

# Electronic Biomedical Literature Search for Budding Researcher

SUBHASH B. THAKRE<sup>1</sup>, SUSHAMA S. THAKRE<sup>2</sup>, AMOL D. THAKRE<sup>3</sup>

## ABSTRACT

Search for specific and well defined literature related to subject of interest is the foremost step in research. When we are familiar with topic or subject then we can frame appropriate research question. Appropriate research question is the basis for study objectives and hypothesis. The Internet provides a quick access to an overabundance of the medical literature, in the form of primary, secondary and tertiary literature. It is accessible through journals, databases, dictionaries, textbooks, indexes, and e-journals, thereby allowing access to more varied, individualised, and systematic educational opportunities. Web search engine is a tool designed to search for information on the World Wide Web, which may be in the form of web pages, images, information, and other types of files. Search engines for internet-based search of medical literature include Google, Google scholar, Scirus, Yahoo search engine, etc., and databases include MEDLINE, PubMed, MEDLARS, etc. Several web-libraries (National library Medicine, Cochrane, Web of Science, Medical matrix, Emory libraries) have been developed as meta-sites, providing useful links to health resources globally. A researcher must keep in mind the strengths and limitations of a particular search engine/database while searching for a particular type of data. Knowledge about types of literature, levels of evidence, and detail about features of search engine as available, user interface, ease of access, reputable content, and period of time covered allow their optimal use and maximal utility in the field of medicine. Literature search is a dynamic and interactive process; there is no one way to conduct a search and there are many variables involved. It is suggested that a systematic search of literature that uses available electronic resource effectively, is more likely to produce quality research.

**Key words:** Research, Steps in literature search, Search engine, Literature review, Level of evidence

## INTRODUCTION

Research is scientific way of acquiring knowledge and establishing truth. Interest in particular topic begins research process. Search for specific and well defined literature related to subject of interest is the foremost step in research. When we are familiar with topic or subject then we can frame appropriate research question. Appropriate research question is the basis for study, objectives, and hypothesis. So, research is a science, begins with question, follow experimentation, data generation and communicating to the wider scientific community; perhaps to community. Broadly speaking medical literature is used to describe anything from creative writing to more technical or scientific works [1]. Web search engine is a tool designed to search for information on the World Wide Web. The emergence of digitalisation and internet has increased possibility of making information available to any one, any where, any time and in any format [2,3]. Journals, dictionaries, textbooks, indexes, e-journals-all can be found on the internet in growing numbers [4]. Majority of researchers, health care providers and students are not familiar about types of medical literature, not have orientation about basic biomedical research, not enough knowledge and skills concerning literature search makes budding researcher incapacitate [5].

The ability to describe and analyse published literature on a subject and develop discussion and argument is central to evidence base research. A literature review is an assessment procedure that is commonly applied in biomedical research. Effective literature search is a crucial stage in the process of writing literature review and significance of which is often overlooked [6]. PubMed; the most popular and publicly available life science literature retrieval tool, is generally used for retrieval of specific information from MEDLINE rather than an exploratory medium [7]. PubMed provides free access to one of the largest searchable biomedical databases [8]. This article outlines important considerations in the search strategy and recommends practical advice for budding

researchers to ensure best use of their valuable time. Search engines for internet-based search of medical literature include PubMed, Google scholar, Scirus, Yahoo search engine, etc. [9].

A budding researcher must have knowledge about literature resources, components of research question, types of literature, levels of evidence, and detail about strengths and limitations of search engine as available, ease of access, reputable content, and period of time covered which will allow optimal use and maximal utility in the field of medicine.

## Literature Resources

A number of sources are now available in the biomedical field apart from PubMed, which provides free access to the largest biomedical resource available and is updated daily. Specifically, PubMed listed 5,666 journals (as on April 25, 2013) indexed from various countries [10,11]. Encouragingly, the national initiative by the Indian Council of Medical Research (ICMR) funded project, 'National database of Indian medical journals' by the National Informatics Centre Services Incorporated. (NICS), New Delhi, provides among others, a bibliographic database of about 100 prominent peer - reviewed Indian biomedical journals indexed from 1985 onwards through indMED (<http://indmed.nic.in/>), accessed on April 25, 2013) as also full text of 63 Indian biomedical journals (medIND) [12].

When you are familiar with topic before actual research then it is possible to frame appropriate research question. Each search question has four components remembered best by the mnemonic-PICO [8,13] 1. Patient (P) – What is the patient group of interest e.g. acute cholecystitis. 2. Intervention (I) – What is the intervention of interest e.g. expectant management. 3. Comparison (C) – What is the comparison intervention of interest e.g. surgery. 4. Outcome (O) – What is the primary outcome e.g. survival.

## Basics of Biomed literature [9,14] and level of evidence [15]

**Types of medical literature:** Different types of publications have different characteristics.

### Primary Literature

Primary sources are original materials. Primary literature is authored by researchers, contains original research data, and is usually published in a peer-reviewed journal. Conference papers, pre-prints, and preliminary reports are also primary literature.

### Secondary Literature

Secondary literature consists of interpretations and evaluations that are derived from or refer to the primary source literature. Examples include review articles, systematic reviews, meta-analyses and reference works. This literature is available on Cochrane library, Web of Science, PubMed, etc.

### Tertiary Literature

Tertiary literature consists of a distillation and collection of primary and secondary sources such as textbooks, encyclopedia articles, and guidebooks or handbooks[14].

Open Access (OA) Vs free access Literature: Open access journal articles are those articles whose summary or abstract [100-150 words] is only freely available on the internet and for a full article the reader has to pay for it according to charges in US dollars or in pounds or in Euro pounds, while an non-open access ones, are those for everything a reader or even who wants to cite the articles has to pay on order to gain access to them [16]. Open Access Journals are usually of high or very high impact factor Journals. But one problem is that open access Journals offers a profiteering business for the publishers at the expense of the academic community by charging [17].

Users are probably more interested in knowing whether they can freely access the article, and the word "free" conveys this more clearly. Full article is freely available on the internet [18].

The global scenario of OA journals is equally encouraging. Specifically, the Directory of Open Access Journals (DOAJ) currently provides (as on April 25, 2013) 9,048 OA free, full text quality controlled scientific and scholarly journals from 120 countries including India. United States tops the tally with 1,270 OA journals, followed by Brazil (801), United Kingdom (575), India (463) and Spain (442). Just 22 countries with more than 100 OA journals each account for 6,672 (78.33%) OA journals [19].

Significant developments in OA publishing have taken place in recent time like the US National Institutes of Health (NIH) Public Access Policy [20]. The NIH Public Access Policy ensures that the public has access to the published results of NIH funded research. It requires scientists to submit final peer-reviewed journal manuscripts that arise from NIH funds to the digital archive PubMed Central upon acceptance for publication. To help advance science and improve human health, the Policy requires that these papers are accessible to the public on PubMed Central not later than 12 months after publication.

**Level of evidence [15]:** Levels of evidence is a ranking system used in evidence -based practices describing the strength of the results measured in a clinical trial or research study. The design of the study (such as a case report for an individuals patient or a double blind randomised controlled trial) and the endpoints measured (such a survival or quality of life) affect the strength of the evidence. Levels of evidence I-IV.

1. Ia –Evidence from Meta-analysis of Randomized Controlled Trials.
2. Ib –Evidence from at least one Randomised Controlled Trials.
3. IIa –Evidence from at least one well designed controlled trial which is randomised.
4. IIb –Evidence from at least one well designed experimental trial.

5. III –Evidence from case, correlation, and comparative studies.

6. IV –Evidence from a panel of experts.

### Articles/Record [21]

Articles tend to be narrow in scope and are good for focused treatment of a topic. Scholarly journals contain high-quality articles usually written by experts and use data and statistics to back arguments. Popular magazines and newspapers are good for current treatment of a topic and are good resources for editorials and opinions. Note that popular magazines are not peer-reviewed. Articles may be useful when: Your topic is very recent and your research topic is very narrow in scope.

For searching any article you need to have three important prerequisites- one computer, second internet and third web address.

### Web Sites

Web sites can be very good for finding quality information. However, you have to take the responsibility to rigorously evaluate each site for quality; anyone can post a Web page, regardless of their expertise or intentions.

**Web search engines [22]:** A web search engine is a software system that is designed to search for information on the World Wide Web. The search results are generally presented in a line of results often referred to as search engine results pages (SERPs).

Important and widely used web of search- engines ; (Canadian medical association survey 2005) were Google, Google scholar, PubMed and Scirus [5].

### PubMed [23], [10]

PubMed is a free resource that is developed and maintained by the National Center for Biotechnology Information (NCBI), at the U.S. National Library of Medicine (NLM) located at the National Institutes of Health (NIH), it is a part of the Entrez information retrieval system. PubMed comprises over 22 million citations for biomedical literature from MEDLINE, life science journals, and online books. PubMed Central (PMC) offers all articles free to the users.

**Special features of PubMed:** Automatic suggestions, Automatic term mapping, Automatic Spell check feature and suggestions, Features of related citations, Limit/Filters, advanced search, etc. Queries in PubMed are now immediately analysed by two content sensors. One searches for citation data, such as author names, journal titles or abbreviations, publication dates and volume/issue numbers, and then displays matching citations at the top of the result set. A second sensor examines queries for drug names, and then displays links to information about the drug from a new addition to the NCBI Bookshelf, PubMed Clinical Q&A. PubMed will look for a match in several lists- Medical Subject Headings (MeSH) Translation tables: Heading and Sub-heading, Journal Translation table, and Author Translation table. MeSH is the U.S. (National Library of Medicine's (NLM) controlled vocabulary used for indexing articles for MEDLINE/ PubMed. MeSH terminology provides a consistent way to retrieve information that may use different terminology for the same concepts.

Every term (single word or phrase- group of words in comma inverted coma) is searched in all three tables and then record of available articles is provided. Each record is called as article or citation and group of record is called as set. Each record consisting of set of data element (fields) title, author(s), affiliation, language, publication date, journal title, MeSH terms and abstract. Example, If you search query is Heart attack- this term will matched with MeSH Translation table heading and subheadings. It will find similar matches (qualifier) like ischemic heart disease, myocardial infarction, coronary artery disease etc. This is one of the most

useful ways to improve the quality of a search.

Many more useful features like Automatic suggestions, Automatic term mapping, Automatic Spell check feature and suggestions, Features of related citations, Limit/Filters (article type, text available, publication date etc.), Advanced search (narrow, expand or exclude search) and save search or send to features. With the help of advance search builder you can search literature in a timely, precise and effective manner. Initially our search is very broad but by use of bullion operator (AND, OR, and NOT) you can narrow, expand or exclude search terms so that you can reach to specific research question (query). During entire process of literature search; you are the decision maker in respect of when to start and when to stop search. Every time it is not possible to read entire accessed literature due to many more reasons. In this situation you can use most useful feature i.e. save search. Before the use of save search one has to sign in at NCBI after which save search is activated so that retrieved literature can save in Search NCBI database, My Bibliography, save searches, etc. By use of these features you can manage your search literature like retrieving, editing, etc. If you are not interested in sign in option then use send to and choose destinations like file, Email, etc. Sometimes we are interested in single author, single citation or journal then you can visit PubMed tool -single citation matcher.

Before one start to use PubMed, it is recommended to undertake the "PubMed Tutorial," the Web-based learning program that will show how to search and gather open access and non-open access articles [24].

**"GoPubMed"**(<http://www.gopubmed.org/web/gopubmed/>) and **"MeshPubMed"** (<http://www.ncbi.nlm.nih.gov/mesh/>):

GoPubMed is a knowledge-based search engine for biomedical texts [25]. The gene Ontology (GO) and MeSH; serve as "Table of contents" in order to structure the millions of articles of the MEDLINE database. The search engine allows its users to find relevant search results significantly faster than PubMed [26].

## Google and Yahoo Search Engines

Google (<http://www.google.com>) and Yahoo search (<http://www.search.yahoo.com>) are world's most hit web pages and two largest web-based search engines [27].

Although the search they offer is not limited for medical literature, still the ease of usability, advanced search options, and several other user-friendly features make them an automatic first choice of the most medical researchers. Google provides a web search engine-a tool that constantly indexes the expanding World Wide

Web search engines	Web address
Google	<a href="http://www.google.com">http://www.google.com</a>
Google scholar	<a href="http://www.scholar.google.com">http://www.scholar.google.com</a>
Yahoo	<a href="http://www.yahoo.com">http://www.yahoo.com</a>
PubMed	<a href="http://www.nlm.nih.gov/pubmed">http://www.nlm.nih.gov/pubmed</a>
National library of Medicine Gateway	<a href="http://www.gateway.nlm.nih.gov/gw/Command">http://www.gateway.nlm.nih.gov/gw/Command</a>
Indian Database: Ind Med	<a href="http://www.medind.nic.in">http://www.medind.nic.in</a>
Free Medical journals and books	<a href="http://www.freemedicaljournal.com">http://www.freemedicaljournal.com</a> <a href="http://www.freebooks4doctors.com">http://www.freebooks4doctors.com</a>
Internet Medical book store	<a href="http://www.freemedicalbooks.org">http://www.freemedicalbooks.org</a>

[Table/Fig-1]: Web Search engines and web addresses

Web and allows you to search the index [28] [Table/Fig-1].

One can use Google Analytics to track clicks on links that lead away from his/her site. Because links that lead away from site are not automatically tracked, one will need to manually tag all outbound links one want to track. To do this, one will have to add some Java Script customisations to his/her page and to the links one want to track. Google offers options for phrase search, search within a specific website and terms to be excluded. There

is no automatic term mapping (MeSH) so the disadvantage is that you are able to search only requested field. Take an example if you are interested in heart attack; Google search engine searches only Heart attack. It is not possible to search similar terms like, coronary artery disease, myocardial infraction and Ischemic Heart Disease. Advance search feature is available with Google but it is not very specific to our query. Therefore, it is very difficult to understand within short time that which one is useful.

Similarly, Yahoo search offers useful features like shortcut keys and advanced search, latter enabling users to use controlled vocabulary. Pull-down menus, focusing the type of results (web/images/videos/local) make it a simple to use engine.

**Google Scholar [29]:** Google Scholar provides a simple way to broadly search for the relevant scholarly literature and research. Google Scholar is a subset of the larger Google search index, where one can search across many disciplines and sources, from one place-peer-reviewed papers, theses, books, abstracts and articles from academic publishers, professional societies, preprint repositories, universities, and other scholarly organisations. Key features of Google Scholar: Include help for searching diverse sources from one convenient place, finding papers, abstracts and citations, locating the complete paper through library or on the web and learning about key papers in any area of research. One can sort articles by types, time, and citations rendering it a simple engine to use.

**Ranking of articles:** Google Scholar aims to sort articles the way researchers do, weighing the full text of each article, the author, the publication in which the article appears, and how often the piece has been cited in other scholarly literature. The most relevant results will always appear on the first page.

While using Google Scholar, one has to keep in mind its limitations too. It does not index the majority of the scholarly materials indexed by commercial database vendors. Moreover, it does not provide a list of the sources it is indexing. It has never shared with the public their search algorithm which is why many times one may not find key pieces of literature in the database. Perhaps it could be used for citation verification rather than for true searching purposes [5].

**National Library of Medicine Gateway [30,31]:** National library of medicine (NLM) Gateway is a user-friendly web-based system that will search not only Medline Medical Literature Analysis and Retrieval System Online (MEDLINE), but also several other NLM databases at the same time. NLM has developed an extensive controlled vocabulary called MeSH that leads to greater search accuracy and relevancy to locate precise medical terminology. MEDLINE is the U.S. NLM premier bibliographic database that contains over 19 million references to journal articles in life sciences with a concentration on biomedicine. A distinctive feature of MEDLINE is that the records are indexed with NLM MeSH.

## Indian Databases

**IndMed [32]:** IndMed database covering prominent peer reviewed Indian biomedical journals. It has been designed to provide medical professionals/ researchers/ students and the medical library professional quick and easy access to Indian literature.

## Non-Profit Organisations

**Medical Matrix (<http://www.medmatrix.org>):** Medical Matrix offers you information from the largest peer-reviewed directory on the Internet. All the sites within Medical Matrix have been pre-selected by a team of physicians and medical librarians. This content is indexed to document level to make your search more productive, complete, and efficient, thus eliminating the need to search through pages of material for your result. Medical Matrix lists over 6000 medical web sites and links to over 1.5 million documents ensuring that precise information is delivered [33]. Hospitals, medical libraries and professional associations on the Web:(<http://www.arcade.uiowa.edu/hardin-www/hslibs.html>)



link to sites that reproduce or index medical literature. The online catalogues of medical libraries are a window to the world of medical publishing with links to academic, hospital and military medical libraries and other medical sites worldwide. The home page also links to a list of open access medical journals [34].

**Free Medical Journals:** For direct access to the current issues of several hundred free, full-text medical journals, Free Medical Journals (<http://www.FreeMedicalJournals.com>) offers good source [35]. With a goal to promote the open access of full text medical journals on the Web, it has the journals arranged alphabetically and by specialty.

**Internet medical bookstore:** This section contains many topics on medicine and each subtopic contains many free medical books and resources and these are highly beneficial for doctors and students. Some of the resources in this section can be viewed online and some of them can be downloaded [36].

Often researchers will need to consult medical texts; first, however, they must be identified and obtained. For information about medical textbooks, CD-ROMs, and software that are available for sale, several useful reservoirs are available and promoting free access to medical books [37,38].

## Medscape

Medscape (<http://www.medscape.com>) is a web resource for physicians and other health professionals. It features peer-reviewed original medical journal articles, CME (Continuing Medical Education), a customised version of MEDLINE database, daily medical news, major conference coverage, medical images, medical dictionary and drug information-including a drug database (Medscape Drug Reference, or MDR) and drug interaction checker. All content in Medscape is available free of charge for professionals and consumers alike, but registration is required [39].

Basic steps in literature search [40]. The 6 steps to an effective literature search were devised by Library staff to provide searchers with a systematic plan to literature searching.

1. Scope your research-What type of information would best meet your needs? It clarifies our need and ultimately focuses on precise search query i.e. research question.
2. Choose resources to search- data base/search engine- high quality featured data bases can narrow our search, save time, effective and efficient.
3. Choose your search terms- by words (e.g. obesity) or phrase (e.g. "obesity and exercise")
4. Complete your search strategy- start with broader search and finishes with precise results. When to start, how to process and when to stop search; you are a decision maker.
5. Find the full text- once you provide query, it display summary results and highlight text availability i.e. free full text article
6. Manage information. Searched information need to edit, format and store as require required, so that future retrieval of similar literature is simple and very easy.

## Here are Some General Rules To Go By

**Basic search [41]:** Use the Basic Search when you have only a single term to search. Use the Basic Search when you are only searching by the author.

**Advanced Search [41]:** Use the Advanced Search when you have more than one concept to search, to search in a specific field and when you want to limit search by language or publication type.

**Literature Search:** It is a dynamic and interactive process; there is no one way to conduct a search and there are many variables involved. For quality research we need to have comprehensive and periodic searches. A budding researcher must keep in mind the strengths and limitations of a particular search engine/database while searching for a particular type of data. It is suggested that

a systematic search of literature that uses available electronic resource effectively, is more likely to produce quality research.

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**PARTICULARS OF CONTRIBUTORS:**

1. Associate Professor, Department of Community Medicine, Government Medical College, Nagpur and Faculty for Research Methodology, MUHS, Nashik, Maharashtra, India.
2. Associate Professor, Department of Community Medicine, Indira Gandhi Government Medical College, Nagpur and Faculty for Research Methodology, MUHS, Nashik Maharashtra, India.
3. Assistant Professor, Department of Pathology, Jawaharla Neharu Medical College, Sawangi, Wardha, Maharashtra, India.

**NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:**

Dr. Subhash B. Thakre,  
Associate Professor, Community Medicine, Government Medical College, Nagpur, 440015- Maharashtra, India.  
Phone: 9822366532, E-mail: drsubhasht@rediffmail.com

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