Validation of Search Filters for Identifying Pediatric Studies in PubMed

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Objective To identify and validate PubMed search filters for retrieving studies including children and to develop a new pediatric search filter for PubMed.

Study design We developed 2 different datasets of studies to evaluate the performance of the identified pediatric search filters, expressed in terms of sensitivity, precision, specificity, accuracy, and number needed to read (NNR). An optimal search filter will have a high sensitivity and high precision with a low NNR.

Results In addition to the PubMed Limits: All Child: 0-18 years filter (in May 2012 renamed to PubMed Filter Child: 0-18 years), 6 search filters for identifying studies including children were identified: 3 developed by Kastner et al, 1 developed by BestBets, one by the Child Health Field, and 1 by the Cochrane Childhood Cancer Group. Three search filters (Cochrane Childhood Cancer Group, Child Health Field, and BestBets) had the highest sensitivity (99.3%, 99.5%, and 99.3%, respectively) but a lower precision (64.5%, 68.4%, and 66.6% respectively) compared with the other search filters. Two Kastner search filters had a high precision (93.0% and 93.7%, respectively) but a low sensitivity (58.5% and 44.8%, respectively). They failed to identify many pediatric studies in our datasets. The search terms responsible for false-positive results in the reference dataset were determined. With these data, we developed a new search filter for identifying studies with children in PubMed with an optimal sensitivity (99.5%) and precision (69.0%).

Conclusion Search filters to identify studies including children either have a low sensitivity or a low precision with a high NNR. A new pediatric search filter with a high sensitivity and a low NNR has been developed. *(J Pediatr 2013;162:629-34)*.

To keep up-to-date with the latest developments in their field and to practice in an evidence-based manner, pediatric health care professionals need to target literature searches in medical databases to search for primary studies and systematic reviews in children. Different search filters for identifying only pediatric studies using PubMed and Medline/Ovid are available to facilitate this.[1-4] They differ with respect to the number of search terms used. The existing search filters for identifying studies of children in PubMed have not been validated and, therefore, it is not clear how well the different search filters are able to identify all studies in PubMed that involve children and how many abstracts need to be screened before relevant papers are identified.

The performance of other PubMed search filters, for example, for identifying systematic reviews or randomized controlled trials (RCTs) or clinical queries have been validated previously.[5,6] The performance of search filters can be expressed in terms of sensitivity, precision, specificity, accuracy, and number needed to read (NNR). These parameters can only be calculated in a database of known dimension, where all records are tagged beforehand according to formulated criteria.

To advise pediatric health care professionals about the usefulness of the different available search filters for identifying studies including children, we developed this study with 3 separate objectives. The first objective was to identify all available search filters. The second objective was to evaluate the performance of the search filters focusing on identifying all relevant studies (sensitivity of the filters) and the effort needed to obtain these results (expressed as NNR to identify 1 relevant paper). The third objective was to develop an improved search filter for identifying studies in PubMed that include children.

Methods

To identify relevant search filters we searched PubMed on April 7, 2008, for "Information Storage and Retrieval/methods [MeSH] AND (pediatric OR paediatric OR child OR children)," where MeSH stands for Medical Subject Heading. In addition, the internet was searched for "pediatric search filter" using Google. The Cochrane Child Health Field (CHF) was contacted for more information

CCG	Cochrane Childhood Cancer Group
CCTs	Clinical controlled studies
CHF	Cochrane Child Health Field
HSSS	Highly Sensitive Search Strategy
MeSH	Medical Subject Heading
NNR	Number needed to read
RCTs	Randomized controlled trials

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on pediatric search filters, and finally, the Cochrane Childhood Cancer Group[7] (CCG) filter was included.

The performance of a search filter is based on calculations of the sensitivity, precision, specificity, accuracy, and NNR. To evaluate all the measurements of the performance of the different pediatric search filters, we constructed a reference database consisting of RCTs and clinical controlled studies (CCTs) in children identified in PubMed using the existing search filters. To validate the results of the sensitivity of the different search filters, we developed the validation database consisting of RCTs included in Cochrane systematic reviews.

Development of the Reference Dataset

We chose to restrict our research to only RCTs and CCTs to avoid an excessive number of retrieved studies. Therefore, the reference dataset was obtained by combining the Cochrane Highly Sensitive Search Strategy (HSSS) for identifying RCTs and CCTs[8] (**Appendix 1**; available at www.jpeds.com) with the identified child filters with a limit of 1 week in September 2008 in PubMed.

The obtained records were assessed by 2 authors independently (E.L., M.L.) to determine whether a study included children or not. The following inclusion criteria were used: studies which included children (aged 0-18 years), or reviews in which studies with children were evaluated. The following exclusion criteria were used: prenatal, post mortem, and microbiologic studies, which did not present outcomes directly related to children, and reviews or comments in which no studies with children were discussed. When it was not possible to assess the inclusion criteria based only on the abstract and/or the MeSH headings, the full text article was obtained. When no information on the age of the participants could be found in the full text article, the record was excluded, as were records, which could not be obtained as full text. Discrepancies between assessors were resolved by consensus. A third author was consulted in the few cases for which no agreement between the 2 assessors could be obtained. The final reference dataset consisted of relevant studies (RCTs and CCTs including children) and known irrelevant studies (RCTs and CCTs not including children).

Development of the Validation Dataset

To develop the validation dataset (gold standard), we performed a search to identify pediatric RCTs or CCTs, which were included in a Cochrane systematic review (**Appendix 2**; available at www.jpeds.com). From the list of retrieved records, we selected every fifth review. For the selected reviews, it was assessed whether children were included (aged 0-18 years). Reviews with adults only (ie, people aged ≥18 years) were excluded. Reviews that discussed children among adults were included. RCTs or CCTs included in the selected Cochrane reviews were eligible to be included in the validation dataset if children were included in these studies. Furthermore, these publications had to be available in Medline and searchable with the PubMed interface as well. RCTs and CCTs were excluded when participants were adults only, the age of the participants was not clearly defined, the age was not mentioned, or the full text article could not be obtained to verify the age of the participants. Duplicate and triplicate RCTs and CCTs were removed. The validation dataset consisted only of 1357 relevant studies (RCTs and CCTs including children).

Calculation of Sensitivity, Precision, Specificity, Accuracy, and NNR within the Reference Dataset

The sensitivity, precision, specificity, accuracy, and NNR were calculated using the reference dataset in PubMed. The sensitivity is a measure of the proportion of relevant documents retrieved compared with all relevant documents, and the precision indicates the proportion of correctly retrieved articles against all the articles retrieved by the search. The specificity is a measure for the non-retrieval of non-relevant citations,[6] and the accuracy is the proportion of articles of relevant citations retrieved and non-relevant citations not retrieved.[5] The NNR (ie, 1/precision) is defined as the number of relevant and irrelevant articles one has to screen to find one of relevance.[9] The formula in **Table I** were used for calculating these parameters.

Calculation of Sensitivity within the Validation Dataset

To validate the method for calculating the sensitivity of the identified child filters using the reference dataset, the sensitivity of these search filters was also calculated as the proportion of RCTs and CCTs identified by the different search filters against the validation dataset (**Table I**). All

Table I. Formulas for calculating the sensitivity, precision, specificity, accuracy, and NNR of searches for finding pediatric studies

	Relevant	Not relevant	Total
Identified	A (hits, correct inclusion; true positives)	B (noise, incorrect inclusion; false positives)	Total identified
Not identified	C (missed hits, incorrect exclusion; false negatives)	D (correct exclusion; true negatives)	Total not identified
Total	A + C (total relevant hits)	B + D (total not relevant hits)	A + B + C + D (total collection, database)

NNR is defined as 1/precision.
Sensitivity = A/(A + C).
Precision = A/(A + B).
Specificity = D/(B + D).
Accuracy = (A + D)/(A + B + C + D).
NNR = (A + B)/A.