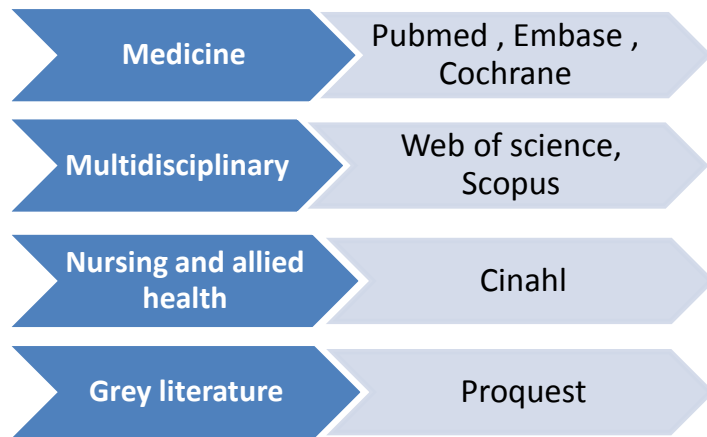
Figure 8: "Keyword 1" AND "Keyword 2" : include "Keyword 1" and "Keyword 2" togather (a) "Keyword 1" OR "Keyword 2" : include either "Keyword 1" or "Keyword 2" (b), "Keyword 1" NOT "Keyword 2" : include "Keyword 1" exclude "Keyword 2" (c)

Figure 9: The advanced search buttons are seen for Cochrane (a) and Pubmed(b). It is possible to build a search with using functions appeared under drop-down menus

Figure 10: Different search results can be composed to yield the final results

Tables

Table 1. **Table 1.** Most commonly used search engines of databases based on their field

Medicine	Pubmed , Embase , Cochrane
Multidisciplinary	Web of science, Scopus
Nursing and allied health	Cinahl
Grey literature	Proquest

Table 2. Limitations of databases

- Search results from bibliographic databases depend on the search strategy used
- Obtaining a comprehensive selection of references can involve searching several databases because their coverage varies
- Not surprisingly, the results of our study suggest limitations of MEDLINE and EMBASE in locating relevant conference and journal supplement abstracts
- Most databases only include published articles; it is necessary to search separately for grey literature

Table 3. Hierarchical terminology categories in different search engines

Pubmed	MeSH
Embase	EMTREE
Cochrane	MeSH
CINAHL	CINAHL Headings