Information retrieval in MEDLINE®: Searching for literature about critical care

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ABSTRACT

More than ever, update of knowledge and decision-making in health care are based on the use of recent scientific information. The effects of the information society's technological transformation are visible in the most frequent options of clinicians, being common the use of databases, in order to keep pace with the rapid growth of scientific publications. The most frequently used database is MEDLINE. Thus, in order to understand its functioning, especially related to subject searching, the way information is represented and the possible forms of retrieval will be analyzed. In this context, a study carried out to get update information about subject information retrieval will be presented in the detail. The results are interpreted based on recognized effectiveness measures of evaluating information systems.

KEYWORDS: MEDLINE, information retrieval, critical care

1. INTRODUCTION

The clinical decision is taken based on clinicians' experience and also on recent literature. The volume of new published medical literature is expanding very quickly, forcing the use of databases in order to search for suitable literature. The most frequently used database is MEDLINE, which can be searched through several systems as PubMed, among others.

PubMed[1] is a free online service of the United States National Library of Medicine (NLM) that includes over 18 million citations from MEDLINE and from other life sciences journals. MEDLINE is the NLM's premier database, containing references mostly on biomedicine from 1949 to the present. This database indexes citations from more than 5.200 journals in a total of 37 languages from 80 countries.

From 2005, updates to MEDLINE run from Tuesday to Saturday, adding between 2.000 and 4.000 citations daily. An amount of 670.000 citations were added in 2007. Updates are suspended for several weeks between November and December, due to the upgrade of Medical Subject Headings, the vocabulary used for subject indexing[2].

2. INFORMATION REPRESENTATION AND INFORMATION RETRIEVAL IN MEDLINE

Information representation in MEDLINE considers the input of descriptive elements as author, title, abstract, pagination and also considers the subject indexing.

Medical Subject Headings (MeSH) is the vocabulary maintained by NLM and is used to index citations. It is composed by 24.767[3] descriptors presented in both an alphabetic and a hierarchical structure. MeSH vocabulary is organized in 16 categories, also called tree structures, each one divided into subcategories. Within each subcategory, descriptors are organized hierarchically from most general to most specific. An example of the tree structure is shown in Table 1. Each MeSH descriptor represents a single concept and indexers use generally 5 to 15 headings per article. The terms that represent the major points of the article are marked with an asterisk (*).

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[1] Available from World Wide Web: <http://www.pubmed.gov>.

[2] U.S. NATIONAL LIBRARY OF MEDICINE®, Fact sheet: What is the difference between MEDLINE® and PubMed®?; U.S. NATIONAL LIBRARY OF MEDICINE®, Fact sheet: MEDLINE®.
[3] This value corresponds to the 2008 edition.

Table 1: Example of a tree structure

Category	Anatomy
Subcategory	Body Regions
Descriptor	Head
Descriptor	Face
Descriptor	Eye
Descriptor	Eyebrows
Descriptor	Eyelids
Descriptor	Eyelashes

MeSH vocabulary contains a group of subheadings used to qualify the descriptors, for example diagnosis or therapy[4]. Each term have its' own group of qualifiers. Table 2 illustrates an example of a MeSH term with the allowable qualifiers.

Table 2: Example of a MeSH descriptor

MeSH descriptor	Allowable qualifiers	
cell count	CL	Classification
	EC	Economics
	ES	Ethics
	HI	History
	IS	Instrumentation
	MT	Methods
	SN	Statistics & numerical data
	ST	Standards
	TD	Trends
	UT	Utilization
	VE	Veterinary

When searching for a subject, the user has two possibilities of defining a search strategy: using text words or using MeSH. The first consists in typing the word or phrase in the general query box. The system will map[5] the search in order to find the correspondent MeSH terms and develop a search process that includes all terms (text word and MeSH).

The other way of searching for a subject is using MeSH vocabulary. After entering the MeSH database, the searcher can type the subject in the query box and proceed with the search. When the system doesn't find the exact term, a list of suggestions is shown in order to help the searcher. On the other hand, when searching with MeSH, one can choose the available qualifiers, offering more precise strategy definitions[6]. Knowing MeSH headings,

one may search using field tags in the general query box. For example, a search strategy for thromboembolism, could be typed as follows: thromboembolism [mh].

A sample of a retrieved MEDLINE citation is shown in figure 1. The article was indexed with a comprehensive group of MeSH terms.

Figure 1: MEDLINE citation

Nippon Rinsho. 2008 Aug;66(8):1542-6.

[Modification of daily life in patients with mild hypertension]

[Article in Japanese]

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Modifications of lifestyle not only have antihypertensive effects by themselves but also help reducing the dose of drugs. In addition to dietary modification and exercise, moderation of drinking and stopping smoking are important for hypertensive patients. Drinking should be restricted to 20-30 mL/day or less in terms of ethanol in males and 10-20 mL/day or less in females. And, smoking is a powerful risk factor for ischemic heart disease and stroke although its hypertensive effect is not established. Also, protection against the cold, stress management, and control of sleep prevent progress of hypertension and its cardiovascular complication.

Publication Types:

- English Abstract
- Review

MeSH Terms:

- Alcohol Drinking/adverse effects
- Cardiovascular Diseases/etiology
- Cardiovascular Diseases/prevention & control
- Cold/adverse effects
- Constipation
- Diet
- Exercise
- Female
- Humans
- Hypertension/etiology
- Hypertension/prevention & control
- Hypertension/therapy*
- Life Style*
- Male
- Risk Factors
- Severity of Illness Index
- Smoking Cessation
- Stress

PMID: 18700555 [PubMed - indexed for MEDLINE]

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[4] Additional information is available in the MeSH browser: < http://www.nlm.nih.gov/mesh>.

[5] The *Automatic Term Mapping* feature enables the translation of typed text words into MeSH vocabulary terms.

[6] To understand PubMed search tools in detail, see U.S. NATIONAL LIBRARY OF MEDICINE®, NLM® Training: PubMed®.

3. PROEMINENT STUDIES DEVELOPED WITH MEDLINE

The first study developed with this database is an important reference in information retrieval studies. In fact, Frederick Lancaster studied MEDLARS, the first non online version, in order to obtain some answers about the database performance. This study, developed between 1966 and 1967, considered the information needs of real users as doctors and researchers and tested the effectiveness measures of recall and precision, the coverage of MEDLARS, the response time of the system, the search results format and the effort the user would expend in order to get a satisfactory response. Based on the study's conclusions, Lancaster recommended a review of the search request model, a review of the indexing process as well as of the indexing language and also recommended the establishment of a search strategy that explored all the possibilities of retrieving the requested subject[7].

In the 90s a group of researchers led by R. Brian Haynes[8] compared the performances of 27 online and compact-disc systems displayed by both NLM and suppliers. The searches were carried out by clinicians, librarians and by vendors' representatives. The results were very different considering both the diversity of systems and the searchers. Clinicians and vendors achieved less precise results than librarians[9].

Haynes and the researchers group developed several studies in the recent years in order to obtain optimal search strategies for retrieving quality articles. These strategies were adopted for use in the Clinical Queries interface of PubMed[10].

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[7] LANCASTER, FW., Evaluating the performance of a large computerized information system; LANCASTER, FW., MEDLARS: Report on the evaluation of its operating efficiency.

[8] This group is entitled The Hedges Team and works at the Health Information Research Unit, McMaster University.

[9] HAYNES, RB., et al., Performances of 27 MEDLINE systems tested by searches with clinical questions.

[10] HAYNES, RB., et al., Optimal search strategies for retrieving scientifically strong studies of treatment from MEDLINE: analytical survey; HAYNES, RB., WILCZYNSKI, NL., Optimal search strategies for retrieving scientifically strong studies of diagnosis from MEDLINE: analytical survey; MONTORI, VM., et al., Optimal search strategies for retrieving systematic reviews from MEDLINE: analytical survey; WILCZYNSKI, NL., et al., An overview of the design and methods for retrieving high-quality studies for clinical care.

4. SEARCHING FOR LITERATURE ABOUT CRITICAL CARE

4.1. BACKGROUND

The intensive care area is "a differentiated and multidisciplinary area of the medical sciences, that deals specifically with prevention, diagnosis and therapy of patients with a probable failure of one or more vital functions, but potentially reversible"[11,12].

The intensive care units may vary from hospital to hospital, as far as services, organization and human resources are concerned. Smaller hospitals have, frequently, a single unit, and university hospitals have more than a unit, separated by specialties or sub-specialties. Nevertheless, all the units have common requirements. According to international guidelines, any unit must have access to specialized information as books and journals[13].

Considering the free access to PubMed and regarding the quick and precise decisions in critical care, it is important to explore the end users' strategies and search results.

4.2. METHODS USED FOR THIS STUDY

We developed a study in order to get update information about information retrieval in critical care, considering that, according to international standards, critical care services should have access to recent literature. This study had two parts. The first took place in June of 2006 and was carried out in the intensive care department of a Portuguese hospital. The searchers group was composed of ten doctors with different levels of experience using PubMed. Each doctor searched in accordance with a previously created form. The form was created together with a researcher of this area, who also proceeded to the literature hand search, in order to determine the set of relevant articles about two subjects recognized for its importance:

1- Sepsis and corticosteroids,

2 – ARDS and mechanical ventilation.

The search was limited to articles about humans and published from 2004 to 2005 in the journal *Critical Care Medicine*. This publication was selected, because it presented the highest impact factor in the Journal Citation Report of 2004, between journals directly related to critical care. Despite the discussion about the accuracy and usefulness of impact factors, they still are the most used values, being confirmed is some studies as valid[14].

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[11] PORTUGAL. Ministério da Saúde, Cuidados Intensivos: Recomendações para o seu desenvolvimento.

[12] Author's translation.

[13] HAUPT, MT., et al., Guidelines on critical care services and personnel: Recommendations based on a system of categorization of three levels of care.

[14] SAHA, S., SAINT, S., CHRISTAKIS, DA., Impact

All the doctors searched in a period of time where PubMed did not suffer any changes related to search facilities. While searching, the users talked with the research team about their difficulties. At the end, the researchers printed the users' search strategies and the citations list.

The results of PubMed searches were evaluated on the basis of their recall and precision, considering that recall is the system's ability to retrieve all relevant items and precision is the system's ability to retrieve only relevant items, rejecting non-relevant information.

The second parte of this study took place in June of 2008 and consisted in repeating the same search strategies used by the group of doctors. The results of both parts were compared.

4.3. FINDINGS

After analysing the results of the study, after analysing doctor's search strategies and after checking the relevant articles not retrieved and the irrelevant articles retrieved, we drew the conclusion that in order to achieve the best result it's advisable to search with both natural language and controlled vocabulary (MeSH). We verified that the natural language searches provided higher recall than the searches that used controlled vocabulary. The searches that used controlled vocabulary achieved results with higher precision than the natural language searches. The automatic term mapping can help the end user in translating the natural language, nevertheless the success depends on the user's capacity to use proper words or correct expressions.

The searches that used MeSH vocabulary had the same results at the two parts of this study, but the searches that used natural language retrieved more relevant articles in 2008, probably due to new mapping features[15]. Searches that used an acronym (related to the second subject) had a higher precision level in 2008. The term mapping differed from 2006.

The users' opinions all went in the same direction: searching with MeSH is difficult, time consuming and doesn't achieve the best results. The users more experienced in using all the search resources mentioned that the vocabulary related to critical care was outdated.

Another conclusion of the study was that editorials have less exhaustive indexing than other articles. Editorials may have important notices about the accuracy of some information published in previous issues, being common the relation between citations of different publication types. Editorials don't have abstracts and their title is frequently distant from the content. These facts make difficult any possibility of retrieving relevant editorial items.

4.4. STRENGTHS AND LIMITATIONS OF THE STUDY

In our study we used a small subset of the database. Thus, in order to confirm our conclusions, it would be useful to expand the study to a larger group of items considering other journals and other subjects. On the other hand, it would be advisable to enlarge the literature hand search group in order to eliminate any partial opinions.

The study reported in this paper used an uncommon method in this kind of studies: it applied qualitative research tools as the observation and the semi-structured interviews with the group of end users. Usually the users have few or no contact with the research team, but we concluded that this contact can enrich a study.

5. CONCLUSION

Information technology advances may cause the impression that a system is prepared for success as long as it has a friendly interface. In a moment where the information professional's place is under discussion, we can observe that they still have an important rule in the information retrieval process. Information professionals have a place in developing qualitative studies in order to evaluate not only a system performance, but also the vocabulary specificity in any area of interest.

Some of the conclusions we achieved are detected only by information professionals. The end user may not understand all the possibilities that the system allows. On the other hand, the use of reference managing software contributes to the creation of a personal archive of citations and many researchers may develop their searches limited to recent dates. As we could verify, MEDLINE introduced some changes that allow different search results from past items. Therefore, when a researcher looks for retrospective information, he may need to repeat the searches already conducted.

We can conclude that the presence of information professionals help the users getting the most accurate information. Thus, this paper can be of interest for both information and health professionals.

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