

**D. Munasinghe¹,
S. Ranasinghe².**

*¹ Postgraduate Institute of
Medicine, University of Colombo*

*² University of
Sri Jayewardenepura.*

How to conduct a Literature review effectively using effective searching techniques

1. Literature Review

A literature review plays a crucial role in gathering and evaluating existing knowledge on a specific topic or research question. It involves a critical and comprehensive examination of existing scholarly research, academic articles, publications, and relevant sources in the academic context. In a literature review, a researcher should conduct a systematic search; review the information retrieved, synthesize it, and present it in a methodical way.

Retrieving information from various sources in a systematic and structured manner is essential for researchers, as it not only saves time but also enhances the quality of their work. In order to retrieve relevant literature, a researcher should be capable of conducting a proper search in an effective way. Hence this paper focuses on the systematic way of conducting a search by developing well-designed search formulae including different types of search strategies.

2. Developing a search formulae including search strategies

Developing a search strategy plays a vital role in the search process, as it provides an overarching framework for conducting a comprehensive search and serves as a record of the search history. By crafting well-thought-out search strategies, researchers create a systematic approach for gathering relevant information. This process involves several key steps as indicated below.

- (i) Identifying the research topic or the information needed
- (ii) Concept mapping

- (iii) Identifying relevant information sources
- (iv) Developing search formulae using search strategies
- (v) Conducting the search using different scholarly information sources, maintaining the search history
- (vi) Evaluating the search results

2.1. Identifying the research topic or the information needed

A thorough understanding of the research topic is essential inclusive of background information, aims and limitations.

2.2. Concept mapping

Identifying specific keywords, concepts, and themes related to the research topic. This includes synonyms, antonyms, broader and narrow terms too. That is to ensure, the researcher covers all relevant aspects and angles of their subject matter- leaving no stone unturned.

2.3. Identifying relevant information sources

A researcher should have a proper knowledge on scholarly information sources related to their subject discipline or the research topic. A variety of information sources are available in print and in electronic formats. As e-information resources, a researcher can use scholarly journals, bibliographic and full-text databases, scholarly search engines such as Google Scholar, academic institutional repositories, and academic and professional social networks such as ResearchGate and Academia. edu.

Databases and search engines

Electronic databases offer an extensive compilation of journal articles, confer-

■ Dilhani Munasinghe, MSSc(UoK), BA.Hons.(UoK), Vishard (Music), FLA (Sri Lanka), CTHE (SEDA-UK accredited), Senior Assistant Librarian, Postgraduate Institute of Medicine, University of Colombo, Email: dilhani@pgim.cmb.ac.lk, <https://orcid.org/0000-0002-8351-6568>.

■ Shirani Ranasinghe, Deputy Librarian, E-Resources and Research Support Division, University of Sri Jayewardenepura, E-mail: shirani@sjp.ac.lk

Corresponding author:

Dilhani Munasinghe
Email: dilhani@pgim.cmb.ac.lk,

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ence proceedings, reports etc. with an organized index comprising bibliographic information, abstracts and often providing direct access to the full text of published articles. These databases undergo regular updates to incorporate recently published scholarly literature. In any subject discipline, the databases serve as invaluable resources, aiding researchers and other professionals in staying abreast of the latest advancements and insights within their field of practice. Additionally, scholarly databases facilitate targeted searches, allowing to explore precise information pertaining to specific techniques or outcomes. By leveraging these electronic databases, orthopedic surgeons can effectively expand their knowledge base and continually enhance their clinical practice by staying informed of the most current research. Some examples are PubMed- MEDLINE Cochrane Reviews, Research4Life portal etc.

PubMed (National Library of Medicine Database)

PubMed, which is the most famous and prominent database in the field of Medicine and Health sciences is developed and maintained by the National Center for Biotechnology Information (NCBI) at the National Library of Medicine (NLM). At present, PubMed offers access to an extensive collection of approximately 23 million citations (1) This vast compilation encompasses biomedical journals listed in the renowned MEDLINE database, along with a collection of life science journals and pertinent online books. The majority of the content comprises indexed citations and abstracts, those indexed in PubMed Central and open-access journals provide full-text access. The continuous growth and regular updates of PubMed ensure its relevance as a comprehensive and reliable repository for accessing scientific literature in the realm of biomedicine(1–4).

2.4. Developing the search formulae using search strategies

Searching techniques

Simple searching

Simple searching refers to the basic methods used to find information in various sources. There are several keyword-based search criteria that are commonly used:

Keyword searching: This involves looking for specific words or phrases within a document or database. Users enter one or more keywords that are relevant to

the information they are seeking, and the search system returns results that include those keywords. Most journals now require a list of keywords to be submitted with the manuscript. These act as critical identifiers of the article content. Therefore, using keywords will enable the researcher to identify articles of a similar interest.

Author search: This is a search criterion that allows users to find works by a specific author. By specifying the author's name, the search system will display results that include publications written by that author. Most established clinicians tend to work in their particular fields and are involved in publications of their research interests. Therefore, searching under a specific author-especially if she /he is a 'known clinician'- will give the researcher a spectrum of the current work that is being done in that area..

Title search: Researchers can employ this search criterion to find documents or resources using the title of a particular publication. By entering the title or a portion of it, the search system will generate results containing works with similar or exact titles.

Subject search: This refers to searching based on a specific subject or topic. A researcher can use relevant keywords or phrases related to the subject, and the search system retrieves results that focus on that subject.

These techniques enable users to quickly locate information based on specific criteria, making it easier to find relevant resources within a vast amount of available data. Some databases offer specific codes such as [AU] for author. [TI] for title etc.

Advanced searching

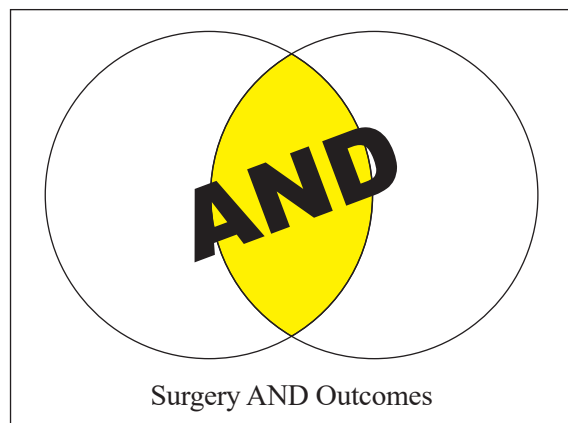
Advanced searching techniques offer additional features to refine and optimize search results. Different databases offer different facilities with pre-designed symbols. Symbols may vary from database to database. Some commonly used techniques are truncation, wildcards, Boolean logic operators, phrase searching, field searching, proximate searching, set combination etc.

Truncation: Truncation involves using a symbol (may be *, ?, #) to search for variations of a word. A stem of a word can be used with the pre- designed symbol either to the left or to the right. It will retrieve documents that include all possible words. For example, searching for "frac" would yield results for "fracture", "fractures", "fractured" etc..."

Wildcard characters: Wildcard characters are used to replace unknown or variable parts of a word. Usually for spelling variations in British and American English and for plurals it can be used. The most common wildcard character is the question mark (?), which represents a single character. For example, searching for "wom?n" would return results for both "woman" and "women".

Boolean Logic Operators: Boolean operators ("AND," "OR," and "NOT") are used to connect multiple search terms or phrases and refine search results. "AND" narrows the search by requiring that both terms be present in the results. "OR" broadens the search by including results that have either term. "NOT" excludes results containing a specific term.

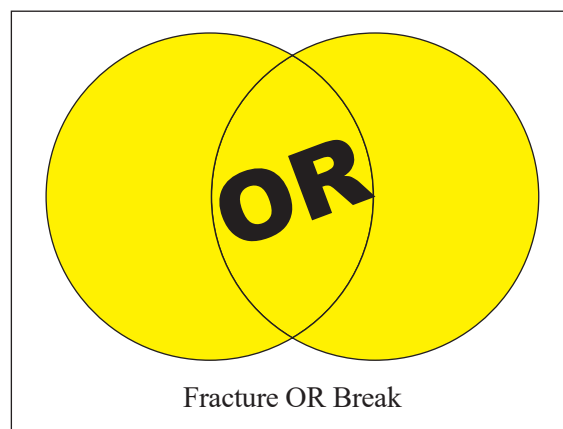
AND Operator: The use of the AND operator helps to narrow down the search results by requiring all specified search terms to appear in the retrieved articles. This allows to retrieve studies that specifically address the intersection of multiple concepts or keywords. For example, using "surgery AND outcomes" would retrieve literature that specifically discusses surgical procedures and their corresponding outcomes. It ensures that the search results include both the term "surgery" and the term "outcomes".



OR Operator: Unlike the AND operator, the OR operator broadens the search results by retrieving articles that contain any of the specified search terms. This operator is particularly useful when applied to synonyms, alternative terms, or related concepts in a search. For instance, using "fracture OR break" would retrieve studies that explore both fractures and breaks in orthopedic cases.

Example: "fracture OR break"

This query will retrieve articles that discuss either fractures or breaks in orthopedic cases. It captures both terms and allows for a more comprehensive search of the related concepts.

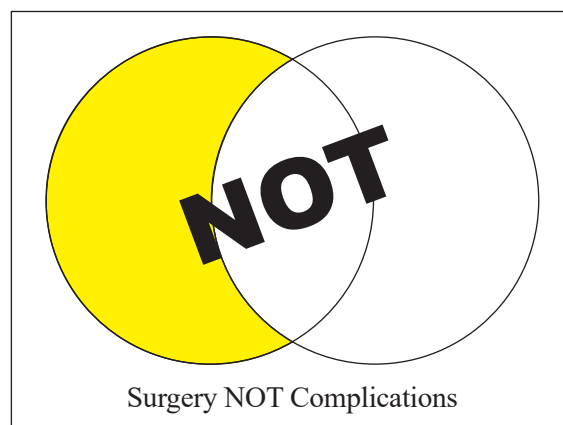


In the above example if the term was used with truncation i.e. "Frac" and "Break" then the search would get further expanded to cover all the variations of these two terms as well

NOT Operator: While the AND and OR operators include specific terms in their search results, the NOT operator excludes certain terms or concepts. However, caution must be exercised when using the NOT operator, as it can inadvertently exclude relevant articles

Example in orthopedic research: "surgery NOT complications"

This query will exclude articles discussing complications related to surgery in orthopedics. It will retrieve articles related to surgery but without any overlap with complications.



Instead of the words AND, OR, NOT some databases use +, - and ().

Combining Boolean Operators: Combining Boolean operators allows researchers to create more complex search queries by connecting multiple search terms and refining their results further.

Example: ("knee surgery" OR "hip surgery") AND outcomes

This query would retrieve articles that discuss either knee surgery or hip surgery and then narrow down the search to focus on the outcomes of those surgeries. By using the OR operator within parentheses, both knee and hip surgeries are included before applying the AND operator to specify the outcomes.

Using Parentheses: Parentheses are used to group terms and control the order of operations within a search query. They help to clarify the relationship between terms and ensure that the search engine executes the operators in the desired sequence.

Example: ("arthritis" OR "osteoarthritis") AND ("exercise" OR "physical therapy")

This query groups the terms related to arthritis and the terms related to exercise and physical therapy using parentheses. By doing so, the search engine will first evaluate the terms within each parentheses pair and then combine the results using the AND operator.

Advanced Search Queries: Advanced search queries can incorporate multiple Boolean operators and parentheses to achieve more refined and targeted search results.

Example: ("back pain" OR "spinal disorders") AND (surgery OR treatment) NOT complications

This query retrieves articles that specifically discuss back pain or spinal disorders, and then narrows down the search to include either surgery or treatment. The NOT operator is then used to exclude articles that discuss complications. By using both parentheses and multiple operators, researchers can create advanced search queries tailored to their specific needs.

By combining Boolean operators and using parentheses effectively, researchers can create complex search queries that allow for more precise and refined literature review. This helps to focus the search on specific subsets of relevant articles, ensuring to gather the most relevant information for the research topic.

Tips for Using Boolean Strategies:

(1.) Start with a Focused Search using the AND Operator.

First begin the search with a focused query that combines essential search terms using the AND operator. This will narrow down the search results and retrieve articles that include all the specified terms.

Example: "knee surgery AND outcomes"

This query will retrieve articles specifically related to knee surgery and its outcomes, providing a focused starting point for the literature review.

(2.) Gradually expand with the OR Operator if necessary:

If a sufficient number of articles are not retrieved or the researcher needs to get more related articles, expand the search by including synonyms, alternative spellings, or related concepts using the OR operator. This helps to capture a broader range of relevant articles.

Example: "knee surgery OR total knee replacement"

This query will retrieve articles that discuss either knee surgery or total knee replacement, accommodating both terms and broadening the search results.

(3.) Combine Boolean Strategies with MeSH Terms and Search Filters:

International Standard for Medical Subject Headings (MeSH), is a useful tool for organizing and retrieving information from biomedical literature. It offers a standardized set of terms that ensures accurate and precise searching. The hierarchical structure of MeSH makes it easier to navigate through related concepts and topics. It fosters interoperability and collaboration by being recognized and used on a global scale. This shared vocabulary improves the integration of disparate datasets. MeSH terms aid in the clarification of ambiguous or overlapping concepts, reducing confusion and facilitating clear communication. Overall, MeSH helps researchers find accurate and relevant information by improving the organization, discoverability, and accessibility of biomedical literature.

Example: the non-medical term "nose bleeding" corresponds to the medical condition known as "epistaxis" in the MeSH

It is recommended to use Boolean strategies in conjunction with other search techniques like Medical Subject Headings (MeSH terms) and search filters. MeSH terms provide a standardised vocabulary to improve the precision and relevance of search results, while search filters allow for additional criteria such as publication dates or study types.

Example: (("knee surgery" OR "total knee replacement") AND outcomes) AND "MeSH term: Orthopedics"

This query combines Boolean operators (AND, OR) with a MeSH term related to orthopedics. It ensures that the search results include the specified knee surgery outcomes within the field of orthopedics.

Phrase searching: By enclosing search terms in double quotation marks (" "), a researcher can search for an exact phrase rather than individual words. This ensures that the search results include the words in the specified order. For example, searching for "orthopedic surgery" would retrieve documents with this phrase.

These advanced search techniques provide greater control and precision in retrieving relevant information, thus helping users retrieve more accurate and targeted search results.

Proximity searching: Proximity searching helps to retrieve articles containing the required 'nearby' words. To create a proximity search in PubMed, enter terms using the following format:

"search terms"[field:~N]

- Search terms = Two or more words enclosed in double quotes.
- Field = The search field tag for the [Title] or [Title/Abstract] fields.
- N = The maximum number of words that may appear between your search terms.

For example, to search PubMed for citations where the terms "hip" and "pain" appear with no more than two words between them in the Title/Abstract search field, try the search:

"hip pain"[Title/Abstract:~2]

Search results may include hip pain, hip-related pain, hip joint pain, hip/groin pain, hip biomechanics and pain, pain after total hip arthroplasty, pain in right hip, and more(5).

Field searching : Searches can be limited to specific fields. Using the title field for periprosthetic fracture:

"Title: perirprosthetic fracture" will retrieve results that specifically mention "periprosthetic fracture" in the title. This narrows down the search to titles directly related to the field. Since various databases offer different techniques, a researcher has to pay attention to select the correct way.

Limiters and filters: A variety of limiters and filters are available in different databases. A researcher can choose those according to his/her requirement. Some common filters are year/date of publication, Language, Gender, type of publication, study type, geographical variations etc.

By applying these advanced searching techniques search results can be refined to get the most relevant articles and retrieve more targeted information relevant to the specific interests and needs of the researcher.

2.5. Conduct the search with different databases and maintaining records

Literature searching is an iterative process, In order to obtain highly relevant articles covering all aspects of the research topic, a researcher has to conduct searches using all possible related databases and other information resources.

Maintaining a record of the search history is essential. As research progresses, it is common for researchers to refine or alter the focus of their investigation. Having a documented search history enables to revisit their previous search queries, modify them according to new insights or changing research requirements to build upon the foundation that has already been established. The advantages of this systematic and structured approach to information retrieval are manifold.

2.6. Evaluate the articles and refine search queries based on initial results:

The literature retrieved has to be evaluated in order to obtain the most relevant and scholarly information. Researchers should assess the relevance and quality of

retrieved articles and make adjustments to their search queries if needed.

For example, if the initial search results are too broad or include irrelevant articles, researcher can refine their search by adding additional search terms using the AND operator or using the NOT operator to exclude specific terms.

Literature can be evaluated using several criteria such as checking the authority including the publisher and sponsorship, scope, writing style, type of the article and type of the source, content, format, currency, indexing source, impact factor of journals etc...

Finally, it must be emphasized that, when conducting a literature search, researchers should have a plan (before sitting in front of the computer) in order to get maximum number of relevant literature without wasting time, energy and money, and that most library services (inclusive of the authors' libraries) do offer advice to help formulate a searching strategy and offer 'hands on help' in conducting literature searches.

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