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All Information Is Not Equal: Using the Literature Databases PubMed and The Cochrane Library for Identifying the Evidence on Granulocyte Transfusion Therapy

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Keywords

Databases, bibliographic · PubMed · The Cochrane Library · Information seeking behavior · Evidence-based medicine

Summary

To be able to take well-informed decisions or carry out sound research, clinicians and researchers alike require specific information seeking skills matching their respective information needs. Biomedical information is traditionally available via different literature databases. This article gives an introduction to two diverging sources, PubMed (23 million references) and The Cochrane Library (800,000 references), both of which offer sophisticated instruments for searching an increasing amount of medical publications of varied quality and ambition. Whereas PubMed as an unfiltered source of primary literature comprises all different kinds of publication types occurring in academic journals, The Cochrane Library is a pre-filtered source which offers access to either synthesized publication types or critically appraised and carefully selected references. A search approach has to be carried out deliberately and requires a good knowledge on the scope and features of the databases as well as on the ability to build a search strategy in a structured way. We present a specific and a sensitive search approach, making use of both databases within two application case scenarios in order to identify the evidence on granulocyte transfusions for infections in adult patients with neutropenia.

Introduction

Researchers and clinicians are nowadays confronted with a vast and incessantly growing amount of biomedical information. The availability and constant advancement of the search instruments on the internet as well as of connected and easy-to-use technologies like mobile devices often lead to the assumption that the demand for information is easily met. Unfortunately, this is not the case when it comes to high-quality and authoritative information, which is the kind of information that actually makes a difference in healthcare practice. The challenge in the daily routine within a clinic or a research setting lies in understanding one's own information needs and subsequently being able to choose the most efficient way for localizing and accessing the appropriate and best information available. Skills in systematically developing strategies for searching the medical literature are therefore vital for every healthcare practitioner who wants to take well-informed decisions.

Biomedical information is traditionally available via different literature databases, which contain references to several publication types that substantially vary in their quality and ambition. This article aims to give an introduction to two important literature sources that should routinely be used in the setting of transfusion medicine, hemotherapy, immunohematology, and clinical hemostasis: PubMed and The Cochrane Library. They are presented using two application case scenarios: First, a young resident physician (Dr. Jung) who needs to find the best available evidence on granulocyte transfusions for infections in adult patients with neutropenia, because his head of department has asked him to brief his colleagues during the clinic's upcoming brown bag seminar. Second, a senior clinician (Dr. Weiss, the head of department) who plans to

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Table 1. Scope and features of the literature databases PubMed and The Cochrane Library

	PubMed	The Cochrane Library
Producer	Content and interface: National Center for Biotechnology Information (NCBI) at the U.S. National Library of Medicine, USA	Content: The Cochrane Collaboration (CDSR, CENTRAL, Methods) and the Center for Reviews and Dissemination, University of York, UK (DARE, HTA, NHS EED). Interface: John Wiley & Sons, Ltd., UK
Access link	*www.pubmed.gov*	*www.thecochranelibrary.com*
Access options	Freely available worldwide	Full access with subscription, in many countries free due to national or institutional subscription or status as low-income country[a]
Content and scope	About 23 million citations from 5,652 peer-reviewed international biomedical journals in the fields of medicine, nursing, dentistry, veterinary medicine, health care systems, and preclinical sciences [1]. Subsets: *indexed for MEDLINE* (since 1946, citations indexed with MeSH) *as supplied by publisher* (citations submitted from a publisher) *in process* (citations currently being indexed for MEDLINE) *PubMed* (citations from PubMed Central; citations that will not receive MeSH and other sources) *Old Medline* (1946 till 1966, only partly indexed with MeSH) Connection to other databases: PubMed is interlinked with factual biomedical databases produced by the NCBI focusing e.g. on genomes and nucleotide sequences	About 800,000 citations compiled from several medical literature databases and additional manual identification of citations [2]. Databases: *Cochrane Database of Systematic Reviews* (CDSR / Cochrane Reviews) since 1996, ca. 8,400 systematic reviews/protocols *Database of Abstracts of Reviews of Effects* (DARE / Other Reviews) since 1994: ca. 28,400 citations of systematic reviews extracted from PubMed, Embase, PsycINFO, CINAHL, Social Care Online, ERIC, AMED and manual selection *Cochrane Central Register of Controlled Trials* (CENTRAL / Trials) since 1898: ca. 783,700 citations reporting RCT/CCT from MEDLINE, Embase, Review Groups´-manual selection *Health Technology Assessment Database* (HTA / Technology Assessments) since 1989, ca. 13,100 citations of HTA reports *NHS Economic Evaluation Database* (NHS EED / Economic Evaluations) since 1968, ca. 15,600 citations of economic evaluations *Cochrane Methodology Register* (CMR / Method Studies) since 1904, ca. 15,700 citations reporting methods for conducting reviews and clinical trials
	Update: daily (Tuesday to Saturday)	Update: CDSR daily, CENTRAL monthly, DARE/HTA/EED quarterly
Publication types	Unfiltered source → different publication types (e.g. journal articles, case reports, letters, comments, guidelines, legal cases, interviews, clinical trials, reviews) occurring in academic journals.	Prefiltered source → only specific publications types, which have either been critically appraised or carefully selected, e.g. CENTRAL: RCT/CCT; CDSR and DARE: systematic reviews; HTA: HTA reports.

Table 1 continued on next page

conduct a clinical trial on the subject and is writing an application for the ethical review board, in which she needs to prove the lack of clinical evidence on the topic.

PubMed and The Cochrane Library – Two Diverging Literature Sources

Both clinicians routinely use the biomedical literature database MEDLINE available via the search interface PubMed. They are also aware of another resource that is well-known for its focus on evidence-based medicine: The Cochrane Library. Table 1 gives an overview of the scope and features of these two diverging literature databases, which nonetheless are useful for both search approaches, respectively, as will become clear in the course of this article.

PubMed

Created and maintained by the US National Library of Medicine (NLM), PubMed provides free access to 23 million citations (in most cases with abstract) within the fields of medicine, nursing, dentistry, veterinary medicine, healthcare

Table 1. Continued

	PubMed	The Cochrane Library
Search options	Search language: English (original titles are translated) Basic and advanced search: Search Builder, History Logical operators AND/OR/NOT: e.g. (infection OR sepsis) AND (neutropeni* OR granulocytopeni*) Phrase searching: e.g. 'granulocyte transfusion' or: granulocyte transfusion* Truncation: * on the right, e.g. neutropeni* Standard filters: e.g. ages, language, species, date Thesaurus: Medical Subject Headings (MeSH) are he NLM controlled vocabulary used for indexing citations (ca. 25,000 MeSH and up to 80 subheadings) Unique search options: Search interface *Clinical Queries* (methodological filters), *Related Citations*: algorithm which displays similar citations based on one relevant citation	Search Language: English (original titles are translated) Basic and advanced search: Search Manager Logical operators AND/OR/NOT and NEAR/NEXT: e.g. (infection* OR sepsis) NEAR/3 (neutropeni* OR granulocytopeni*) = max. three words between terms Phrase searching: e.g. 'granulocyte transfusion*' Truncation: * on the right, left, middle / ? wildcard for one or letter in the middle and 0-1 letters on the right, e.g. *esophag* Standard filters: search limits for publication dates Thesaurus: Medical Subject Headings (MeSH) Unique search options: Browsing of Cochrane Reviews by topics and Review Groups
Managing results	Export: via *Send to* > *Citation manager* (max. 200 citations) or *Send to* > *File* > *MEDLINE* in the results list Account: *MyNCBI*, save searches permanently, recent activity recording, automatic email alerts or RSS feeds for saved searches, display format preferences, filter options, bibliography, collections	Export: via *Export all* or *Export selected* in the results list Account: *My Profile*, save searches and articles, alert manager for saved searches
Training/education	Factsheet: *www.ncbi.nlm.nih.gov/books/NBK3827/* Tutorial: *www.nlm.nih.gov/bsd/disted/pubmed.html*	Factsheet: *www.thecochranelibrary.com/view/0/HowtoUse.html* Tutorial: *www.wileyonlinelibrary.com/training*

[a]Abstracts and plain language summaries of Cochrane Reviews are freely available worldwide (*www.thecochranelibrary.com/view/0/FreeAccess.html*), Cochrane Reviews published since February 2013 are freely accessible 12 months after publication. DARE is freely available on the CRD website (*www.crd.york.ac.uk/CRDWeb/*).

systems, and preclinical sciences. It currently indexes around 5,650 international peer-reviewed journals chosen by a selection committee, extending back to 1946. All different article types published within these journals are represented in the collection, wherefore it is generally considered an unfiltered source of primary literature. Citations originally written in languages other than English are translated, thus establishing English as the required search language. The database MEDLINE is the centerpiece and best known subset of citations available via PubMed [3, 4].

In order to optimize information retrieval from its extensive collection, PubMed offers several features, the most distinctive one being a controlled vocabulary closely dovetailed with the MEDLINE citations. These so called Medical Subject Headings (MeSH) form a comprehensive thesaurus, searchable via its own database, which describes the biomedical domain and is annually adapted as the field develops. MeSH terms are sorted hierarchically into broader and narrower terms. They are used by NLM experts to manually enrich the citations by characterizing their content. MeSH can be explicitly used to search PubMed, not only yielding more relevant results but also allowing for a more sensitive search approach. Therefore, they are regularly employed by search experts. However they are also automatically embedded in

every search that is run on PubMed's basic search. This process taking place in the background is called *Automatic Term Mapping*. The inserted words are mapped against the MeSH thesaurus, hence expanding the search in a comfortable way.

Another remarkable feature is PubMed's *Advanced Search*, a search interface which offers more control over the search process by allowing the selection of specific database fields, e.g. the title/abstract field (words need to occur in either the title or the abstract to retrieve a citation), or by enabling the database user to build the search strategy stepwise using logical operators (AND, OR, NOT), thus making a more structured search approach possible. A third search interface which is of great value for the clinical setting is called *Clinical Queries*. Here the extensive content available via PubMed is limited in a nifty methodological way to those citations in the database which best meet the information needs of clinical practitioners regarding therapy, diagnosis, etiology, prognosis, or clinical prediction.

Additional features include standard filters, which enable restricting a search to specific article types, species, age groups or publication dates, the *Related Citations* algorithm, which calculates similar citations based on one citation, as well as a variety of convenient export options. To complete a good search experience, the *MyNCBI Account*, available for free after registration, facilitates saving citations and searches permanently. Furthermore, it allows creating alerts which automatically email new content that has been added to PubMed based on previously saved searches.

In spite of the features outlined above, all of which are described in detail in [5–7], a PubMed search, initially considered simple, is in fact a complex process in which the challenge consists in retrieving relevant citations from a constantly increasing amount of publications.

The Cochrane Library

The Cochrane Library provides high-quality information based on publication types that are crucial in evidence-based medicine. It is created and maintained by The Cochrane Collaboration, a global independent network of health practitioners, researchers, and patient advocates [8]. The second important content provider is the Centre for Reviews and Dissemination (CRD) at the University of York. The Cochrane Library consists of six different databases, all of which are searched at the same time by default [2]. Below we present the three most important databases.

The *Cochrane Database of Systematic Reviews* (CDSR) is the primary output of the Cochrane Collaboration. It comprises routinely updated systematic reviews, which synthesize the results of clinical trials on a certain topic, generally an intervention for a specific disease but also diagnostic test accuracy. Cochrane Reviews are produced by authors who are associated with and supported by one of the 53 Cochrane Review Groups. They are comprehensive works, known for their methodological quality, and are available as full texts, structured abstracts as well as plain language summaries, summarizing the evidence on the topic. The database also contains protocols, which are pre-registered systematic reviews that are currently being conducted.

The *Database of Abstracts of Reviews of Effects* (DARE) provides citations on systematic reviews that have been produced independently from the Cochrane Collaboration. These reviews are quality-assessed, summarized, and made available as citations with structured abstracts and critical commentary.

The *Cochrane Central Register of Controlled Trials* (CENTRAL) gathers citations (in most cases with abstracts) reporting randomized clinical trials (RCT) and controlled clinical trials (CCT). They are selected from the two most extensive medical literature databases, MEDLINE and Embase, and complemented by citations identified by the 53 Cochrane Review Groups [9]. CENTRAL can be considered the best available resource for localizing publications on RCT and CCT.

The Cochrane Library differs from PubMed insofar as it is a pre-filtered resource, which only contains specific publication types (RCT/CCT in CENTRAL, systematic reviews in CDSR and DARE). Generally, the content has been either critically appraised or carefully identified and selected [10]. Two search interfaces are available: a basic and an advanced search interface (*Search Manager*). The Cochrane Library offers similar search features as PubMed, e.g. usage of MeSH, limiting the search to specific databases or publication dates, saving of searches, and setting up alerts in a personal account. Additionally, Cochrane Reviews can be browsed by topic or review group.

Substantial parts of the references contained in The Cochrane Library are available within PubMed (CDSR and parts of CENTRAL). Nonetheless, it is a resource worth searching separately because it offers publication type-structured, critically appraised content and includes citations from primary literature databases other than PubMed (table 1).

Application Case Scenarios – Identifying Evidence on Granulocyte Transfusion Therapy

From the short description of the two scenarios given in the introduction, it should have become evident that the information needs of both clinicians are quite diverse. Dr. Jung can only spend some hours on the search after finishing his several shifts this week. He primarily needs to find high-quality synthesized information on the topic and therefore aims to develop a precise search that will yield the most important evidence. This is quite contrary to Dr. Weiss who has taken the whole next week off her clinical duty in order to concentrate on developing a very sensitive search for primary literature that should make her aware of any published clinical trial worldwide that has ever been conducted on the subject. As preparation before diving into an extensive and detailed

Table 2. PICO framework structuring Dr. Jung's clinical question

Population	adult patients with neutropenia/granulocytopenia and infection/s
Intervention	granulocyte transfusion/s
Comparison	no granulocyte transfusion/s
Outcome	effectiveness/efficacy (reducing mortality)

Fig. 1. The Cochrane Library basic search result list, featuring the different databases.

search herself, she has asked one of her residents to summarize the available evidence and present it to her staff.

Application Case Scenario 1: The Young Resident Physician Searching for Summarized Evidence

Dr. Jung's academic education is quite recent, and he remembers having been taught that an information need is best managed formulating an answerable clinical question [11, 12] by breaking it down in a structured way using the PICO framework [13, 14] depicted in table 2. It will help him build the search strategy by defining the concepts that he will need to include in his search.

After having jotted down the main concepts, Dr. Jung feels fairly well prepared. From former experiences he knows that using PubMed, with its thousands of journals, is not the best way to start a precise search that aims to identify summarized evidence. Therefore he uses The Cochrane Library where experts have already critically appraised the primary literature and summarized the methodologically strongest studies [15]. He starts with a simple search and types into the basic search interface:

Simple search: 'granulocyte transfusion' AND neutropenia AND infections

The logical operator AND is used to combine different concepts in such a way that all of them need to occur within the reference, otherwise it will not be displayed as a result. Dr. Jung also uses phrase searching (done by enclosing the words in quotation marks), which is useful when searching for an exact phrase. It is especially important for searching English databases, because many concepts are expressed in two or more words, rather than in composite words as commonly found in the German language ('granulocyte transfusion' = Granulozytentransfusion).

He does not include the outcomes in his search because he does not know how effectiveness has been defined by researchers even though it is likely to have been measured as reduction of mortality (fig. 1).

With his simple search Dr. Jung retrieves three Cochrane Reviews and another systematic review produced outside of the Cochrane Collaboration (*Other Reviews*). Of those four reviews, two are relevant for his clinical question, given that the other references do not report on adult patients but on neonates and children, a population that is not relevant for his clinical setting. Happy about finding two relevant Cochrane Reviews that save him a lot of time, he realizes that granulocyte transfusions are not only being used therapeutically [16], but are also being evaluated for the prevention of infections in neutropenic patients [17]. Dr. Jung is sure that prophylactic granulocyte transfusions are also of interest to Dr. Weiss. He also notices that the two relevant Cochrane Reviews are from 2009 and 2010. Before looking into the reviews' full texts, he therefore decides to search for more recent articles covering the gap between the publication date of the systematic reviews and the current date. To do so, he first of all looks at the 12 experimental clinical trials which have been found with his search in CENTRAL (*Trials*). They are by default displayed

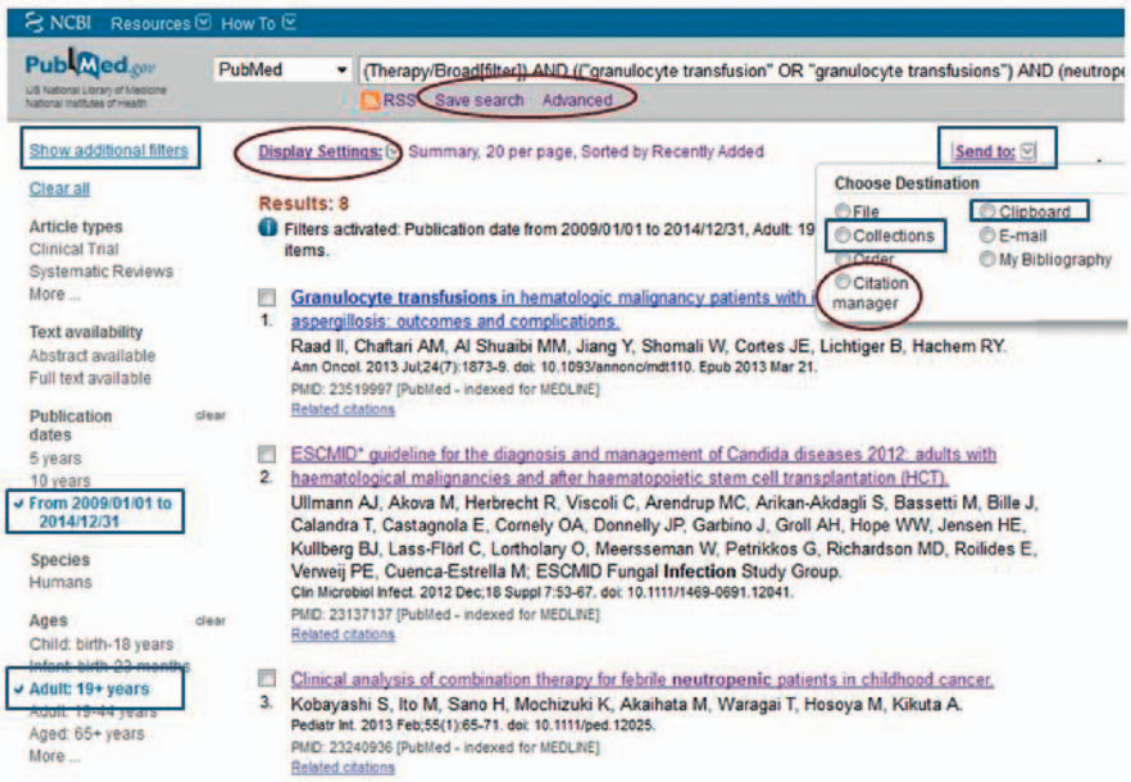

Fig. 2. Search result list in PubMed highlighting the database's features.

in order of relevance, wherefore he changes the display settings to *Sort by / Date*. Unfortunately, the most recent RCT is from 2008, and should already be included in the Cochrane Reviews.

Now it is time to use PubMed. Even though Dr. Jung is tempted to use PubMed's basic search, he thinks twice and decides to use a clinical search interface, using special filters [7, 18], which was recently pointed out to him by a medical librarian. He clicks on *Clinical Queries* (found below *PubMed Tools* on the PubMed homepage) and inserts the simple search that he just used in The Cochrane Library, but adds more synonyms that he has extracted from the abstracts of the Cochrane Reviews. Synonyms are generally included in a good search strategy to make it more sensitive and consider heterogeneous language usage. They are added to search concepts with the logical operator OR and put in brackets, to ensure the right order of processing [19, 20]:

Simple search: "granulocyte transfusion" AND neutropenia AND infections

Search with more synonyms: ('granulocyte transfusion' OR 'granulocyte transfusions') AND (neutropenia OR neutropenic OR 'neutrophil dysfunction' OR granulocytopenia) AND (infection OR infections)

The *Clinical Queries* page is divided into three sections, of which the first one, *Clinical Study Categories*, is of interest to Dr. Jung. After having executed his search, further options for restriction are displayed: *Category* (therapy, diagnosis, etiology, prognosis or clinical prediction guides) and *Scope* (broad or narrow) [7]. He decides to use the category *therapy* in combination with a *broad* scope. In the background the *Automatic Term Mapping* takes place, expanding his search terms by adding MeSH. He gets 174 results and by clicking on *See All* the database switches back to PubMed's standard results page (fig. 2). The search now reads:

(Therapy/Broad[filter]) AND (('granulocyte transfusion' OR 'granulocyte transfusions') AND (neutropenia OR neutropenic OR 'neutrophil dysfunction' OR granulocytopenia) AND (infection OR infections))

Dr. Jung filters the results by adding the standard filter *Publication dates* found on PubMed's left side menu, narrowing the results down to the *Custom Date Range* 2009 to 2014. He quickly scans the resulting 24 references realizing that, again, in some the patients are neonates or children. Therefore he additionally restricts the population by using the *Age* filter that is available under S*how Additional Filters / Ages / Adult: 19+ years*. Now he is down to eight results. Among them are mostly newer retrospective observational studies and one guideline (fig. 2).

At this point, a closer look at the filters Dr. Jung has just used is necessary. The *Therapy/Broad[filter]* is a methodological filter, which means that the filtering of the data does not only rely on one word or one subject heading (MeSH), but on a comprehensive search strategy which has been carefully developed by information specialists. These kinds of filters are generally optimized to retrieve relevant citations based on balancing sensitivity and specificity of the results [14, 18]. On

Table 3. Expanded PICO framework structuring Dr. Weiss' research question

Population	(Adult) patients with neutropenia/granulocytopenia and infection/s	
	text words (title/abstract)	*MeSH*
	neutropeni* granulocytopeni* neutrophil dysfunction*	neutropenia[MeSH]
	infection* sepsis septicimia bacteremia fungemia mycos*	bacterial infections and mycoses[MeSH] → bacterial infections[MeSH] → infection[MeSH] → sepsis[MeSH] → bacteremia[MeSH] → fungemia[MeSH] → mycoses[MeSH] → fungemia[MeSH]
Intervention	granulocyte transfusion/s	
	text words (title/abstract)	*MeSH*
	granulocyte transfusion* leukocyte transfusion*	granulocytes/transplantation[MeSH] leukocyte transfusion[MeSH]
Comparison	no granulocyte transfusion/s	
Outcome	effectiveness/efficacy (reducing mortality)	

the contrary, the standard filters offered on PubMed's left side menu discriminate the search results rather strictly by using MeSH. The *Age* filter used by Dr. Jung therefore only retrieves those citations that have been assigned the subject heading *Adult[MeSH].* Naturally, these filters generate more specific results, but lack sensitivity. In Dr. Jung's case this is an acceptable approach because his search is aimed to be specific rather than sensitive [19].

Dr. Jung screens his eight results, ticks the relevant references, and adds them to his *Clipboard*, a feature that is available on the upper right corner of the results list by clicking on *Send to*. The *Clipboard* retains selected references throughout the search process as long as the browser session is maintained. Additionally, Dr. Jung adds the citations of the two Cochrane Reviews. He easily found them by inserting the last name of the first author together with the beginning of the title. Satisfied with the outcomes of his search, he logs in to his *MyNCBI account*, found on the uppermost right corner of the database, and saves the relevant search results on his *Clipboard* in a permanent *Collection* that he names 'evidence on granulocyte transfusion therapy'. Later at home, he will look at the full texts of the references and summarize them for the brown bag seminar.

Application Case Scenario 2: The Senior Clinician Searching Comprehensively for Clinical Trials Worldwide

After the clinic's brown bag seminar Dr. Weiss is pleased with the briefing received by her resident Dr. Jung and glad to learn that there are two relatively current Cochrane Reviews available, both of them stating that the evidence on either therapeutic or prophylactic granulocyte transfusions in adult neutropenic patients is inconclusive. The more recent observational studies additionally underline the need for well-designed, randomized, prospective trials to determine the efficacy of granulocyte transfusions. She is sure Dr. Jung has done a great job searching the evidence gap between 2009 and 2014. Nevertheless, for writing the application for the ethical review board, she needs to make sure that no experimental clinical trial has been missed and that there are no further observational studies available besides those identified by Dr. Jung. Therefore, she plans a more sensitive search approach by developing a comprehensive search strategy.

To start with, she jumps into PubMed by clicking on the link to Dr. Jung's collection, which he sent her via his *MyNCBI* account. Dr. Weiss changes the display settings from the standard PubMed setting *Summary* to the more detailed *Abstract* by clicking on *Display Settings* in the upper left corner of the results list. She closely reads the abstracts of the eight references found by Dr. Jung and extracts additional synonyms, complementing the PICO framework (table 3). She applies truncation, an advanced searching technique in which a word ending is replaced by an asterisk. It enables searching for different grammatical forms of a word simultaneously (neutropeni* = neutropenic, neutropenia) [19, 20].

Next she displays the subject headings (MeSH) assigned to each citation, by clicking on *Publication Types, MeSH Terms, Substances* found below the abstract. She additionally extracts the most important MeSH and checks their definitions and hierarchical structure in the *MeSH database* (found below *More Resources* on the PubMed homepage). Because PubMed au-

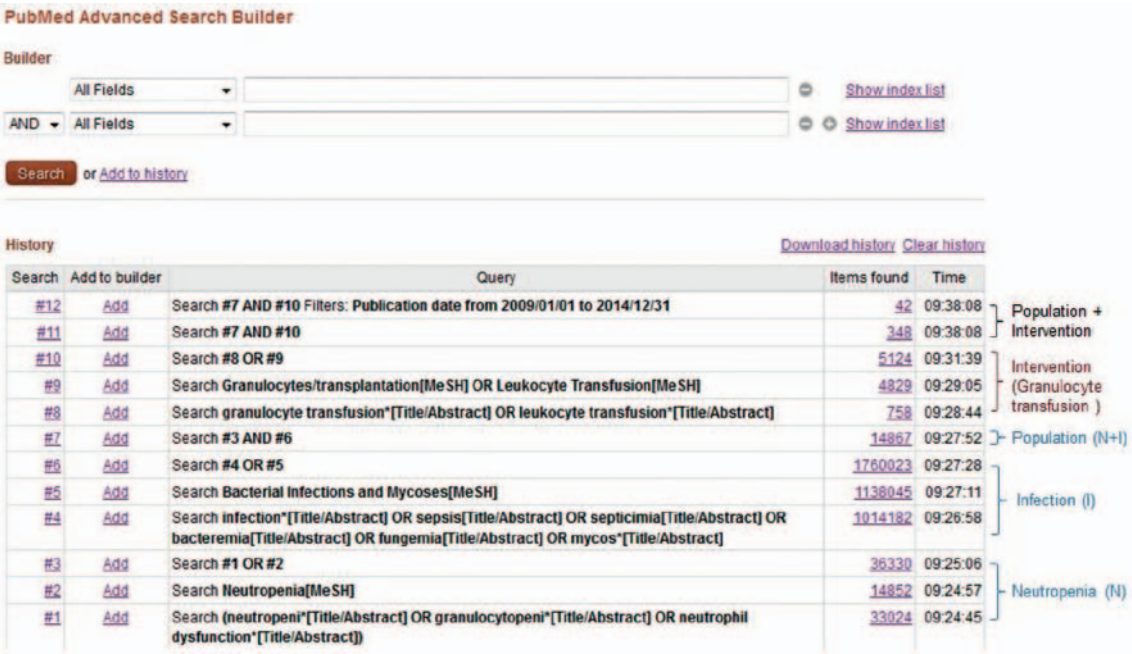

Fig. 3. PubMed's Advanced Search Builder featuring a structured search approach.

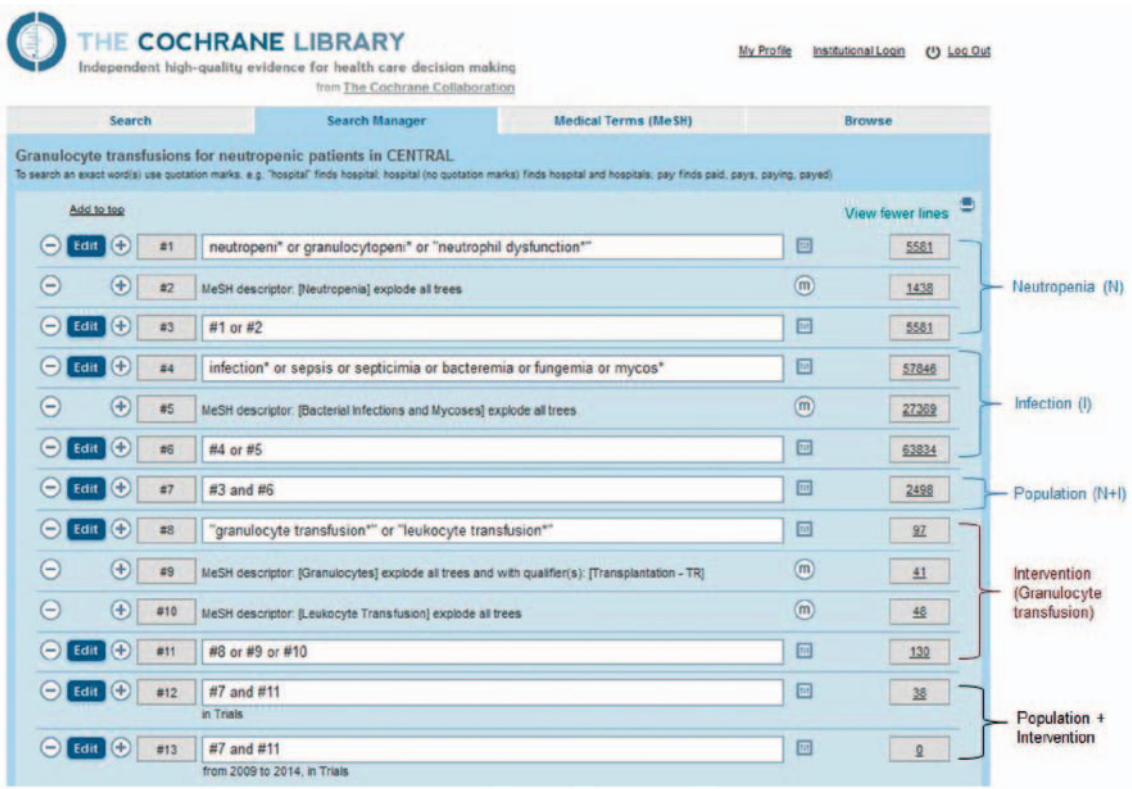

Fig. 4. The Cochrane Library's Search Manager featuring a structured search approach.

tomatically includes narrower MeSH terms in the search, Dr. Weiss only needs to use *Neutropenia[MeSH]* and *Bacterial Infections and Mycoses[MeSH]* to describe her population (table 3). Another notable feature of the MeSH can be seen in the wording of the intervention (table 3): In *Granulocytes/transplantation[MeSH]*, the first part *Granulocytes* is the MeSH, while */transplantation* is a subheading that specifies the MeSH. Subheadings can be used in combination with MeSH to further define the search concept.

Like Dr. Jung, Dr. Weiss does not include comparison and outcomes in her search. These two aspects, generally, are recommendable for inclusion only when building a very specific

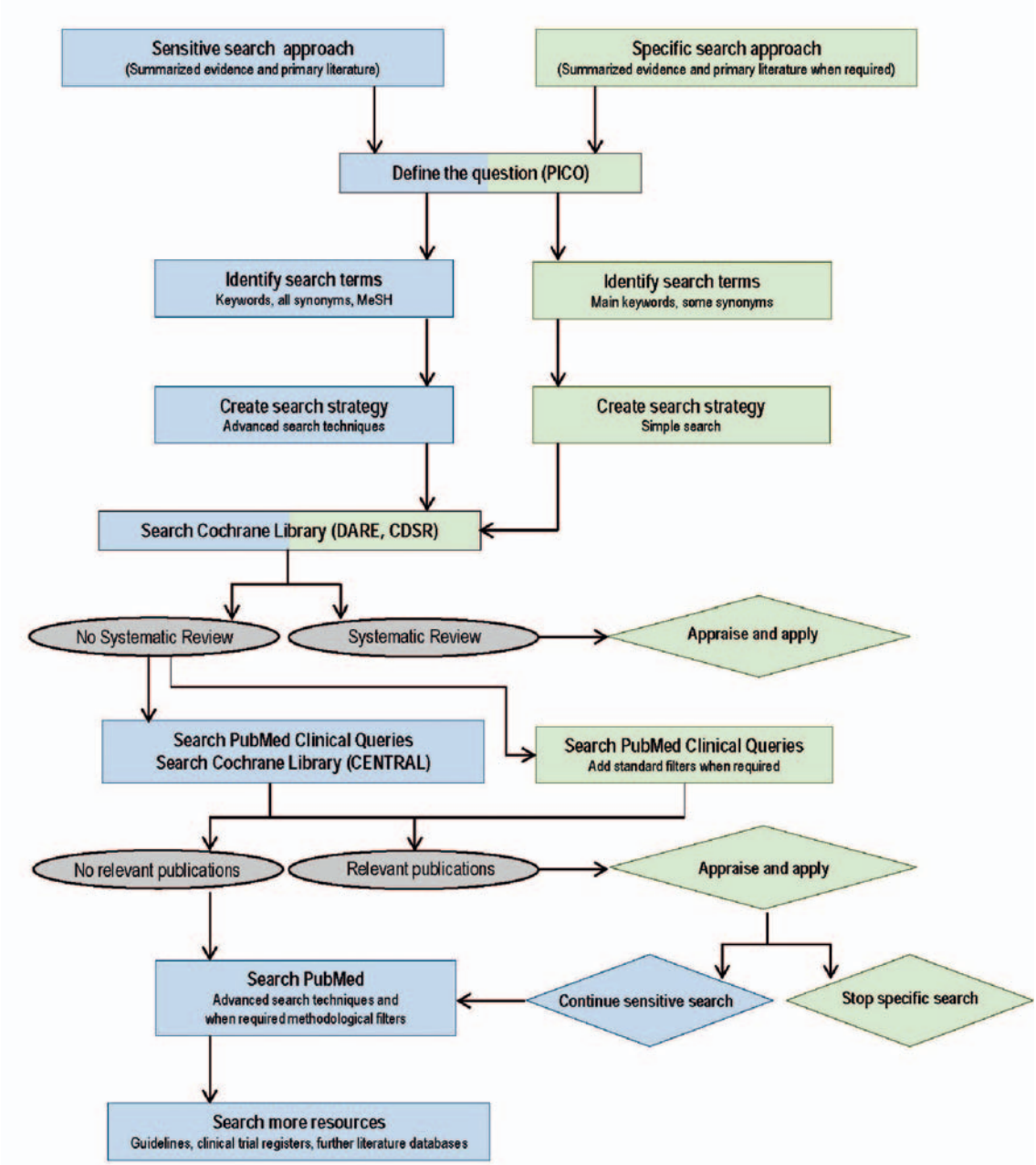

Fig. 5. Sensitive and specific search approaches for identifying evidence within the medical literature, adapted from [24–26].

search [20]. As she aims to build a sensitive search, she prefers to evaluate these aspects by screening her results, not by proactively restricting her search. Dr. Weiss has now compiled all the text words and MeSH that she wants to include in her search. She opts for PubMed's advanced search by clicking on *Advanced* found below the basic search box. Here, she uses the *Advanced Search Builder* to construct her search stepwise (fig. 3). Generally, words and MeSH describing one concept are combined with the logical operator OR, while the combination of the different concepts that build the strategy is done with AND [14, 19].

Dr. Weiss' sensitive search approach retrieves 42 references, which she does not restrict by applying age or publication type and thus MeSH-based standard filters. As a consequence, the results also include the newest references in PubMed, instead of only those within the MEDLINE subset (table 1). She carefully screens the abstracts of the retrieved references and identifies four additional observational studies compared to those found by Dr. Jung. In the future, Dr. Weiss wants to be updated on new results deriving from her sensitive search. Therefore she clicks *Save Search* found below the search box and logs in to *MyNCBI*. She names the search strategy and ticks the option to be updated of new search results added to PubMed via email. Last but not least she exports her references (by ticking *Citation Manager* in *Send to)* in order to import them into a reference management software in a further step.

Next, Dr. Weiss applies her sensitive search strategy to The Cochrane Library to search for experimental trials. She uses

the advanced search interface *Search Manager* (fig. 4) and restricts it to the CENTRAL database (*Trials*). She does not identify any RCT or CCT published after 2009. But she wants to look at the 38 publications on experimental trials prior to 2009 later on to see how they have been designed. Therefore, she uses the export option *Export All* found above The Cochrane Library's result list.

For her application Dr. Weiss has gathered two Cochrane Reviews and nine newer observational studies altogether. From the references to studies included in the Cochrane Review on therapeutic granulocyte transfusions [16], she is aware about a phase III RCT published in 2008 [21], but not yet assessed within the Cochrane Review, and about an ongoing multicenter RCT (RING study [22]).

If she had additionally searched a study register, e.g. the World Health Organization's International Clinical Trials Registry Platform (ICTRP), she would also have identified a second ongoing multicenter RCT in Germany (GRANITE study [23]). This fact illustrates that nowadays a sound search for clinical evidence should not only rely on published publications found in literature databases but also should be conducted in clinical trial registers in order to include unpublished, not yet published, or ongoing research [14, 20].

When to Use Which Database

From the two application case scenarios it should have become clear that search approaches do highly depend on the underlying information needs. Summarized in a simple way, they can be broken down into two approaches: Either a basic information need that is best met by a specific search which aims to identify summarized evidence and, if this is not available, continues into the primary literature, or a broader information need that is best met by a sensitive search which aims to identify summarized evidence and primary literature of different evidence levels as well as ongoing research (fig. 5).

Conclusions

Literature databases like PubMed and The Cochrane Library offer sophisticated tools for searching an increasing amount of medical publications of varied quality and ambition. A search approach, be it specific or sensitive, has to be carried out deliberately and requires both a good knowledge on the scope and features of the databases as well as the ability to build a search strategy in a systematic and structured way. To be able to take well-informed decisions or carry out sound research, clinicians and researchers alike require specific information seeking skills matching their respective information needs. A specific search can generally rely on the most important keywords describing the main concepts of the research question and should primarily be met by searching for summarized and appraised literature. The Cochrane Library offers two databases focusing on synthesized research (CDSR, DARE) and one database exclusively listing RCT and CCT (CENTRAL). If required, a simple search can be amended by a PubMed search for primary literature. This should ideally be undertaken by using the *Clinical Queries* interface, thus avoiding the confrontation with an unmanageable amount of information. A sensitive search approach, in contrast, requires the careful identification of text words and controlled vocabulary (MeSH) as well as the usage of advanced search techniques and should be undertaken in both The Cochrane Library and PubMed. Additionally it should include further primary literature databases, e.g. Embase, Web of Science, CINAHL and LILACS, as well as clinical trial registers listing ongoing and unpublished research. Against the background of an increasingly complex information environment, we generally recommend that clinicians and researchers work together with or get advice from medical librarians or information specialists, whenever possible, in order to conduct more efficient and professional searches.

Disclosure Statement

The authors declare no conflicts of interest concerning this work. The search approaches presented in this paper have been undertaken in March 2014.

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