Cardio Online Reader – Conjunctions in Cardiology Knowledge

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Abstract

Background: The progress of scientific knowledge produces an excessive amount of scholarly literature. For effective clinical use it is necessary to use time, quality and relevance filtering.

Objectives: We decided to create an independent web based interface for searching the PubMed Database for recent evidence-based articles in the domain of cardiology.

Results: The Cardio Online Reader (COR) application (http://neo.euromise.cz/cor) offers an easy way to reach valid and relevant articles filtered by keywords, MeSH terms, authors, date of publication and type of publication. Results can be commented, rated, stored as citations and shared using most popular web sharing services.

Conclusion: Using COR can positively affect clinical decisions of physicians bringing them relevant and up-to-date scientific information.

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Keywords

Electronic databases, Web 2.0, medical subject headings, decision support

EJBI 2011; 7(1):69–74 recieved: October 20, 2011 accepted: November 1, 2011 published: November 20, 2011

1 Introduction

The progress of scientific knowledge in the field of medicine forces physicians in the clinical practice to keep in touch with recent scholarly literature. The most important communication medium for transfer the research results into the practice are scholarly articles in specialized expert journals. The amount of these articles grows in time and in last years the growing accelerates. Ways how to cope with this trend are not new [1, 2, 3], but the need of their practical use in the clinical practice is more and more urgent. Doctors in clinical practice need relevant information quickly and easily accessible [4].

Electronic databases are well arranged sources of information about biomedical articles published in an electronic or printed form. They collect metadata about articles published all around the world in the large number of journals.

The most important free accessible resource of biomedical science articles is the PubMed database, which is one of key services provided by the National Center for Biotechnology Information (NCBI). On the August 1, 2011 the PubMed database contained 21 067 999 article citations.

For acquiring the right (requested) result filtering from so big amount of articles it is necessary to describe the content of the article in right categories of metadata. On the other hand we require an easy to use and complex tool for searching through the database.

The web interface of the PubMed database [5] is accessible via http://www.ncbi.nlm.nih.gov/pubmed. It offers one html form field for searching the key terms in the

database. It puts the accent on the syntax of search query, for the definition should be defined precisely. The search engine returns often tens of thousands results when the search query consists of one or two key terms. The result list is sorted by the time of adding into the PubMed in a descendent order (by default), so the most recent articles come at first, but this order says nothing about qualitative parameters of articles.

The NCBI web pages also offer an advanced search tool for the PubMed database http://www.ncbi.nlm.nih.gov /pubmed/advanced. Users can define the search query in the PubMed Advanced Search in 39 parameters, which stores the PubMed database. Advanced Search saves a history of searched queries for each user. These queries can be repeatedly retrieved.

The web interface of Advanced Search is more complicated to use then one form field in the basic search. The definition of the query is time consuming and it needs an experience with search query formulation for obtaining high-quality results.

2 Objectives

Clinicians and healthcare participants should obtain the requested information for clinical decisions quickly and in an easy way. Our purpose was to simplify the process of obtaining searched articles in the stressing and time lacking situation of clinical practice. We wanted to allow any clinical worker or other interested person to gain highquality results with no experience in large bibliographical database search. The only requested ability is to manage Internet browser.

Our aim is to provide a multidimensional view on the medical knowledge and its usability in the clinical practice.

As a data source we choose the PubMed database and we established an objective to create a new independent interface to filter out a specific part of resources (Evidence-based Medicine Categories, specific medical domain).

In the structure of metadata indexed in the PubMed database we selected those that represent one of dimensions we consider to be crucial in filtering relevant clinical information.

For the pilot project we assumed to concentrate on one medical domain cardiology. Articles focused on this domain are filtered in the PubMed search query definition by a specific set of Medical Subject Headings (MeSH) terms.

MeSH terms intermediate relations between articles each MeSH term of an article can link to other articles with the same MeSH keyword.

The type of publication representing the strength of evidence supporting the objective of the article is another dimension of the article. We limited publication types only to randomized controlled trials, systematic reviews and guidelines obtaining the strongest clinical evidence [6]. In order to bring the most relevant information and follow the dimension of time we want to order the list of results from the most actual articles.

For the future development we assume including some kind of regional relevance, that gives a new dimension to the knowledge collected all around the world. Some articles can be specific for concrete populations or healthcare systems. The native language of the article and the availability in the language of clinical user plays a very important role for usability of the paper in a particular clinical case or for a target person.

For demonstrating and easy understanding of the search results we want to use mostly graphical representation of the range and parameter specification and search results. In the future development we will prefer graphical MeSH cloud, map of the regional relevance or diagram of the most popular languages used in the papers rather than plain textual results.

3 Results

As a practical result of our efforts we developed the Cardio Online Reader (COR) web application that offers fully functional search interface for articles from Cardiology indexed in the PubMed database.

The actual version of the COR application is freely accessible on $\rm http://neo.euromise.cz/cor$.

The database of citations and abstracts of biomedical science articles is the main part of the COR application. This database uses a MySQL database engine. The main data source for our project is the PubMed database, that can be used free of charge. Import of the data was realized by the query to the PubMed database defining the domain of Cardiology by using the most important MeSH terms from Cardiology. We filtered off articles, which do not fulfill our qualitative criteria from the Evidence Based Medicine point of view.

We selected only these types of articles:

- Randomized Controlled Trials,
- Systematic Reviews,
- Systematic Reviews with Meta-Analysis,
- Guidelines,
- Practical Guidelines.

The result of this query was saved in the XML file. Exported XML file was parsed by one-purpose PHP import script and selected data fields (title, authors, MeSH terms, abstract, unique identifier PMID, date of the abstract publication in the PubMed database, link to the full text, journal title) were saved to the COR database.

The actualization of the COR database proceeds daily by an automatically started PHP script, which uses tools from the Entrez Programming Utilities [7] for gathering metadata for each article published since the last actualization.



Figure 1: An example of COR application web interface showing the list of articles retrieved for parameters set in the filter form fields above.

3.1 The Web Interface of the COR

Contrary to the original PubMed interface we concentrated on the fastest way to reducing the number of search results preserving the focus on results important for the clinical practice.

Users can limit search results by one mouse-click to one category of high quality evidence. Users can also use

six form fields of the filter on the home page of the COR application for entering search criteria. Individual form field stands for entering a part of text in the article title or abstract. Another form field specifies the requested author or authors. The third large form field stands for entering parts or exact full terms of Medical Subject Headings (MeSH) thesaurus. Users can write down requested MeSH terms or they can choose them from a generated

Table 1: Dimensions of clinical information and matching PubMed metadata used in Cardio Online Reader.

Dimension of clinical information	Matching PubMed metadata category
Medical Domain	filtered using MeSH
Related Medical Terms	MeSH
Evidence Based Medicine Categories	Publication Type
Time of Relevance	Publication Date
Regional Relevance	Country of the Journal
	Affiliation
	Country of the Author ? (external data)
	specific population description ? (external data)
Full text Availability	DOI, Full Text Link Out
Language	Language



Figure 2: An example of COR application web interface showing the detail of an article record.

MeSH Cloud or MeSH List, where terms are displayed in relation to their appearance in articles or sorted alphabetically.

In these form fields it is possible to use logical operators AND and OR. It is also possible to use a dynamically generated autocomplete function in these three fields to simplify entering exact phrases.

Users can limit the list of search results by setting the lowest and the highest date of publishing the article in the PubMed database in next two form fields. The dates can be set manually or chosen from the JavaScript date picker.

The last form field stands for the manual choice of the category of EBM quality of evidence.

For the fast choice of most frequented MeSH terms and their insertion to the filter, there is a "MeSH cloud" in the right part of the application web page, where enlisted terms differ in the text size displaying frequency of each term in the database. Users can use the list of last search queries.

3.2 Search Results

The COR application display search results matching entered parameters below the filter. Search results are in descending order sorted by the date of publication in the PubMed database. The simple list of results shows an article title, names of authors and the date of publication in the PubMed database. There can be a maximum of 15 results on one page. User can browse through the result pages. The category of an article is indicated by a graphical icon.

By clicking on the article title in the list of results user can navigate to the detail page of the article record. The detail page shows the article title, names of authors, list of assigned MeSH terms, PMID identifier, link to the original record in the PubMed database, link to the full text of the article (if available on the Internet), article abstract, journal title and the date of publication in the PubMed database. The User of the COR application can rate the helpfulness of the article in the scale from one to five star symbols. This rating is linked to the IP address, so one user can rate a single article only one time. User can also attach a comment to the article.

3.3 Web 2.0 Social Functions

The second big task for the COR application is to allow easy sharing of clinically important results with colleagues, friends and professional community. The detail of the article including abstract and bibliographical data can be shared via email, Facebook, Twitter and other social networks contained in the Share this web service [8].

Excepting a particular scientific article detail, the COR offers an easy way to share a link to itself via Share this service, Facebook, Twitter, e-mail or one of 21 most common social and bookmarking services like Digg, Delicious, Reddit, Yahoo! or Google Bookmarks.

Users can follow a CORs own profile on Facebook and Twitter, Blogger account and YouTube channel. Users can subscribe to RSS channels with last 20 articles or last 20 comments generally or individually for each type of article.

3.4 Future Plans and Improvements

We plan further improvements and simplifications in the web interface of the COR application in the future. One thing which can speed up using the filter and make the work more illustrative is to place a graphical slider and the time plot showing numbers of articles published in the discrete time periods and their selection in the filter.

A long term problem is to optimize the autocomplete function in three form fields in the filter to help users in inserting key terms in the easiest way. This process should be evaluated in the cooperation with common users.

Geotagging can help to make search results more regionally-oriented. Metadata contained in the PubMed database can show in which country the article was published. Geographical information in the field Affiliation is even more interesting. It is possible to find out where the article was created and what population is in the article described. We can draw this information in the map or allow its limitation in the filter.

We assume an individualization of the web interface for registered users in the future development of the COR application. After the registration process and logging in a user could browse the history of own search queries, create lists of favorite articles, let the system send him notification on some events in the database or define own RSS channels or add authorized comments and ratings.

The COR application not only can serve users of the web interface or RSS readers. The same problem as physicians have today with obtaining relevant clinical information will rise in the future for decision support systems (DSS) that can improve practitioner performance [9]. Even DSS algorithms can easily complete well-structured PubMed search query and ask directly the source database, we should prepare computer readable results of the COR application as a simple and independent alternative of the PubMed Entrez Utilities.

By creating an XML data interface we can connect the clinical information system and send it search results or record details on its demands. Possible service for hospital information systems could offer relevant document for the concrete clinical situation defined by MeSH and geographical terms.

4 Discussion

The widely accepted PubMed database of biomedical bibliographies of biomedical publications has a free accessible web interface with a basic or advanced version of the search. We can use other web services for searching biomedical databases for scientific articles by clinical terms or other parameters. These services are more general (Google, Google Scholar) or focused on natural sciences (Scopus).

Why to create another search tool?

The amount of scientific articles indexed in electronic databases increase steeply. A recent question "where to find" has been replacing by questions "how to search" and "how to search the easiest way". The COR offers simple and fast way how to search the PubMed database for articles in the field of Cardiology and with the focus on highest evidence. It copes with only one thousandth of the PubMed database and provides easy-to-use tools for setting the search query that can acquire small amount of articles appropriate to the clinical need.

Other web services are specialized on searching in large databases of scientific bibliography (Vivisimo, Tripdatabase, Pubmeddy - discontinued). The COR is unique in its focus on one domain (Cardiology), on few defined EBM categories most important for clinical practice and in the simplicity of use.

The key question for the progress of the COR application will be the interest of expert medical community. The COR contains tools for sharing scientific information between experts, tools for subjective rating of their quality and tools for expert discussion. Experts could be motivated by functions for registered users, individualized search functions, the ease of use and the fact, that this application is free of charge. The COR application is designed for Cardiology specially.

Filters used for extraction from the PubMed database are firmly defined. The same technology could be used for another one purpose (one expert domain) web portal. Similar filters could be also individually set for registered users, so the scope could be widened to other domains.

5 Conclusion

As an alternative to the widely accepted PubMed search web tool we created the Cardio Online Reader web application. It concentrates on the domain of Cardiology. The COR uses the free accessible PubMed database of biomedical scientific articles and ads an easy-to-use search web interface and functions for sharing, rating and commenting articles.

This application is freely accessible via http://neo.euromise.cz/cor.

Acknowledgments

This work was supported by the project 1M06014 of the Ministry of Education Youth and Sport CR and by the project SVV-2011-262514 of Charles University in Prague.

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