6 Which literature retrieval method is most effective for general practitioners?

If it works, it's out of date
Stafford Beer, British scientist, 1972

ABSTRACT

Introduction. Evidence-based medicine requires new skills of physicians including literature searching. We want to determine which literature retrieval method is most effective for general practitioners (GPs), the printed Index Medicus, Medline through Grateful Med, or Medline on CD-ROM.

Methods. The design was a randomized comparative study. In a continuing medical education course, three groups of health care professionals (87 GPs and 16 other health care professionals) used one of the literature retrieval methods to retrieve citations on four search topics related to general practice. For the analysis in pairs, we used the search results of the 75 participants who completed all four assignments. As outcome measures we used precision, recall, and an overall search quality score; we also had a post-course questionnaire on personal characteristics, experience with computers, handling medical literature, and satisfaction with course instruction and search results.

Results. The recall and overall search quality scores in the Index Medicus groups (n=32) were higher (P≤0.001) than those in the CD-ROM groups (n=31). In addition, the search quality scores in the Grateful Med groups (n=12) were higher (P<0.003) than those in the CD-ROM groups. There were no differences in precision.

Conclusion. In the period 1994 to 1997, the printed Index Medicus was the most effective literature retrieval method for GPs. For inexperienced GPs there is a need for training in electronic literature retrieval methods.

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INTRODUCTION

Due to the rapid expansion of medical knowledge and publications, physicians have difficulties in locating the medical information they need.1 Experience, basic medical knowledge, and skills alone are not enough to practise evidence-based medicine.2 Physicians need to develop skills in retrieving and interpreting information,3 e.g. how to identify relevant diagnostic studies.4 The medical literature is underused,5 although 46-54% of primary care physicians’ questions could be answered using the medical literature.6 7

In order to teach GPs the most effective literature retrieval method, we developed an experiment to compare three of these methods, namely a printed, an online, and a CD-ROM version of the Index Medicus/Medline. The most effective method should give a high proportion of relevant citations of good quality, as well as few non-relevant citations. Furthermore, the ideal literature retrieval method should be wide available, easy to use, convenient, quick to learn, and not expensive or time-consuming.8
In our experimental study, we answered the following research question: Which literature retrieval method is most effective for GPs?

**METHODS**

*Participants*
To invite GPs for the 1-day continuing medical education course "How to retrieve information", we sent an announcement to all 970 registered GPs in the north of the Netherlands with reminders to university affiliated GPs.

*Randomization*
Prior to sending the invitations, we determined the dates of the courses. We randomized the interested GPs to the Index Medicus course, the CD-ROM course, or the Grateful Med course in order of receipt of the registration forms, and depending on the participants’ day of choice. The participants did not know they would be randomized, because the invitation only mentioned one course including three methods in information retrieval.

*Courses*
From 1994 to 1997, we offered our 1-day course 15 times. A professional librarian, who was a GP by training, served as course instructor.

In each course we focused on one of the following three literature retrieval methods: the 1992 printed Cumulated Index Medicus; Medline through Grateful Med - version 6.0 (citations with publication year 1992) provided online by the Karolinska Institute in Sweden; and the 1992 Medline on CD-ROM (Silverplatter Dos version 3.1).

The experimental part of the course consisted of a two hours’ introduction in literature retrieval methods, and an on-site training session. In the introduction, the content and structure of one of the three methods were discussed, including controlled vocabulary, subheadings, and, if appropriate, free-text searching. Sample searches were demonstrated.

The training session started with a try-out search by the participants in one of the three retrieval methods. Next, all three groups received the same four assignments for retrieving and selecting bibliographic citations (appendix 1). The four assignments covered search topics related to general practice: haemorrhoids, sudden infant death, the use of the telephone, and the gatekeeper role (table 1). For the Grateful Med and the CD-ROM groups the order of the assignments was fixed and of increasing complexity. However, for organisational reasons, the assignments of the Index Medicus groups were performed in a varied order. The Index Medicus groups could spend 90 minutes in total on the four assignments. The Grateful Med and the CD-ROM group, however, could spend 80 minutes in total on the four assignments: 20 minutes on each assignment. Additionally for these last two groups, the course instructor gave a 10 minutes feedback directly after each assignment.

After the experimental part of the course with one of the three retrieval methods, the two other methods were discussed and practised as well.

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**Table 1.** The four search queries for a course in literature searching for Dutch GPs.
I.
You have been invited to give a talk on haemorrhoids to a group of colleagues in your town. To collect information, you want to do a literature search using the Index Medicus/Medline on CD-ROM/Medline through Grateful Med of the year 1992.

II.
You want to keep up with the latest developments in the prevention of sudden infant death. You want to do a literature search using the Index Medicus/Medline on CD-ROM/Medline through Grateful Med of the year 1992.

III.
The editor of the Dutch journal Huisarts & Wetenschap (General Practitioner & Medical Science) has asked you to submit an article on the use of the telephone in the physician’s office. You regard this request as a challenge and you decide to do a literature search using the Index Medicus/Medline on CD-ROM/Medline through Grateful Med of the year 1992.

IV.
You are supervising a GP trainee in your practice. She wants to discuss the gatekeeper role of the GP. You want to be well prepared for this discussion, so you decide to do a literature search on this topic using the Index Medicus/Medline on CD-ROM/Medline through Grateful Med of the year 1992.

Questionnaire
After the course, the participants filled in a questionnaire (appendix 2), which covered personal characteristics, experience with computers, handling medical literature, and satisfaction with the course instruction and the search results.

Outcome measures
The effectiveness of the searches was assessed by three measures: precision, recall, and an overall search quality score. Precision is the number of relevant citations as a proportion of the total number of citations retrieved; recall is the number of relevant citations retrieved from the total number of relevant citations in a subset of the bibliography (table 2). In our study, this subset was formed from all citations identified by the 103 course participants and the course instructor. Three judges assessed the relevance and the quality of these citations. Because GPs are more interested in quality than in numbers, we developed an overall search quality score. For this score, we calculated a citation quality score for each relevant citation, based on the following criteria: coverage of the journal by the Science or Social Science Citation Index, or the Dutch list of Additional Scientific Journals for Health Sciences Research of the Royal Netherlands Academy of Arts and Sciences; the journal’s impact factor; study design; and whether the citation was a review. To avoid negative values, we added 100 points to these scores. In a formula: the overall search quality score = a - b - c + 100, in which a = total of quality scores of the selected relevant citations, b = total of quality scores of the missed relevant citations, and c = number of the selected non-relevant citations.
Table 2. Calculation of precision and recall of search results

<table>
<thead>
<tr>
<th>Assessed by course participants as</th>
<th>Assessed by the judges as</th>
</tr>
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<tbody>
<tr>
<td>Relevant</td>
<td>Relevant</td>
</tr>
<tr>
<td>Non-relevant</td>
<td>Non-relevant</td>
</tr>
<tr>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>c</td>
<td>d</td>
</tr>
</tbody>
</table>

\[
\text{precision} = \frac{a}{a + b} \\
\text{recall} = \frac{a}{a + c}
\]

**Statistical analysis**

We used SPSS version 8 for statistical analysis. To check the equal allocation of the participants to the three groups, we compared sex, age, years of experience as general practitioner, and type of practice with the chi-square and Student’s t-tests. To identify the influence of the method on precision, recall and overall search quality scores, a repeated measures analysis of variance was used for each of the three methods (Index Medicus, Medline through Grateful Med, and Medline on CD-ROM). The four assignments constituted the repeated factor in this set up, the method was the between-subjects factor. To identify differences in precision, recall, and search quality scores in pairs due to the method, in each of the four assignments, post hoc multiple comparisons for observed means were used according to Bonferroni. To identify pairwise differences in precision, recall and overall search quality scores in each group for the four assignments in total, simple contrasts were used.

**RESULTS**

**Participants**

Of the 970 invited GPs, 87 participants (9%) took part in the study. Additionally, 16 other health care professionals participated: 7 nursing home physicians, 6 medical researchers in general practice, 2 physiotherapists, and a hospital manager. Of the 103 participants, 73% were male. The mean age of the participants was 43 years. The GPs had 14 years of experience; 55% worked in an urban area; and 36% had a solo practice. Eighty-six percent of all participants were affiliated with a University Department of General Practice.

**Randomization**

The 103 participants were randomized blockwise in 15 groups of 3-12 people: 37 participants were randomized to the Index Medicus course (6 groups), 26 to the Grateful Med course (4 groups), and 40 to the CD-ROM course (5 groups).

**Outcome measures**

The participants performed 366 searches: 310 by the 87 GPs, and 56 by the other health care professionals.
The allocation of the participants to the three groups was performed equally: the chi-square and t-tests showed no significant difference (P<0.01) between the Index Medicus, Grateful Med, and CD-ROM groups in sex or age, nor for the GPs in years of experience or type of practice.

For the analysis of variance and differences in pairs, we used the search results of the 75 participants who completed all four assignments.

The repeated measures analysis of variance showed a significant influence of the method on recall and search quality score (P<0.01).

After combining the search results of the four search topics, the recall and overall search quality scores in the Index Medicus groups were significant higher (P≤0.001) than the recall and overall search quality scores in the CD-ROM groups (table 3). In addition, the search quality scores in the Grateful Med groups were higher (P<0.003) than those in the CD-ROM groups. We found no difference in precision. The precision, recall, and search quality scores of the individual search topics did not show specific patterns (figure 1).

### Table 3. Precision, recall, and search quality scores for 300 searches on 4 search topics in total performed in one of the three sources by 75 course participants. Results are means and (SD).

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Literature retrieval method</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Index Medicus n=32</td>
<td>Grateful Med n=12</td>
<td>CD-ROM n=31</td>
<td></td>
</tr>
<tr>
<td>Precision</td>
<td>55 (15)</td>
<td>50 (24)</td>
<td>56 (19)</td>
<td></td>
</tr>
<tr>
<td>Recall</td>
<td>26a (12)</td>
<td>22 (10)</td>
<td>16 (6)</td>
<td></td>
</tr>
<tr>
<td>Search quality score</td>
<td>83b (5)</td>
<td>71c (6)</td>
<td>65 (6)</td>
<td></td>
</tr>
</tbody>
</table>

(a) p=0.001 vs CD-ROM
(b) p<0.001 vs Grateful Med and CD-ROM
(c) p=0.003 vs CD-ROM

**Questionnaire**

The questionnaire showed that 91% of the 103 participants had possessed a personal computer for mean 5.3 years: 88% used it for patient care, but only 14% for retrieving literature. Although 72% had written an article at least once, 45% never had visited an institutional library.

Almost all participants (99%) were satisfied with the course instruction, and 73% with the search results. Searching was interpreted as easy by 62%. The Index Medicus, though, was never used by 70% of the Index Medicus groups; Grateful Med was never used by 99% of the Grateful Med groups; and CD-ROM was never used by 77% of the CD-ROM groups.
Fig. 1. Precision, recall and overall search quality scores for 300 searches on four individual search topics performed in one of the three sources by 75 participants. Results are means.

- Haemorrhoids
- Sudden infant death
- Telephone
- Gatekeeper

Precision in %
- Haemorrhoids
- Sudden infant death
- Telephone
- Gatekeeper

Recall in %
- Haemorrhoids
- Sudden infant death
- Telephone
- Gatekeeper

Overall Search Quality Score
- Haemorrhoids
- Sudden infant death
- Telephone
- Gatekeeper

* p<0.01 vs CD-ROM, and vs Grateful Med
** p<0.01 vs Index Medicus
*** p<0.01 vs Grateful Med
**** p<0.01 vs Index Medicus, and vs CD-ROM
***** p<0.01 vs CD-ROM
DISCUSSION

In this study performed from 1994 to 1997, we compared three methods to retrieve bibliographic information by GPs with little experience in literature searching. This study shows that the printed Index Medicus was the most effective literature retrieval method for GPs. Specifically, the printed Index Medicus yielded the best results in recall and overall search quality scores, whereas Medline on CD-ROM yielded the lowest. Apparently, the Index Medicus with only the Medical Subject Headings as entries was less confusing than Medline on CD-ROM which offered also free text searching.

No significant differences were found for precision. Obviously, the method used did not influence the critical selection of the retrieved citations. In fact, users consider precision of less importance than recall.9

New in this study was the use of the overall search quality score. Whereas the recall and precision referred to numbers of retrieved citations, the quality score took into account the quality of the relevant citations as assessed by judges as well.

The results of our study could have been influenced by the following aspects of our study design.

Since the course participants were interested volunteers, and 86% were affiliated with a University Department of General Practice, our participants might be more experienced in handling literature retrieval methods than GPs in general. The results of our study, therefore, can not be generalized to the general population of GPs.

Second, although the Index Medicus group spent an average of 2½ minutes longer on each assignment (ten minutes for all four assignments), it is unlikely this had influenced the results significantly.

Third, in the CD-ROM and the Grateful Med groups the assignment order was fixed and of increasing complexity. In addition, each assignment was discussed for 10 minutes afterwards. These factors could have had a positive result on the learning effect, and therefore on the search results. In spite of the lack of this learning effect, it is remarkable the Index Medicus group scored significantly better.

Fourth, although the topics of the assignments were related to daily practice, they were performed in a test situation with a restraint on time, and with a restriction of the information source (only one year). Actually, the printed Index Medicus is available only in institutional libraries, whereas electronic bibliographic information sources may be accessed from home. Furthermore, perusing several years of the Index Medicus could be a time-consuming and tedious task.

Finally, the test period was from 1994 to 1997. Because the software of literature retrieval methods we used was current in the early 90s, the study results are dated. Probably, with more consumer friendly software packages, the same study performed in 1999 may show more favourable results for the electronic sources.

Although the printed Index Medicus yielded the best search results in our study, we would not recommend the Index Medicus to GPs. The Index Medicus may be the most effective literature retrieval method, but it seems not to be the most efficient. GPs even prefer availability of information sources to quality.10
The implications of this study may be found in training programmes for GP trainees and continuing medical education courses. Because many search possibilities confused the inexperienced end users, training sessions need to be concise, clear, and simple. A literature searching training session as part of an evidence-based medicine program is recommended.

Because our study involved inexperienced end users with dated results, a repeated study with more experienced participants may give smaller or even reversed outcome measures of the three literature retrieval methods.

CONCLUSION

In summary, our study, carried out from 1994 to 1997, shows that, out of three, the printed Index Medicus is the most effective literature retrieval method for GPs. Because inexperienced end users had the highest recall and overall search quality scores using the simplest method, and the lowest recall and search quality scores using the method with the most search possibilities, we suggest the development of user-friendly electronic systems, with the provision of extensive training for end users.

Acknowledgments

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REFERENCES

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APPENDIX 1
Three assignment examples
I. Index Medicus assignment

You have been invited to give a talk on haemorrhoids to a group of colleagues in your town. To collect information, you want to do a literature search using the Index Medicus of the year 1992.

(Please read the instructions before you start your search)

STARTING TIME:

<table>
<thead>
<tr>
<th>VOLUME</th>
<th>year</th>
<th>part of the alphabet</th>
<th>index</th>
<th>volume number</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>subject heading</th>
<th>used subheading(s)</th>
</tr>
</thead>
</table>

ARTICLES FOUND (1st word of title + first author, e.g. Risk, Taylor)

1. 6.
2. 7.
3. 8.
4. 9.
5. 10.
II. Grateful Med assignment

You want to keep up with the latest developments in the prevention of sudden infant death. You want to do a literature search using Medline via Grateful Med.

LIMIT YOUR SEARCH TO 1992

1. Fill in the screen up to and including JOURNAL ABBREV (use the arrow key).

2. Please copy the entries from the screen:
   - AUTHOR NAME:
   - TITLE WORDS:
   - SUBJECT WORDS:
   - 2ND SUBJECT:
   - 3RD SUBJECT:
   - 4TH SUBJECT:
   - ENGLISH ONLY:
   - PUBL TYPE:
   - JOURNAL ABBREV:

3. A. Go one line down. You want literature references with abstracts.
   B. Go one line down. Type "S" to answer the question OK TO GO ON TO SEARCH? This will save your search strategy. Give the file the name: a:sids.
      If you want to save a second search strategy give it the name a:sids2.
   C. You want to retrieve both literature references and Medical Subject Headings (MeSH). Please call one of the course instructors! Enter "Y" and make the connection with Stockholm. When you think you have a sufficient number of articles, you can close the connection by pressing Esc.

4. How many references on the prevention of sudden infant death have you found? .... references

5. Read the list of references.
   If you consider a reference relevant, you type "F" to save this reference. The first time you type "F", you are asked to enter the name of the file in which the references will be saved. Enter: a:sids. The second time enter a:sids2. Press ENTER twice.

   When you have finished your search, press Esc. You have two options:
   1. change the search strategy and search again; go to EDIT.
   2. restart (for the next question): go to ACTION.
III. CD-ROM assignment

The editor of the Dutch journal Huisarts & Wetenschap (General Practitioner & Medical Science) has asked you to submit an article on the use of the telephone in the physician’s office. You regard this request as a challenge and you decide to do a literature search using Medline on CD-ROM of the year 1992.

1. Remove the sets of the previous assignment (F10, Clear + number of the set you wish to remove).

2. Which term(s) do you use for your search on the use of the telephone in the physician’s office? 

3. How many references about the telephone in the physician’s office have you found? ....... references

4. Study the list of literature references you have found. 
Mark the references you consider relevant to the article for the journal General Practitioner & Medical Science.

5. Before entering the final command, please call the assistant!
Download the references you have marked and your search strategy to your disk, and give the file the name a:tele.
APPENDIX 2
Questionnaire example

QUESTIONNAIRE MEDLINE ON CD-ROM

PERSONAL DETAILS

please tick the appropriate answer, or write your answer on the dotted line

1. Sex: 
   - man □
   - woman □

2. Age: 
   - .... years

3. Number of years experience as general practitioner
   (if you are not a general practitioner please state your occupation or profession: ............................................................)
   - .... years

4. How would you characterise your practice?
   - town practice □
   - rural practice □
   - not applicable □

5. What type of practice do you work in?
   - solo practice □
   - two-person practice □
   - group practice □
   - medical centre □
   - not applicable □

6. Do you have formal relationships with an Academic Centre for General Practice?
   (e.g. as supervisor of general practitioner trainees or students in your practice, or as a medical researcher)
   - yes □
   - no □

7. Are you a member of:
   (LHV = National Association of General Practitioners; LHV NHG = Dutch College of General Practitioners)
   - both LHV and NHG □
   - LHV □
   - NHG □

EXPERIENCE WITH COMPUTERS

8. Do you own a personal computer
   - at home yes □ no □
   - in your office yes □ no □
   (if you answer no to both questions, go to question 10)

9. If you own a personal computer, do you actually use it?
   - yes □ no □
   If so, for what purposes?
   - personal use yes □ no □
   - patient care yes □ no □
   - to retrieve information from literature databases using a modem yes □ no □

10. How many years of experience do you have in using a computer?
    - .... years
11. Have you ever written a report or an article for which you needed literature?  
   no □  
   yes, once or twice □  
   yes, 3-5 times □  
   yes, more than 5 times □

12. Do you read any of the following journals regularly?  
   ▶ Nederlands Tijdschrift voor Geneeskunde  
      (Dutch Medical Journal) yes □ no □  
   ▶ Huisarts & Wetenschap  
      (General Practitioner & Medical Science) yes □ no □  
   ▶ general English medical journals,  
      e.g. the Lancet or the British Medical Journal yes □ no □  
   ▶ English journals for general practice,  
      e.g. Family Practice yes □ no □

13. Have you ever used an academic medical library?  
   never □  
   once a year at the most □  
   several times a year □

14. Have you ever used the computerised catalogue of the university  
    library/academic hospital library (the OPAC)?  
   never □  
   once a year at the most □  
   several times a year □

15. Before this course had you ever heard of  
    ▶ Index Medicus yes □ no □  
    ▶ Medline yes □ no □

16. How many times have you used the printed Index Medicus?  
   never □  
   1-3 times □  
   more than 3 times □

17. How many times have you asked someone else to do a Medline search  
    on CD-ROM for you?  
   never □  
   1-3 times □  
   more than 3 times □

18. Prior to this course, have you ever used Medline on CD-ROM?  
   yes □  
   no □

19. How many times have you asked someone else to do an online search for you?  
   never □  
   1-3 times □  
   more than 3 times □

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20. Are you satisfied with your search results? yes □ no □

21. Using Medline on CD-ROM was: difficult □ easy □

22. In carrying out the assignments did you find it difficult to:
   ▶ find the appropriate search terms yes □ no □
   ▶ use the thesaurus yes □ no □
   ▶ perform the technical procedures, e.g. downloading to the disk or using "show" yes □ no □
   ▶ narrow or broaden the search; or using AND, OR or NOT yes □ no □

23. The next time you need literature on a particular subject, are you going to:
   ▶ use Medline on CD-ROM? yes □ no □
   ▶ order a search in Medline on CD-ROM? yes □ no □
   ▶ order an online literature search? yes □ no □
   ▶ do a manual search of journals? yes □ no □

24. Suppose you were actually faced with one of the course assignments, would you be willing to pay DFl 100 to have an expert do a literature search for you?
   ▶ for the talk to your colleagues yes □ no □
   ▶ for keeping up with the literature yes □ no □
   ▶ for writing a article yes □ no □
   ▶ for the discussion with the general practitioner trainee yes □ no □

25. If you had a CD-ROM player with a subscription on Medline at home, you would be able to search as extensively and as often as you like. How much would you be willing to invest as a once-only investment into equipment? < DFl 250 □ > DFl 250 □

26. Would you be willing to pay up to DFl 1500 a year for a subscription to Medline on CD-ROM? yes □ no □

27. If you require more literature references than you have found now, what would you do?
   ▶ go to a library and ask help yes □ no □
   ▶ go to a (medical) expert yes □ no □
   ▶ look through my own books yes □ no □
   ▶ look through journals yes □ no □

28. In your opinion, did you receive sufficient instruction prior to the assignments? yes □ no □

29. Was the instruction given in the course better than you had expected or were you disappointed? Please comment.

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