Systematically Searching the Literature

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Introduction

A systematic review uses an explicit, pre-specified approach to identify, select, assess, and synthesize the data from studies in order to address a specific scientific or public health question. The transparency and objectivity in a systematic review build on the groundwork created with a comprehensive literature search. The search should retrieve all of the literature to address the research question as appropriate to the scope of the review. An inadequate search potentially results in an incomplete or biased evidence base.

A literature search for a systematic review seeks to accomplish two goals:
1) **Minimize reporting/dissemination bias**. Selective reporting of positive or significant results can lead to a reporting bias in the literature base. As well, location bias exists due to an article being indexed in only one database. To counter this bias, the retrieved literature needs to encompass a variety of publication types, which can only be accomplished through searching a variety of resources.
2) **Strive for comprehensive retrieval**. The goal is to retrieve as much of the relevant literature as possible given available resources, staff, and time. A comprehensive search has implications for how the search strategy is developed.

Selecting Resources to Search

A comprehensive search requires searching more than one database. While significant content overlap exists among databases, each offers unique content coverage and search functionality. As a result of these variations, a search in one database can retrieve additional articles not retrieved in another database.

Literature searches for systematic reviews are typically conducted in three or more of the following five primary scientific literature databases: Embase (Elsevier), PubMed (National Library of Medicine), Scopus (Elsevier), Toxline (National Library of Medicine), and Web of Science (Thomson Reuters). Additional sources are searched only when the search topic is not complex or when they address an explicit type of information need. For example SciFinder, the Chemical Abstract Service database of chemical literature, is typically searched when the topic is chemical specific; e.g., bisphenol A analogs.

Formulating the Search Strategy

The formulation of a search strategy is an iterative process and primarily involves four steps.

Step 1: Identify PECO Concepts

To retrieve the relevant literature, the search terminology is built around the PECO statement, which defines the population, exposure, comparison and outcome(s) defined in the review protocol for addressing the research question. NTP concepts range from focused topics involving one exposure (i.e., chemical or substance) associated with one health outcome to extensive topics reviewing multiple exposures associated with multiple health outcomes.

Step 2: Compile the search terminology

One of the primary considerations when crafting a systematic review search strategy is the need to strive for increasing the likelihood of retrieving all (or most all) relevant studies; that is, to maximize recall (sensitivity). However, the approach to maximize recall comes with a tradeoff. The more extensive the search strategy, the higher the number of irrelevant documents retrieved; resulting in lower precision (specificity).

Given the goal of retrieving as much relevant literature as possible (high recall), the search strategy requires using text words as well as controlled vocabulary. A controlled vocabulary, such as PubMed's Medical Subject Headings (MeSH), is a standardized set of subject headings often used to index content. The value of a controlled vocabulary is that it ensures that any article retrieved with a specific MeSH term will be about that topic (aiding precision).

Text words are literally the words used in the text of the database record, whether in the title, abstract, author, or journal fields. Because there are alternative words and phrases that can be used to describe a concept, all possible ways of referring to that concept need to be included in the search. Text words not only encompass the term used for the main concept, but also include synonyms, related terms, alternative spellings, and abbreviations (e.g., cancer, tumor, tumour, neoplasm, lesion, or leukemia and other specific cancer types).

Text words are identified by scanning relevant studies and reviews as well as by consulting with experts. When possible, text words are only searched within the title and abstract fields. Despite limiting to these two fields, numerous irrelevant results are often retrieved due to the terms of interest only being mentioned once in the abstract and not in the intended context. The terminology is tested by searching individual terms separately as well as in combination with each other to assess how well each term or combination thereof contributes to achieving high recall. After numerous test runs, a final draft set of terminology is identified.

Step 3: Tailor the Search Strategy

The search strategy must be tailored to account for each database's unique search functionality; such as, does the database use a controlled vocabulary, have character limit restrictions, or support proximity searching. Certain topics especially lend themselves to utilizing different databases. For example, a search on "lead" as a text word retrieves an enormous number of irrelevant results because a database cannot distinguish "lead," the heavy metal from "lead," the verb. Searching a database that has indexed records using a "lead" (as in heavy metal) subject heading enhances relevant retrieval. Another useful search function is the ability to do proximity searching to force two concepts to be adjacent to one another; e.g., air near/4 pollut* finds "air pollution," "air and water pollution," "polluted air," among others.

Step 4: Run the Search, Analyze and Revise

The draft strategies are searched in the respective databases. Results are compared against a test set of relevant studies (identified from reviews and topic experts). If test items are missed

or too many irrelevant studies are retrieved, modifications are made to the search terminology or the strategy and rerun.

Conclusion

A methodical and thorough literature search strategy is necessary to generate an unbiased and comprehensive literature base for evaluation in a systematic review. Comprehensiveness is achieved through identifying all pertinent terminology, searching multiple databases, tailoring the search strategy to leverage the unique functionality offered by each database, and repeatedly testing and refining the strategies. The complexity of the topic under review influences how each step in the search process is conducted. The more complex the topic, the more extensive the search strategy needs to be.