

Development of search strategies for systematic reviews: validation showed the noninferiority of the objective approach

Elke Hausner^{a,*}, Charlotte Guddat^b, Tatjana Hermanns^a, Ulrike Lampert^a,
Siw Waffenschmidt^a

^aInformation Management Unit, Institute for Quality and Efficiency in Health Care (IQWiG), Im Mediapark 8, 50670 Cologne, Germany

^bDepartment of Medical Biometry, Institute for Quality and Efficiency in Health Care, Im Mediapark 8, 50670 Cologne, Germany

Accepted 15 September 2014; Published online 29 November 2014

Abstract

Background: Different approaches can be adopted for the development of search strategies of systematic reviews. The objective approach draws on already established text analysis methods for developing search filters. Our aim was to determine whether the objective approach for the development of search strategies was noninferior to the conceptual approach commonly used in Cochrane reviews (CRs).

Methods: We conducted a search for CRs published in the Cochrane Library. The studies included in the CRs were searched for in MEDLINE and represented the total set. We then tested whether references previously removed could be identified via the objective approach. We also reconstructed the original search strategies from the CRs to determine why references could not be identified by the objective approach. As we performed the validation of the search strategies without study filters, we used only sensitivity as a quality measure and did not calculate precision.

Results: The objective approach yielded a mean sensitivity of 96% based on 13 searches. The noninferiority test showed that this approach was noninferior to the conceptual approach used in the CRs ($P < 0.002$). An additional descriptive analysis showed that the original MEDLINE strategies could identify only 86% of all references; however, this lower sensitivity was largely due to one CR.

Conclusion: To the best of our knowledge, our findings indicate for the first time that the objective approach for the development of search strategies is noninferior to the conceptual approach. © 2015 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/3.0/>).

Keywords: Information storage and retrieval; Medline; Data mining; Reproducibility of results; Sensitivity and specificity; Retrospective studies

1. Introduction

Systematic reviews (SRs) serve to inform evidence-based decision-making in health care. Information retrieval in SRs needs to be performed in a systematic and structured manner. The aim is to identify all relevant studies on the question of interest. This requires both searches in several information sources and the use of comprehensive search strategies [1–3].

Searches in bibliographic databases are particularly laborious and often comprise many search lines. The structure of the search strategies follows the PICO scheme (population, intervention, comparison, and outcome), whereby only search terms related to the first two terms and to certain types of study design are usually used [1]. Using “outcome” as part of the search strategy development is not generally suggested [1].

Information specialists generally choose a “conceptual approach” to identify appropriate search terms for the development of search strategies. For this purpose, they use different sources to identify terms and their synonyms so as to cover the research question as comprehensively as possible [1,4,5]. This means, for example, that if a search aims to retrieve literature on “rheumatoid arthritis,” appropriate synonyms and related terms for the free-text part of the strategy need to be identified. With the conceptual approach, different sources (eg, MEDLINE Plus or the Entry Terms of the MeSH database) help to identify synonyms and related terms. Several synonyms and related terms are conceivable in the previous example, such as “juvenile rheumatoid arthritis,” “Caplan syndrome,” “Felty syndrome,” “rheumatoid nodule,” “Sjogren syndrome,” “ankylosing spondylitis,” “Still disease,” “Sicca syndrome,” “Bechterew disease,” and so on. However, it remains unclear how to decide which terms to include in the search strategy. Furthermore it is difficult, and might even be impossible, to determine when the strategy is complete.

* Corresponding author. Tel.: +49-221-35685-0; fax: +49-221-35685-1.
E-mail address: elke.hausner@iqwig.de (E. Hausner).

What is new?**Key findings**

- Objectively developed search strategies are noninferior to conceptually developed ones.
- The objective approach may be potentially superior to the conceptual approach and might require fewer resources.
- The lower sensitivity of the original MEDLINE strategies conceptual approach was largely due to one CR.
- Precision was not used as a quality measure, as the validation of the search strategies was performed without study filters.

What this adds to what was known?

- The objective approach is a reliable method for developing high-quality search strategies.

What is the implication and what should change now?

- The objective approach should be routinely used in the development of high-quality search strategies.
- This is in line with the principles of evidence-based medicine (ie, decision-making on the basis of empirical evidence).

The Cochrane Handbook recommends the identification of articles reflecting the inclusion criteria of the reviews and the extraction of thesaurus headings and free-text terms [1]. However, the Handbook contains no details on the development of a structured approach. The approach chosen therefore strongly depends on the personal expertise of the information specialists involved.

In addition, it is difficult to assess whether a search strategy actually identifies all relevant references on a research question. Checklists for the assessment of search strategies are available, such as the Peer Review of Electronic Search Strategies (PRESS) checklist by Sampson et al. [6,7]. However, they are largely designed to identify errors in the search strategy. Consequently, the assessment of content of search strategies is largely based on expert opinions and can thus be considered to be methodologically weak [8].

A more objective approach can help solve the limitations of the conceptual approach and be adopted for those components of the search for which no validated search filters exist (eg, population, intervention, or observational studies). This approach comprises the following steps: generation of a total set (relevant references from SR), splitting of the total set into a development set and comparator set, development of the search strategy with references from the

development set (analyzing information derived from the titles and abstracts of relevant references with text-mining tools), and validation of the search strategy (checking whether references from the comparator set can be identified with the search strategy developed beforehand). The objective approach can thus be used to test whether relevant references identified beforehand can be found by means of a specific search strategy, thus determining the retrieval rate of relevant references. A further advantage of the objective approach is that, in the event of a larger number of hits, the search strategy can be adapted on the basis of the available evidence. For instance, whether a search term can be specified by means of a search for phrases can be discussed and decided on the basis of the proportion of identified (or unidentified) references.

This approach draws on already established methods for developing and testing search filters [9–11] and is based on the term frequency analysis of relevant references identified beforehand. Our previous article published in 2012 describes this approach with a practical example [12].

We initiated three projects to further develop and validate an objective approach for the development of search strategies. In the first project, the aim was to develop a more transparent selection and documentation of overrepresented free-text terms and thesaurus headings identified by means of text analysis. In the second project, which we present in this article, a retrospective validation of the objective approach was conducted by means of Cochrane reviews (CRs). In addition, a third project is under way with the aim of comparing the objective with the conceptual approach in a prospective study.

2. Objective

The aim of our study was to determine whether the objective approach for the development of search strategies was noninferior to the conceptual approach commonly used in CRs. For this purpose, we analyzed the sensitivities of the objectively developed search strategies for relevant references included in CRs.

3. Methods

According to the Cochrane Handbook [1], the preparation of a CR requires a comprehensive bibliographic search containing a wide range of synonyms, related terms, and variant spellings. The approach for search strategy development described in the Handbook corresponds to the conceptual approach.

Because of the high quality of search strategies in CRs, the present analysis used references from CRs to assess the objective approach. This corresponds to the assumption that all articles relevant to an indication are included in the corresponding CR and that these are found by the respective conceptual strategy.

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