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Tips and tricks for using the internet for professional purposes

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- Online resources provide access to large amounts of information which is expanding every day. Using search engines for reaching the relevant, updated and complete literature that is indexed in various bibliographical databases has already become part of the medical professionals' everyday life.
- However, most researchers often fail to conduct a efficient literature search on the internet. The right techniques in literature search save time and improve the quality of the retrieved data.
- Efficient literature search is not a talent but a learnable skill, which should be a formal part of medical education.
- This review briefly outlines the commonly used bibliographic databases, namely Pubmed, Cochrane Library, Web of Science, Scopus, EMBASE, CINAHL and Google Scholar. Also the definition of grey literature and its features are summarised.

Keywords: literature; internet; bibliographical database

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Introduction

The internet has become one of the most popular resources for up-to-date knowledge for medical professionals. The online resources offer access to large amounts of information quickly with flexible e-learning tools in various formats, especially with mobile technologies as opposed to traditional education instruments. Many studies demonstrate how important the online resources have become for decision making.[1]

Due to the huge amount of information readily available to physicians, finding the evidence is an issue. Even well-published researchers often fail to appreciate the background knowledge required to conduct a good literature search on the internet. A successful search should be time-efficient, reproducible, complete, up-to-date and focussed so that it minimises hits without missing relevant data and this is only possible when the right search techniques are used. Critical appraisal of the literature is also an essential part of this process.[2] Otherwise, the 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.[3]

The ability to use the right search techniques is not a talent but a skill to be learned and taught. This paper briefly outlines some simple techniques that orthopaedic surgeons can use to improve their use of web-based information and e-learning resources.

Bibliographic databases

A bibliographic database is an organised digital collection of references to published literature including multiple journals, books and proceedings. They are regularly updated with newly published entries. These databases can be classified based on their field (medicine, nursing, etc.) and can be searched via specialised search engines. Some of them are well known such as PubMed, EMBASE, Cochrane Library, CINAHL, Scopus and Google Scholar.

Tips and tricks for a best search in a bibliographical database

Basic suggestions for a literature search are:

1. A successful search starts with the definition of the scope of the search
2. Choose the right search engines or bibliographical database(s)
3. Choose the right search terms - note the Medical Subject Headings (MeSH)
4. Build the search query(s)

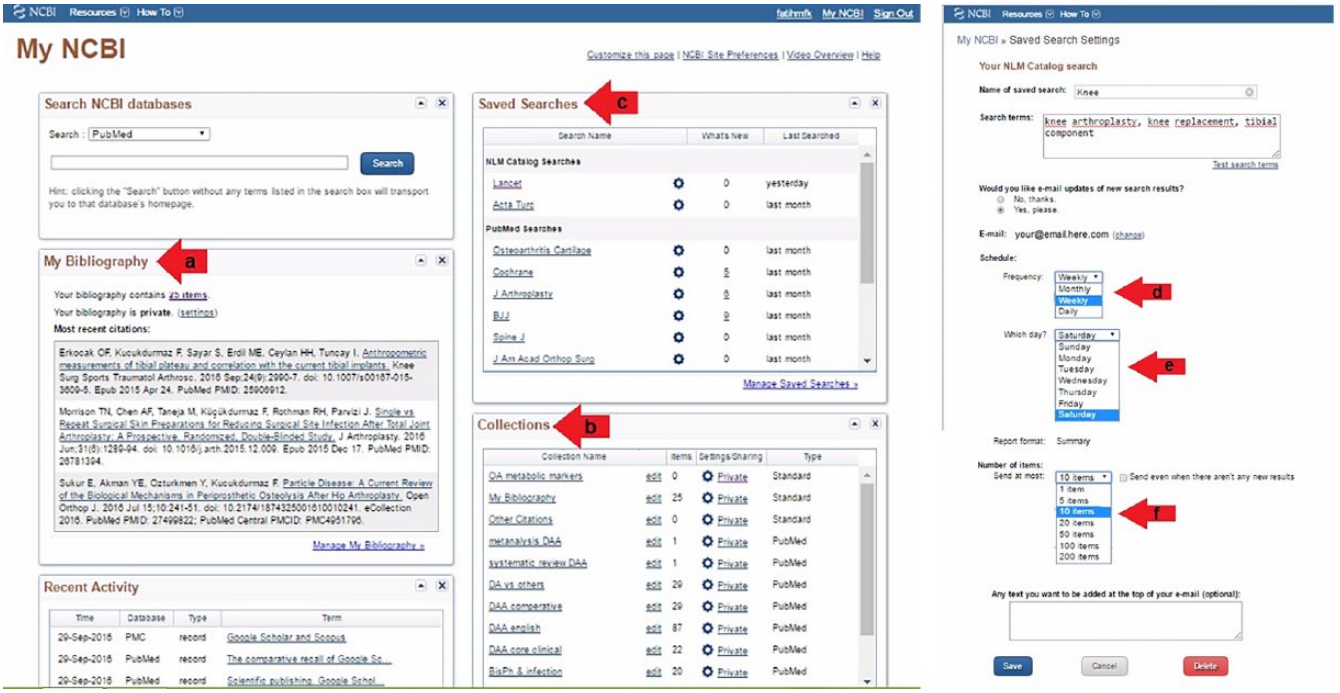

Fig. 1 My NCBI allows customisation of PubMed. a) My Bibliography; b) collections; c) save the searches; d) setting the frequency of alerts; e) the day of alerts and d) the number of items in each alert.

5. Refine the results by using
    a. Filters (author, journal, publishing date, language etc.)
    b. Truncation
    c. Boolean operators
    d. Combine the queries
    e. Include or exclude or merge the terms/queries

There are two important points to be kept in mind:

1. "Advanced search" option exists in many bibliographic databases and this option makes it possible to use all these functions by beginners
2. All bibliographic databases have links to tutorials on their main page to explain the most effective way to carry out a search

Below, find some brief information about the most popular bibliographic databases.

PubMed. PubMed, a service of the United States National Library of Medicine, which provides free access to Medical Literature Analysis and Retrieval Systems Online (MEDLINE). It indexes the citations and abstracts from medical, nursing, dental and veterinary healthcare and much of the literature in biology and biochemistry, as well as fields such as molecular evolution. PubMed also includes additional selected life sciences journals not in MEDLINE.

PubMed is updated Tuesday through Saturday. Academic institutions can link their electronic subscriptions to PubMed offering their users enhanced access to full-text articles. PubMed allows search results to be narrowed using several limiters including: article type, text availability, publication dates, journal categories, ages etc.

PubMed provides a free NCBI account, by which the settings can be personalised. "My NCBI" allows storage of bibliographies (Fig. 1a), creating collections of citations (Fig. 1b) and saving searches (Fig. 1c). Also a registered user can set e-mail alerts on specific topics by which the user is e-mailed automatically about the automated searches. Researchers can specify the frequency (Fig. 1d), day of the e-mail alert (Fig. 1e) and the number of items (Fig. 1f) they wish to receive as search alerts.

- A search can be done by directly searching terms in the title, abstract, authors' names, and institution.
- The selected articles (Fig. 2a) from the retrieved results can be sent to various destinations (Fig. 2b):
    - File – in ".txt" format to be printed out or to copy and paste
    - Clipboard – to keep the selected items instantly
    - Collections – for your own interest
    - E-mail – to share
    - Order
    - My Bibliography
    - Citation manager

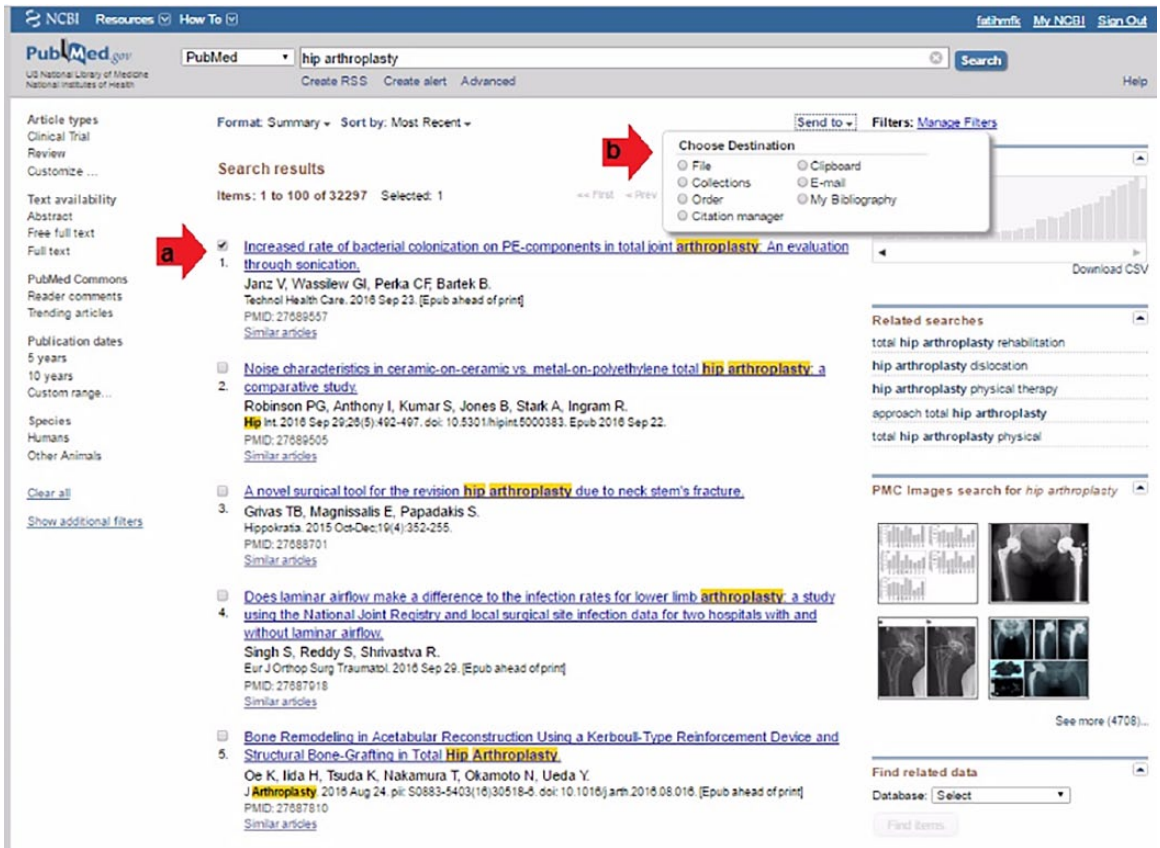

Fig. 2 a) Select the papers; b) choose and send the selected items to listed destinations.

- Another way to make a search is to build a search query by using medical subject headings (MeSH) under “More Resources” on the homepage. The MeSH database helps to narrow the search according to the sub-headings. (Fig. 3) These searches can be combined with the previous searches, which results in more comprehensive search results
- The truncation symbol is used to look for variants of a word, such as, “legal*”.This will retrieve legalisation, legalising, etc. in addition to the root word "legal".
- For making a search only on certain journals, such as "knee" related journals, click on ‘Journals in NCBI Databases’ from the PubMed homepage and enter “knee” to retrieve all journals those are related to "knee".(Fig. 4a) Then add the selected journal(s) in to the search builder (Fig. 4b) and combine with the terms that you want to search.

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

Cochrane Library. The Cochrane Library (CL) 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:[4]

- Cochrane Database of Systematic Reviews
- 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

The newly designed algorithm of CL has four search tools, for some of the features the user must be registered and logged in:

1. Search
   - allows performance of quick searches with a few terms as well as a more advanced search when the pull-down menus are used.
2. Search manager
   - for creating complex search strategies with Boolean and proximity operators, nesting, and field searching (Fig. 5)

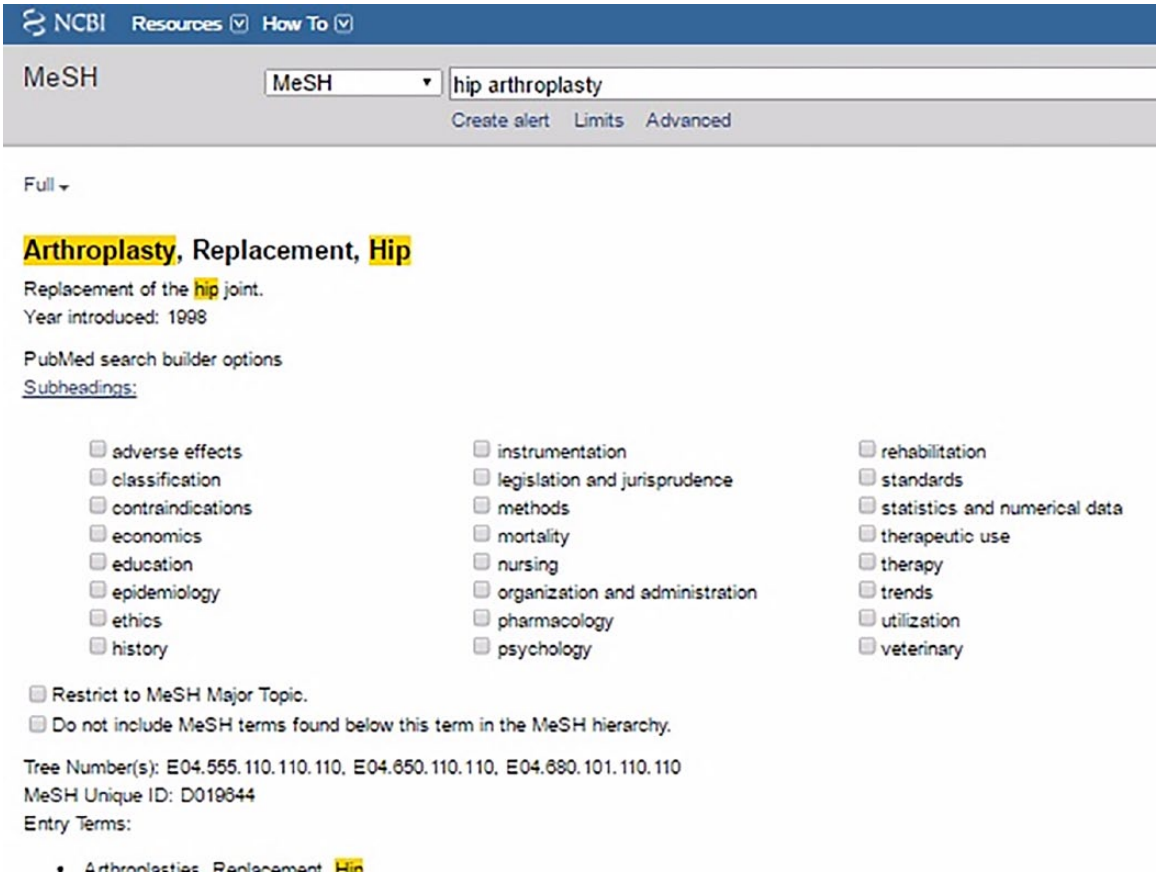

Fig. 3 MeSH database allows narrowing the searches based on field.

3. MeSH
   - for comprehensive searching of medical concepts
   - permuted index, tree(s) and results, on one page
4. Browse
   - by topic, new reviews, updated reviews, A – Z or review group
   - all other Cochrane Library Databases, Other Reviews, Trials, Methods Studies, Economic Evaluations

For experienced users, who want the convenience of field tags in pull down menus, the Search Tab offers a number of options for users interested in developing more complex searches. The Search Tab supports logical operators, nesting, and wildcards.

- Different searches (up to five) can be incorporated and can be filtered by adding search limits (Fig. 6) of database, status and dates. All the search results yielded in Search Tab can be moved to the Search Manager to create complex searches using MeSH and combined searches.
- Search Alerts are for receiving emails when your previously saved search matches a new article loaded on The Cochrane Library.
- "Save" button is to save your search so you can view and rerun it at a later time. Just as in PubMed, an automatic alert can be set that will notify you when new articles matching your search are loaded on The Cochrane Library.

Web of Science. Web of Science (WoS) provides access to four multidisciplinary databases of bibliographic information; Web of Science™ Core Collection, KCI-Korean Journal Database, Russian Science Citation Index, SciELO Citation Index. The WoS database has Basic Search, Cited Reference Search and Advanced Search options. The searches can be done by topic, title, author, author identifiers, editor, publication name, DOI and year published. Each search can be combined with another search using "AND", "OR" or "NOT" operators. Then the search results can be refined based on Databases, Research Domains, Research Areas, Document Types, Authors, Group/Corporate Authors, Editors, Funding Agencies, Source Titles,

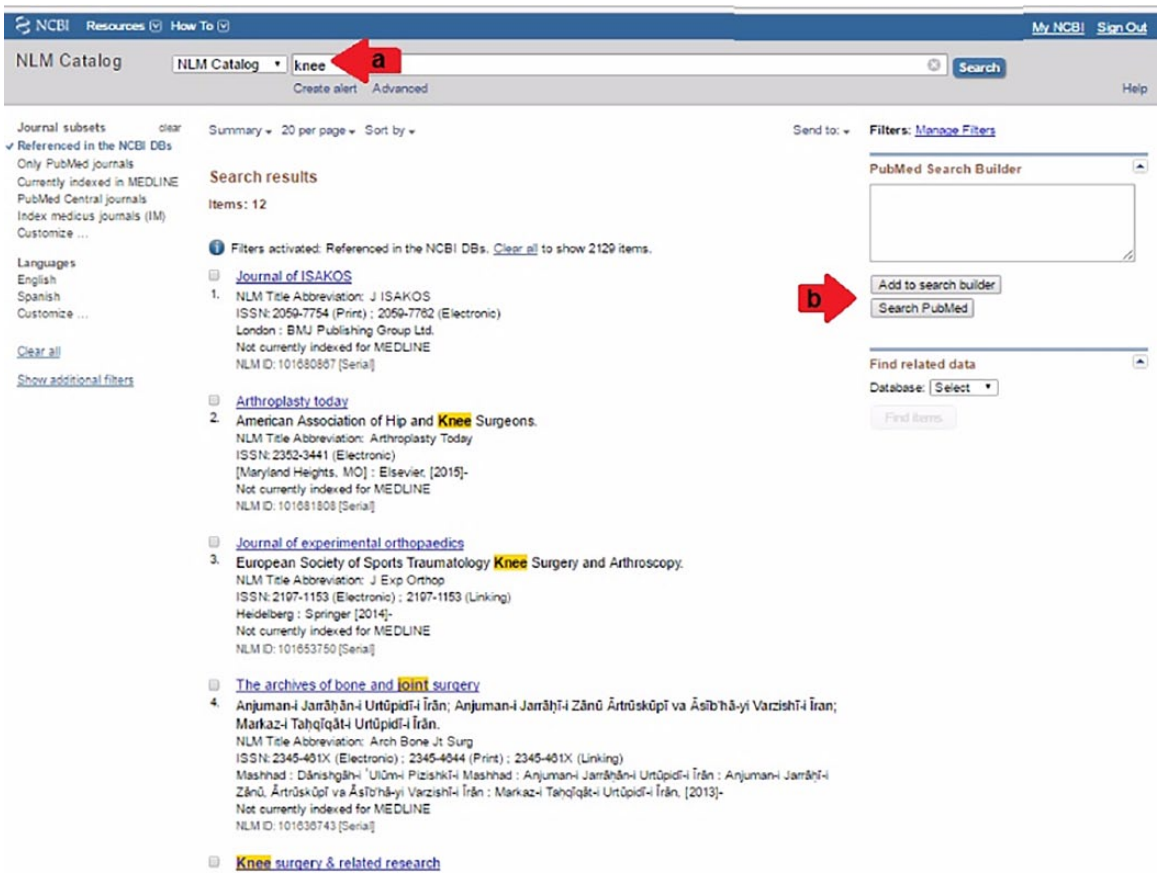

Fig. 4 NLM Catalog database. a) The keyword for finding the related journals; b) selected journals can be added to "the search builder" to search the terms in the selected journal.

Conference/Meeting Titles, Publication Years, Languages, Countries/Territories. (Fig. 7) Beside the list of articles in the results section, the citation time and usage count of each article is shown by default. Also the search term can be further analysed by the "Analyze Results" button in various fields with bar graphics.The "Create Citation Report" button is for demonstrating the citations with bar graphics.[5]

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.[6] Most of the search tools are similar to PubMed and Cochrane, such as searching the term in different parts of the article, incorporating the searches, Boolean operators etc. (Fig. 8) However, Scopus has some different features. Scopus indexes 21,915 journal titles from over 5,000 publishers and over 52 million records. Compared with PubMed, Scopus has 52 million records indexed *versus* 23 million citations indexed in PubMed. Scopus has the ability to search for conference and meeting abstracts and patents as a secondary source. This may be important for a researcher if that particular study is not published. Also Scopus provides the citations for the articles.

EMBASE. Excerpta Medica Database (EMBASE) is the electronic database of biomedical journals published by Elsevier. EMBASE can be considered as the European version of MEDLINE. It contains about 31 million records with coverage of over 8,500 journals. EMBASE contains over 2,800 journals that are not included in MEDLINE and it is more comprehensive in the areas of pharmacology, psychiatry and biomedical engineering. EMBASE requires institutional subscription. There is no individual access. One of the unique features of EMBASE is to have a broad access to the "grey literature" with over 2.2 million conference abstracts.[7]

CINAHL

Cumulative Index to Nursing and Allied Health Literature (CINAHL) is a research tool for nursing, allied health

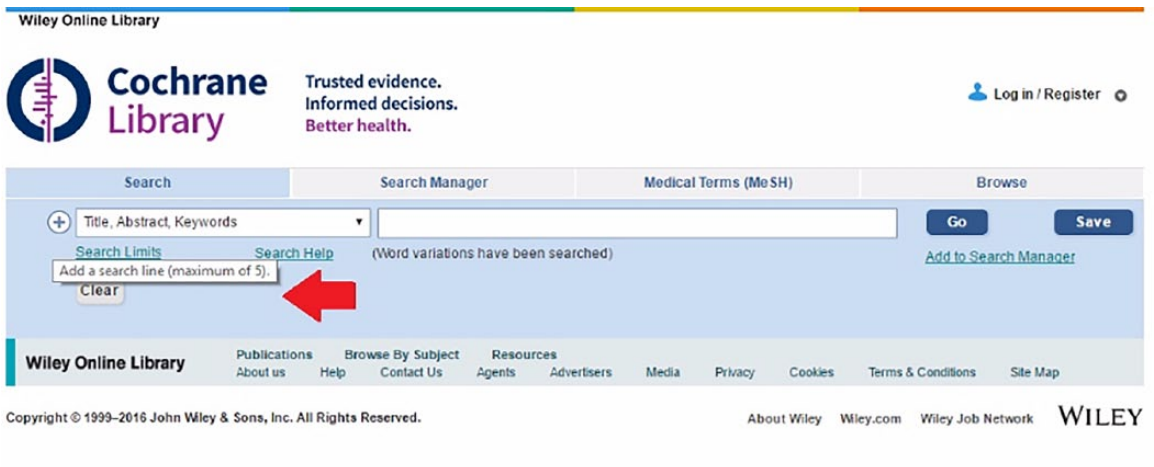

Fig. 5 Different searches can be incorporated in the Cochrane library.

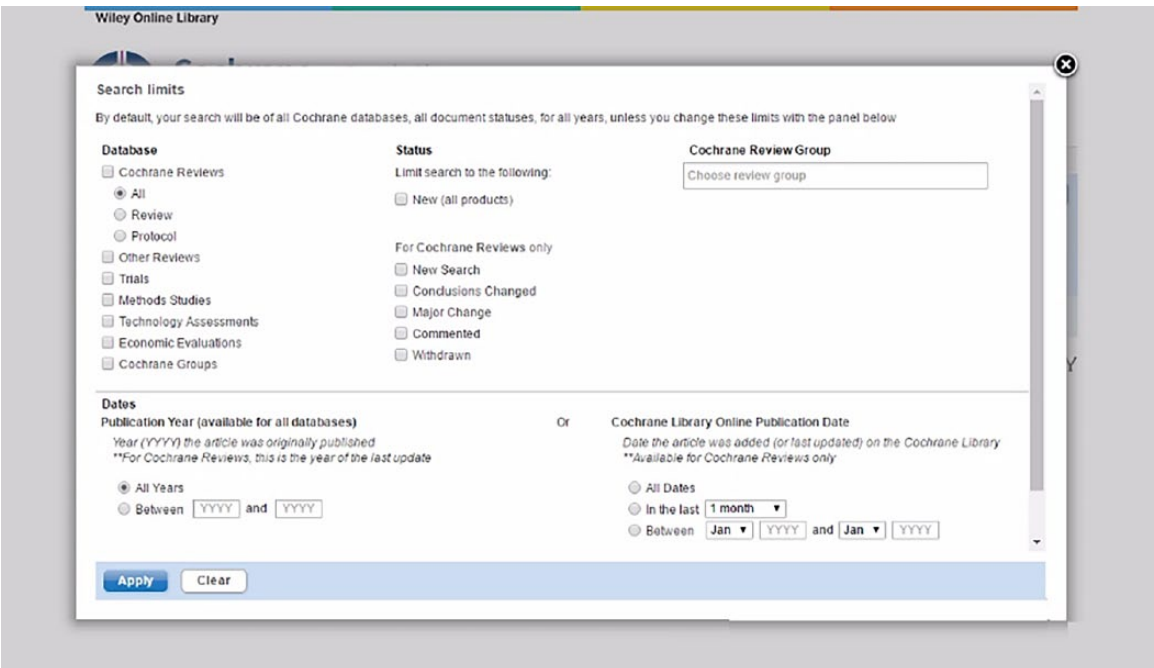

Fig. 6 The Cochrane Library provides various search limits.

professionals, biomedical and healthcare. CINAHL has been published by EBSCO Publishing since 2003 and is available exclusively on the EBSCO host platform since 2006. CINAHL provides a paid service.

Google Scholar

Google Scholar was launched by Google in November 2004 to provide a scholarly search engine. Google Scholar indexes the scholarly journal articles, article pre-prints, post-prints, working papers, dissertations, theses, technical reports, scholarly books, abstract collections, US legal opinions. Google Scholar excludes news articles, magazine articles, press releases and announcements, images and books reviews.

Google Scholar is a search engine as well as providing citation metrics that quantify the impact of their own published work, and these numbers are becoming part of a CV. On the other hand, Google Scholar does not provide incremental query optimisation, export of a large number of references, a visual search builder or a history function and the frequency of its updates is unknown.

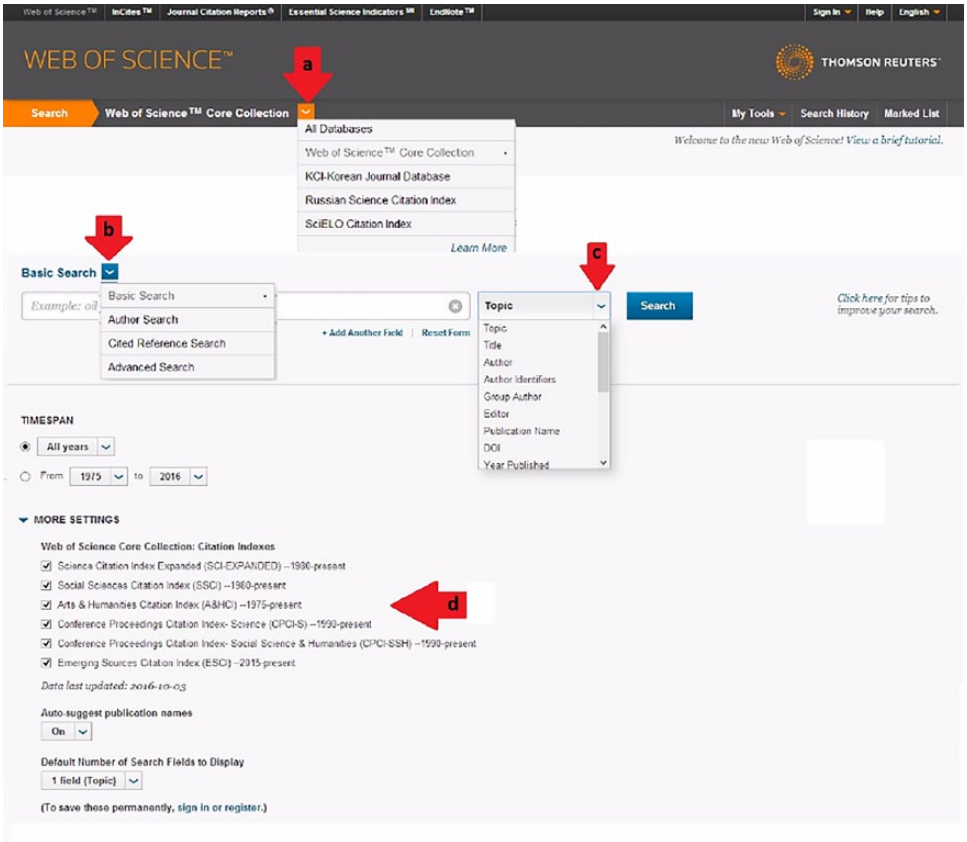

Fig. 7 Web of Science (WoS). a) There are 4 different databases; b) different search tools; c) topic-based search and d) core collections of WoS.

Although some of the studies[8,9] found that Google scholar is sufficient for a literature search, many studies[10-12] pointed out that Google scholar is not enough as a database to be used alone.

Boeker et al[10] measured the relative recall and precision of searches with Google Scholar and they found the Google Scholar insufficient as a bibliographic search engine when structured retrieval methodology is necessary. Also the coverage of Google Scholar may vary by discipline compared with other general databases.[13]

Google Scholar puts the highly cited papers at the top of the list and this in turn means that these papers gain more citations while new papers hardly appear at the top of the list and therefore get less attention by the users and fewer citations. This is called the "Matthew" effect.[14]

Grey literature

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.[15,16] Examples of grey literature would include white papers, pre-prints, technical reports etc. In short, grey literature is defined as literature that is not formally published in sources such as books or journal articles.[15]

The grey literature publications may include, but are not limited to the following types of materials: pre-prints, preliminary progress and advanced reports, technical reports, statistical reports, memoranda, state-of-the art reports, market research reports, theses, conference proceedings, technical specifications and standards, non-commercial translations, bibliographies, technical and commercial documentation, and official documents not published commercially.[17] The conference abstracts and other grey literature have been shown to be sources of approximately 10% of the studies referenced in Cochrane Reviews.[18]

A publication bias may occur when the decision of submission of a study is influenced by the significance of outcome or its conformity with published literature. The studies with statistically significant findings are more likely to be published in journals that are indexed in bibliographic databases and this is a bias against the null hypothesis.[19-22] Therefore investigators may decline to

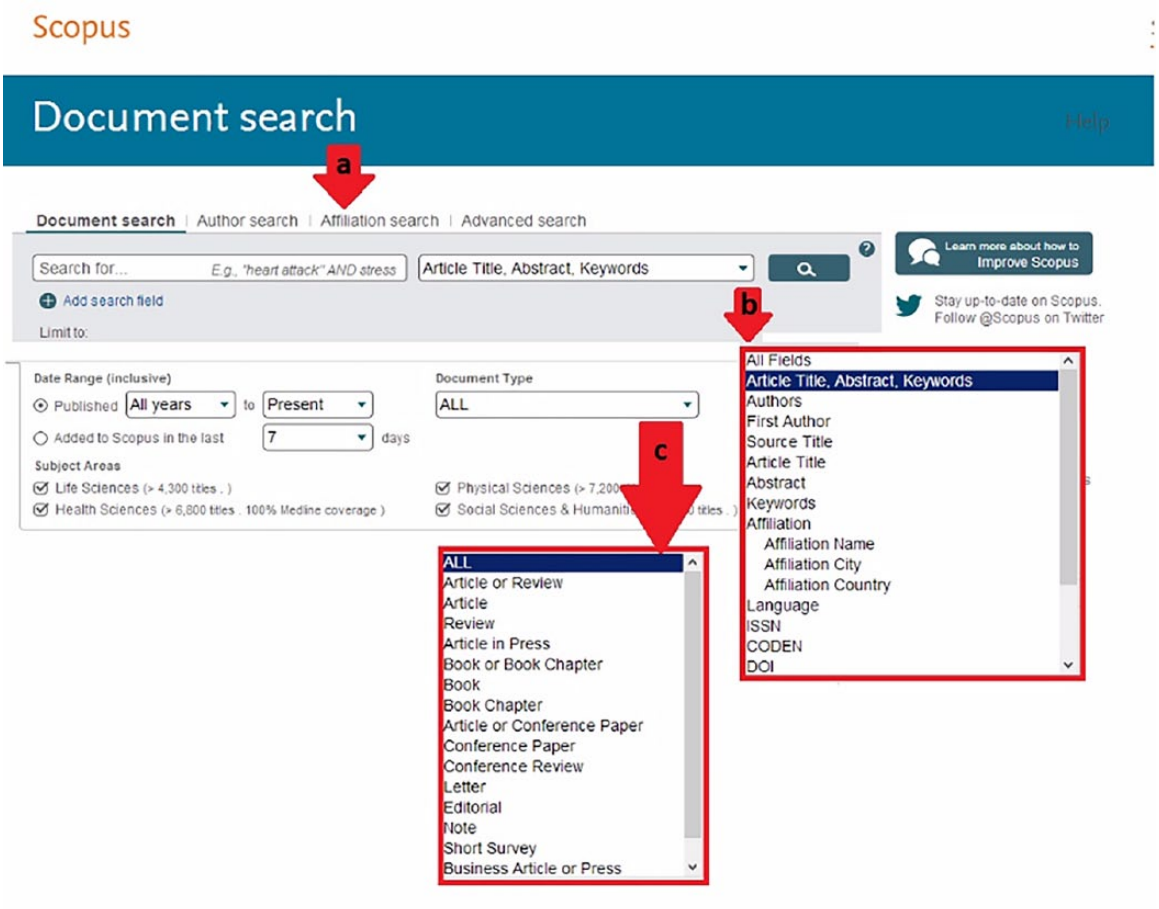

Fig. 8 Scopus. a) Different search tools of Scopus; b) search fields and c) document types.

submit the studies that end up with the null hypothesis and therefore a publication bias occurs.

The grey literature should be included when a structured retrieval methodology is necessary. It was shown that when the grey literature was excluded from a meta-analysis, the final outcome may over-represent the studies with statistically significant findings and inflate effect size estimates.[16] The exclusion of grey literature (unpublished studies) ends up with a selection bias which compromises the validity and reliability of meta-analysis when unpublished findings differ in some systematic way from published findings.[20]

The grey literature is more difficult to retrieve[16] because it is still difficult to find large databases cataloguing the grey literature due to its cost and inherent difficulties. Some libraries have collections of grey literature; The British Library,[23] Australian and New Zealand Policy Online,[24] Arxiv[25] and RePEc[26] have extensive collections of grey literature. Greynet[27] also produces a journal on grey literature and has been a key advocate for the recognition and study of grey literature, particularly in library and information sciences. Also *The Grey Journal* (indexed by Scopus) appears three times a year with a thematic issue in the field of grey literature and it is available via EBSCO's LISTA-FT Database.[28]

In summary, medical professionals should be trained to make a time-efficient, precise, accurate and effective literature search. Each database has a different search engine and databases with specific features. The differences in algorithms of search engines often results in the delivery of different results in response to the same terms. In order to make a comprehensive literature search, it is recommended to use multiple bibliographic databases.

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