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Effectiveness of bibliographic searches performed by paediatric residents and interns assisted by librarians. A randomized controlled trial

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Conflicts of interest

The authors have no financial relationships relevant to this article to disclose.

Effectiveness of bibliographic searches performed by paediatric residents and interns assisted by librarians. A randomized controlled trial

Key messages

Implications for practice

Support by an expert biomedical librarian significantly improves both the outcomes and the process of online bibliographic searches performed by paediatric residents and interns in medical databases, using real life clinical scenarios.

For such health professionals, the intermediation of an information professional adds value in the process of retrieving evidence to be used as a basis for clinical practice.

Implications for policy

The study shows quantitative evidence of the fact that biomedical librarians play an important role in the process of acquisition and selection of information for clinical decision making in a paediatric teaching hospital.

Assisted bibliographic searches are an important, value-adding asset for clinical decision making in a paediatric teaching hospital.

Structured abstract

Background

Considerable barriers still prevent paediatricians from successfully using information retrieval technology.

Objectives

To verify if the assistance of biomedical librarians significantly improves the outcomes of searches performed by paediatricians in biomedical databases using real-life clinical scenarios.

Methods

In a controlled trial at a paediatric teaching hospital, 9 residents and interns were randomly allocated to an assisted search group, and 9 to a non-assisted (control) group. Each participant searched PubMed and other online sources, performing pre-determined tasks including the formulation of a clinical question , retrieval and selection of bibliographic records. In the assisted

group, participants were supported by a librarian with ≥ 5 years of experience. The primary outcome was the success of search sessions, scored against a specific assessment tool.

Results

The median score of the assisted group was 73.6 points (IQR 13.4) vs. 50.4 (IQR 17.1) of the control group. The difference between median values in the results was 23.2 points (95% CI 4.8 - 33.2), in favour of the assisted group (P value, Mann-Whitney U test: 0.013).

Conclusions

The study has found quantitative evidence of a significant difference in search performance between paediatric residents or interns assisted by a librarian and those searching the literature alone.

Introduction

Paediatricians, as all doctors, need up to date, evidence-based and clinically relevant information to support their daily practice[1, 2]. For a long time, electronic sources such as online databases have been considered primary tools for retrieving appropriate evidence for clinical decision making[3]; however, doctors still encounter considerable barriers related to these information sources. For example, they lack both adequate search skills and familiarity with the task due to low frequency of use, etc.[4-7]. Furthermore, a recent review failed to demonstrate a positive impact of information retrieval technology on clinical decision[8].

Empirical research has suggested that clinicians need better skills to obtain more relevant evidence from searches[6, 9, 10], particularly concerning the correct formulation of a clinical question and the techniques for retrieving bibliographic records from databases[1, 11]. Consequently, both support from librarians and information professionals and educational interventions aimed at improving clinicians' skills in this area have been widely discussed in the last few years.

Reviews have recently been carried out on the contribution of library services in general[12] and of clinical librarian programs in particular[13, 14], along with case reports[15] and descriptive or evaluative studies, often relying on opinion, subjective measures and self-reported outcomes by participants[16-18]. Although there are signs of some impact from services on time saved by clinicians and on patient outcomes, the evidence is inconclusive, due to study sizes and methodological limitations, such as the inherent difficulty in defining useful and reliable impact measures[19].

The same considerations seem to hold true for the impact of structured educational interventions. A systematic review and a critical appraisal found only very limited evidence that information skills training for health professionals was successful in improving such skills[20, 21]. As for more general evidence-based medicine (EBM) training, one review found that "standalone teaching improved knowledge but not skills, attitudes, or behaviour", while advocating more clinically integrated teaching methods[22]. One pre-post intervention study on paediatric residents[23] showed a significant impact of educational interventions on skills involved in formulating a clinical question and executing a bibliographic search; a qualitative study, although based on self-reported outcomes and featuring a small number of doctors, suggests a good level of perceived effectiveness of both mediated search and information skills training[24]. On the other hand, EBM skills acquired by paediatricians in short courses seem to be hardly sustainable over time, especially when practitioners experience common barriers such as lack of time, isolation and lack of institutional support.[25]. Finally, a recent Cochrane review on "interventions for increasing the frequency and quality of questions formulated by healthcare providers in practice and in the context of self-directed learning" concluded that "sustainability of effects from educational interventions for question formulation are unknown"[26].

The aim of the present study is therefore to verify the following hypothesis: does the assistance of a skilled biomedical librarian significantly improve the outcomes of a search performed in biomedical databases, compared with the outcomes of a search conducted by a clinician alone?

Methods

Participants and setting

Data for the randomized controlled trial were collected between 25/10/2007 and 27/12/2007 at two general units of a large Italian paediatric teaching hospital. All paediatric residents and interns were considered eligible for the trial: as residents and interns are frequent healthcare providers in

academic units, this criterion allowed to set the study results in everyday clinical practice, while assuring comparable background experience of participants. Besides, residents and interns are specifically trained on theoretical and practical EBM methods; since skills progressively decay after graduation if not regularly used[27], this group results in a particularly challenging comparison for assisted searches.
Of the 23 contacted subjects, 22 agreed to participate. 14 of them were graduated residents, while the remaining 8 were interns, 5 of which were in their final year and writing up their final dissertation. Prior to randomization, between 16/10/2007 and 24/10/2007, all participants underwent a specific refresher intervention on EBM methods (Table 1) in order to further ensure baseline homogeneity as regards both basic EBM knowledge and skills for retrieving and appraising evidence.

Power of the study, randomization, blinding

Sample size was calculated on the basis of finding a difference between groups of 22 points on a total of 100 available points, using the assessment tool described below. Due to the lack of previous studies on the subject, such a figure indicating relevance was obtained by expert opinion prior to the study. Four experienced medical librarians were asked to independently estimate the expected difference in points between assisted and non-assisted users; their evaluations were subsequently averaged. With $\alpha = 0.05$, $\beta = 0.20$ and an estimated standard deviation within groups of 15 points, 9 subjects were needed in each group to detect a statistically significant difference of 22 points over 100; however, considering the possibility of drop-outs, 22 subjects were initially enrolled. Sample size calculation was performed using NCSS-PASS 2000 (Number Cruncher Statistical Systems, Kaysville, UT).
Randomization was performed by the random-digit method, on the basis of computer-generated numbers. A two treatment randomization scheme with random block of varying size was obtained using the Ralloc Procedure in Stata Statistical Software 9 (StataCorp LP, College Station, TX).
A computerized allocation list was generated by the statistician, and was concealed until the intervention took place; using the list, the statistician assigned participants to groups, without knowledge of their identity. Consequently, participants knew if they would attend an assisted or non-assisted search session only when the session began. Conversely, librarians assigned to the assisted sessions did not know the identity of the participant before attending the session. Besides, single clinical scenarios were disclosed both to participants and librarians assisting the searches only when the session took place.
One librarian of the team, not involved in the assisted searches, contacted the enrolled and randomized participants, explaining the characteristics of the intervention and the general aim of the study, and settling the time and place for the search sessions.
Because of the characteristics of the study, it was not possible to blind participants to treatment assignment; however, to reduce assessment bias, the assessment team was blinded to group assignment until all the data were evaluated and the definitive score for each participant was agreed upon.

Intervention and data collection

An experienced clinician developed 12 clinical scenarios of equivalent difficulty by grounding on common practice situations related to therapy or diagnosis, that entailed some difficulties in clinical reasoning and decision-making (Table 2).
The scenarios were randomly distributed to the 18 participants of assisted and non-assisted search groups at the beginning of each search session, and some were consequently common to both

groups. Both assisted and non-assisted search sessions were held in the library and lasted from a minimum imposed time of 30 minutes to a maximum of 90. After being briefly introduced to the tasks by a librarian, each participant had to: a) complete a form with patient/problem-intervention-comparison/control-outcome (PICO) elements of the clinical question resulting from the analysis of the scenario[28], related keywords and the search string that best matched the assigned scenario; b) perform the search in the PubMed database; c) select the most clinically relevant references among those retrieved; d) search for further evidence from other pertinent sources, e.g. guideline repositories, EBM databases, search engines. At the end of the session, he/she was required to save and print the most satisfying search strings together with the best references retrieved. Only in the assisted search group, participants were supported by a librarian with ≥ 5 years of biomedical search experience, blinded to the assignment of the scenario and the respective gold standard of best available evidences; 3 librarians were involved, and each one was assigned 3 search sessions. The librarian was required to give assistance during each stage of the search session, although without directly performing any of the tasks assigned to the participant. For example, librarians helped with the PICO formulation, suggested correct and/or alternative keywords and search strings and offered technical advice for the proper use of PubMed and other search tools. In case of discordant opinions, the final decision on how to complete a given task was up to the participant. Two medical librarians with ≥ 1 year of experience were selected and specifically trained before the intervention; each one of them was then assigned to observe 9 search sessions, recording in detail on a pre-structured form the actions performed by participants and assisting librarians during the accomplishment of the tasks. After the sessions, observers and researchers discussed the data emerging from the field, clarifying specific controversial points.

Primary outcome, assessment tool and data analysis

The primary outcome was the global success of search sessions, as expressed by the total points obtained by participants when the results of their tasks were scored against a specifically developed assessment tool. This tool was conceived to evaluate the performance in terms not only of obtained results, but also of the global search process that lead to finding them, in order to reduce the weight of success due to mere serendipity. Consequently, 4 medical librarians with ≥ 5 years of experience adapted the first 4 items of one of the standard evaluation tools for EBM-related skills, the Fresno Test of competence in evidence based medicine[29]. Such questions concern both the clinical scenario conversion into PICO and the literature search performance; the adaptation involved partial adoption of some items and a different method for attributing points. To these first 4 items, 6 more were added to ensure a more granular measurement of the evidence retrieval and selection processes, grounded in the common experience of clinicians and librarians and the most frequent errors in search strategies reported by the literature[30]. The 10 items of the resulting assessment tool are shown in Table 2 together with their applicable values and relative weight, which were determined by the expert opinion of the 4 librarians.

Item no. 8 (Percentage of relevant articles collected according to EBM criteria) was calculated as the percentage resulting from the comparison between the set of results produced by participants at the end of every observed session and a gold standard. The latter was made of the best available evidence, according to EBM criteria, collected through PubMed searches for each of the 12 clinical scenarios by 1 expert clinician and 2 librarians of the team not involved in the assisted search sessions [31] (Appendix A). The final decision about article inclusion in the gold standard was always made by the clinician, based on clinical experience. The result of each search session was scored by the 4 librarians working together. The team reviewed each search twice to ensure consistency of evaluation; differences of opinion between evaluators were resolved by discussion.

In the results section, data from the main analyses are reported as median and interquartile range (IQR). Due to the sample size, normal distribution of data could not be assumed; therefore,

differences between assisted and non-assisted groups were evaluated by the non-parametric Mann-Whitney U-test. All reported P-values are two-sided and differences were considered to be significant for $P < 0.05$. Data were analyzed by using SPSS 16 (SPSS Inc., Chicago, IL); the point estimate and 95% confidence interval (CI) for the difference in performance between groups was calculated by the statistician using Microsoft Excel 2003 (Microsoft, Redmond, WA).

Results

Of the 22 residents and interns that agreed to participate, 4 did not receive further intervention for the reasons reported in Figure 1. Randomization was thus performed on 18 subjects, 9 of whom were allocated to the assisted search group, and 9 to the non-assisted (control) group. None of them withdrew from the study due to adverse events and therefore all were included in the final analysis. Table 3 shows that baseline demographic and clinical characteristics did not differ significantly in the 2 groups, as the two-sided P-value of the comparison conducted by the Mann-Whitney U Test was > 0.05 for all 3 main variables.

Furthermore, median and IQR for age and clinical experience did not differ significantly between randomized subjects (R) and enrolled but non-randomized subjects (NR), according to Mann-Whitney U Test (age: R 28.6 (IQR 2.3) vs. NR 28 (IQR 6.6), $P = 0.89$; clinical experience: R 4.5 (IQR 3.1) vs. NR 3 (IQR 3.5) , $P = 0.46$); a comparison of post-training results was not possible, since the main reason for non randomizing the subjects was that they had not completed the EBM refresher intervention.

Once the results for each group were evaluated using the assessment tool, the assisted group obtained a median score of 73.6 points (IQR 13.4), whereas the non-assisted (control) group obtained a median score of 50.4 (IQR 17.1). Therefore, the difference between the median values in the results obtained by the assisted vs. the non-assisted group was 23.2 points (95% CI 4.8 - 33.2), in favour of the assisted group (Figure 2). The difference between the median scores was statistically significant, according to the Mann-Whitney U Test ($P = 0.013$).

No secondary outcomes were analyzed in the study. In addition, the following exploratory analysis was performed: as far as single items of the assessment tool were concerned, the only statistically significant difference between the outcomes of the assisted vs. non-assisted group was found in the scores for item 2 (Number of PICO terms translated into search terms): for the assisted group the median was 10 points (IQR 0), while for the non-assisted group the median resulted in 6.7 points (IQR 2.8); two tailed P value for Mann-Whitney U-test was < 0.001. For all other items, Mann-Whitney U-test P values were > 0.05 (Table 4).

Discussion

Principal results

Few quantitative studies have been conducted to investigate the impact of librarians' assistance on the outcomes of bibliographic EBM searches in the medical sector. To our knowledge, our study is the only one comparing the quality of a search performed by health professionals with and without the assistance of librarians; other similar studies[32-34] have focused on search quality either of health librarians or of health professionals.

The present study has found evidence of a significant difference in search performance between paediatric residents and interns assisted by a librarian and paediatric residents and interns searching the literature by themselves. As far as single search sessions in biomedical bibliographic databases are concerned, the technical skills of biomedical librarians[6, 35] seem to provide significant added value to bibliographic searches for this category of health professionals confronted with everyday clinical scenarios.
Besides, the exploratory analysis showed a statistically significant difference between the outcomes of the assisted vs. non-assisted group in the scores for item 2 of the assessment tool (Number of PICO terms translated into search terms). This could suggest that librarians are particularly useful in helping doctors to efficiently turn scenarios into clinical questions, although further research is needed on this issue.
Even if a degree of subjectivity is inevitably involved in the interpretations of some outcome measures in the assessment tool, the present study is the first to our knowledge to draws conclusions based on observation and quantitative measures, without relying on self-reported outcome measures by either librarians or participants.

Limitations

Several considerations, however, may influence the generalizability of the results. Firstly, the duration of a session was not considered as a part of the outcome, while the literature consistently reports that shortage of time is one of the main barriers clinicians face when doing literature searches[5, 6, 31], and one study also points out that searches performed by librarians can help save clinicians' time[34]. Therefore, the assistance by medical librarians seems particularly useful when paediatricians face complex scenarios, for which they feel it is worth spending 30 to 90 minutes searching the literature, before appraising the retrieved evidence; for quicker or – on the contrary – for far more complex scenarios, further research is needed to assess the added value provided by librarians.
Furthermore, the possibility that the observed difference was the result of two individuals performing the search rather that from the involvement of a biomedical librarian could not be entirely excluded, and further research with more complex study designs might be useful to clarify the issue.
Besides, the quantitative method of the study is adequate for a setting in which paediatricians perform single searches in a specific space and time. In real life, users often perform a search in different moments, and repeat the same search over time, either with or without assistance. It may then be useful to adopt a diachronic approach, and to study more in detail and with qualitative methods this complex search behaviour.
Another key question concerns the cost-effectiveness of assisted searches: our approach was exclusively aimed at a first attempt of measuring efficacy of the assistance, and it would be worthwhile to conduct cost-effectiveness studies on assisted bibliographic searches, once the measurement methods are set.
As for the assessment tool, the outcome was measured using a 10-point scale built partly using modified Fresno Test questions[29, 36, 37], and partly more specific items related to characteristics of the PubMed database and in general to the skills needed to use bibliographic databases. Although the choice of items reflects the main dimensions of the literature search process (i.e.: clinical question formulation, search strings and keyword, content- and methodology-related limits and filters, selection and archival tools and use of a variety of sources), further pilot and validation of this tool also for different medical contexts and professions would considerably add to the validity of obtained measures, although both theoretical and empirical studies consistently suggest that there is no gold standard available to evaluate the success of literature searches, which are complex, interactive processes[38-40]. However, the tool allowed for a thorough assessment of all the main

characteristics of a search: indeed, the number of relevant articles retrieved was only one of the items, since it was necessary to test and measure a whole set of skills related to an effective retrieval process. Besides, relevant articles could well have been retrieved partly by chance, in the limited number of example scenarios administered to participants.

Conclusions

As for real-life clinical scenarios, the assistance of a skilled biomedical librarian significantly improves the outcomes of a search performed in biomedical databases, compared with the outcomes of a search conducted by paediatric residents and interns alone. For these health professionals, the intermediation of an information professional adds value to the process of retrieving evidence to be used as a basis for clinical practice.
Further research and evaluation is needed in all the highlighted sectors.
The present study could be a useful basis for further evaluating the role of medical librarians in supporting literature searches performed by paediatricians.

References

1. Sackett, D.L., Rosenberg, W.M., Gray, J.A., Haynes, R.B., & Richardson, W.S. Evidence based medicine: what it is and what it isn't. BMJ (Clinical Research Edition) 1996, **312** (7023), 71-72.
2. Dawes, M., Summerskill, W., Glasziou, P., Cartabellotta, A., Martin, J., Hopayian, K., Porzsolt, F., Burls, A., & Osborne, J. Sicily statement on evidence-based practice. BMC Medical Education 2005, **5** (1), 1.
3. Lindberg, D.A., Siegel, E.R., Rapp, B.A., Wallingford, K.T., & Wilson, S.R. Use of MEDLINE by physicians for clinical problem solving. JAMA: The Journal of the American Medical Association 1993, **269** (24), 3124-3129.
4. Coumou, H.C.H., & Meijman, F.J. How do primary care physicians seek answers to clinical questions? A literature review. Journal of the Medical Library Association: JMLA 2006, **94** (1), 55-60.
5. Davies, K. The information-seeking behaviour of doctors: a review of the evidence. Health Information and Libraries Journal 2007, **24** (2), 78-94.
6. Hersh, W.R., & Hickam, D.H. How well do physicians use electronic information retrieval systems? A framework for investigation and systematic review. JAMA: The Journal of the American Medical Association 1998, **280** (15), 1347-1352.
7. Shirkhedkar, P., & Day, A.S. Medical literature search practice in paediatric junior medical staff: a questionnaire survey. Informatics for Health & Social Care 2008, **33** (1), 69-75.
8. Pluye, P., Grad, R.M., Dunikowski, L.G., & Stephenson, R. Impact of clinical information-retrieval technology on physicians: a literature review of quantitative, qualitative and mixed methods studies. International Journal of Medical Informatics 2005, **74** (9), 745-768.
9. Hider, P.N., Griffin, G., Walker, M., & Coughlan, E. The information-seeking behavior of clinical staff in a large health care organization. Journal of the Medical Library Association: JMLA 2009, **97** (1), 47-50.
10. Oliveri, R.S., Gluud, C., & Wille-Jorgensen, P.A. Hospital doctors' self-rated skills in and use of evidence-based medicine - a questionnaire survey. Journal of evaluation in clinical practice 2004, **10** (2), 219-226.

11. Evidence-based medicine. A new approach to teaching the practice of medicine. JAMA: The Journal of the American Medical Association 1992, **268** (17), 2420-2425.
12. Weightman, A.L., & Williamson, J. The value and impact of information provided through library services for patient care: a systematic review. Health Information and Libraries Journal 2005, **22** (1), 4-25.
13. Wagner, K.C., & Byrd, G.D. Evaluating the effectiveness of clinical medical librarian programs: a systematic review of the literature. Journal of the Medical Library Association: JMLA 2004, **92** (1), 14-33.
14. Rankin, J.A., Grefsheim, S.F., & Canto, C.C. The emerging informationist specialty: a systematic review of the literature. Journal of the Medical Library Association: JMLA 2008, **96** (3), 194-206.
15. Whitmore, S.C., Grefsheim, S.F., & Rankin, J.A. Informationist programme in support of biomedical research: a programme description and preliminary findings of an evaluation. Health Information and Libraries Journal 2008, **25** (2), 135-141.
16. Abels, E.G., Cogdill, K.W., & Zach, L. The contributions of library and information services to hospitals and academic health sciences centers: a preliminary taxonomy. Journal of the Medical Library Association: JMLA 2002, **90** (3), 276-284.
17. Brettle, A., Hulme, C., & Ormandy, P. The costs and effectiveness of information-skills training and mediated searching: quantitative results from the EMPIRIC project. Health Information and Libraries Journal 2006, **23** (4), 239-247.
18. Davidoff, F., & Florance, V. The informationist: a new health profession? Annals of Internal Medicine 2000, **132** (12), 996-998.
19. O'Connor, P. Determining the impact of health library services on patient care: a review of the literature. Health Information and Libraries Journal 2002, **19** (1), 1-13.
20. Brettle, A. Information skills training: a systematic review of the literature. Health Information and Libraries Journal 2003, **20(Suppl 1)**, 3-9.
21. Garg, A., & Turtle, K.M. Effectiveness of training health professionals in literature search skills using electronic health databases--a critical appraisal. Health Information and Libraries Journal 2003, **20** (1), 33-41.
22. Coomarasamy, A., & Khan, K.S. What is the evidence that postgraduate teaching in evidence based medicine changes anything? A systematic review. BMJ 2004, **329** (7473), 1017-1022.
23. Dinkevich, E., Markinson, A., Ahsan, S., & Lawrence, B. Effect of a brief intervention on evidence-based medicine skills of pediatric residents. BMC Medical Education 2006, **6**, 1.
24. Brettle, A., Hulme, C., & Ormandy, P. Effectiveness of information skills training and mediated searching: qualitative results from the EMPIRIC project. Health Information and Libraries Journal 2007, **24** (1), 24-33.
25. Gardois, P., Grillo, G., Lingua, C., Jourdan, A., Piga, A., & Fronteddu, S. Assessing the efficacy of EBM teaching in a clinical setting. Hypothesis 2005, **19** (1), 1, 8.
26. Horsley, T., O'Neill, J., McGowan, J., Perrier, L., Kane, G., & Campbell, C. Interventions to improve question formulation in professional practice and self-directed learning. Cochrane Database of Systematic Reviews (Online) 2010, **5**, CD007335.
27. Arthur, W., Bennett, W., Stanush, P.L., & McNelly, T.L. Factors that influence skill decay and retention: A quantitative review and analysis. Human performance 1998, **11** (1), 57-101.
28. Armstrong, E.C. The well-built clinical question: the key to finding the best evidence efficiently. WMJ: Official Publication of the State Medical Society of Wisconsin 1999, **98** (2), 25-28.
29. Ramos, K.D., Schafer, S., & Tracz, S.M. Validation of the Fresno test of competence in evidence based medicine. BMJ 2003, **326** (7384), 319-321.
30. Sampson, M., & McGowan, J. Errors in search strategies were identified by type and frequency. Journal of Clinical Epidemiology 2006, **59** (10), 1057-1063.

31. Rosenbloom, S.T., Giuse, N.B., Jerome, R.N., & Blackford, J.U. Providing evidence-based answers to complex clinical questions: evaluating the consistency of article selection. Academic Medicine 2005, **80** (1), 109-114.
32. Banks, D.E., Shi, R., Timm, D.F., Christopher, K.A., Duggar, D.C., Comegys, M., & McLarty, J. Decreased hospital length of stay associated with presentation of cases at morning report with librarian support. Journal of the Medical Library Association: JMLA 2007, **95** (4), 381-387.
33. Bradley, D.R., Rana, G.K., Martin, P.W., & Schumacher, R.E. Real-time, evidence-based medicine instruction: a randomized controlled trial in a neonatal intensive care unit. Journal of the Medical Library Association: JMLA 2002, **90** (2), 194-201.
34. McGowan, J., Hogg, W., Campbell, C., & Rowan, M. Just-in-time information improved decision-making in primary care: a randomized controlled trial. PloS One 2008, **3** (11), e3785-e3785.
35. Erickson, S., & Warner, E.R. The impact of an individual tutorial session on MEDLINE use among obstetrics and gynaecology residents in an academic training programme: a randomized trial. Medical Education 1998, **32** (3), 269-273.
36. Ilic, D. Assessing competency in Evidence Based Practice: strengths and limitations of current tools in practice. BMC Medical Education 2009, **9** (1), 53.
37. Shaneyfelt, T., Baum, K.D., Bell, D., Feldstein, D., Houston, T.K., Kaatz, S., Whelan, C., & Green, M. Instruments for evaluating education in evidence-based practice: a systematic review. JAMA: The Journal of the American Medical Association 2006, **296** (9), 1116-1127.
38. Ellis, D. The dilemma of measurement in information retrieval research. Journal of the American Society for Information Science 1996, **47** (1), 23-36.
39. Sutcliffe, A.G., Ennis, M., & Watkinson, S.J. Empirical studies of end-user information searching. Journal of the American Society for Information Science 2000, **51** (13), 1211-1231.
40. Wilson, T.D. Models in information behaviour research. Journal of Documentation 1999, **55** (3), 249-270.

Table 1. Contents of the pre-randomization EBM refresher session (2 days / total 12 hours)

Basic knowledge	EBM core principles Clinical question building (PICO model) Reference management
Evidence retrieval	EBM searching in PubMed The Cochrane Library Clinical practice guideline databases
Evidence appraisal	Clinical study designs Statistics applied to the appraisal process Clinical guideline grading systems and appraisal tools

Table 2. Items of the assessment tool, with applicable values and relative weight

No.	Item description	Applicable values	Weight
1	PICO formulation	% [0-100]	15
2	Number of PICO terms translated into search terms	% [0-100]	10
3	Search string syntax (Boolean operators)	0, 50, 100	5
4	Medical Subject Headings (MESH) use (thesaurus, details, tree structure, age groups, subheadings)	0, 33, 66, 100	10
5	Publication date limit utilization*	0, 100	5
6	Language limit utilization*	0, 100	5
7	Filters (Subsets, Clinical Queries, other limits not listed above)	0, 50, 100	15
8	Percentage of relevant articles collected according to EBM criteria	% [0-100]	15
9	Saving of search strings / results	0, 50, 100	10
10	Pertinent use of other sources	0, 50, 100	10
			Total = 100

* If used = 0; if not used = 100.

Table 3. Baseline characteristics of randomized paediatric residents: distribution between the two groups

Characteristics	Assisted search (N = 9)	Control (N = 9)	*P* value for Mann-Whitney U Test*
Age, median (IQR), y	29.5 (2.8)	28.3 (1.9)	0.504
Clinical experience, median (IQR), y	4.5 (3.8)	3.8 (2.8)	0.303
Post-training results, median (IQR), %	76.2 (21)	76.2 (21.9)	0.779

* Two-tailed exact significance

Table 4. *P* values for the items of the assessment tool

No.	Item description, median (IQR), points	Assisted search (N = 9)	Control (N = 9)	*P* value for Mann-Whitney U Test*
1	PICO formulation	12.5 (4.4)	11.3 (8.8)	0.282
2	Number of PICO terms translated into search terms	10 (0)	6.7 (2.8)	0.001
3	Search string syntax	5 (2.5)	2.5 (5)	0.209
4	MESH use	6.7 (6.7)	3.3 (5)	0.149
5	Publication date limit utilization	**	5 (5)	0.206
6	Language limit utilization	***	****	1
7	Filters	15 (3.8)	7.5 (7.5)	0.119
8	Percentage of relevant articles collected according to EBM criteria	3.2 (8.3)	4.3 (4.2)	0.812
9	Saving of search strings / results	10 (5)	5 (10)	0.153
10	Pertinent use of other sources	5 (5)	5 (10)	1
	Total	**73.6 (13.4)**	**50.4 (17.1)**	**0.013**

* Two-tailed exact significance.
** The value for item 5 was constant for all cases in the assisted group, therefore it was omitted.
*** The value for item 6 was constant for all cases in the assisted group, therefore it was omitted.
**** The value for item 6 was constant for all cases in the non-assisted group, therefore it was omitted.

Figure 1. Flow of participants through each stage of the trial

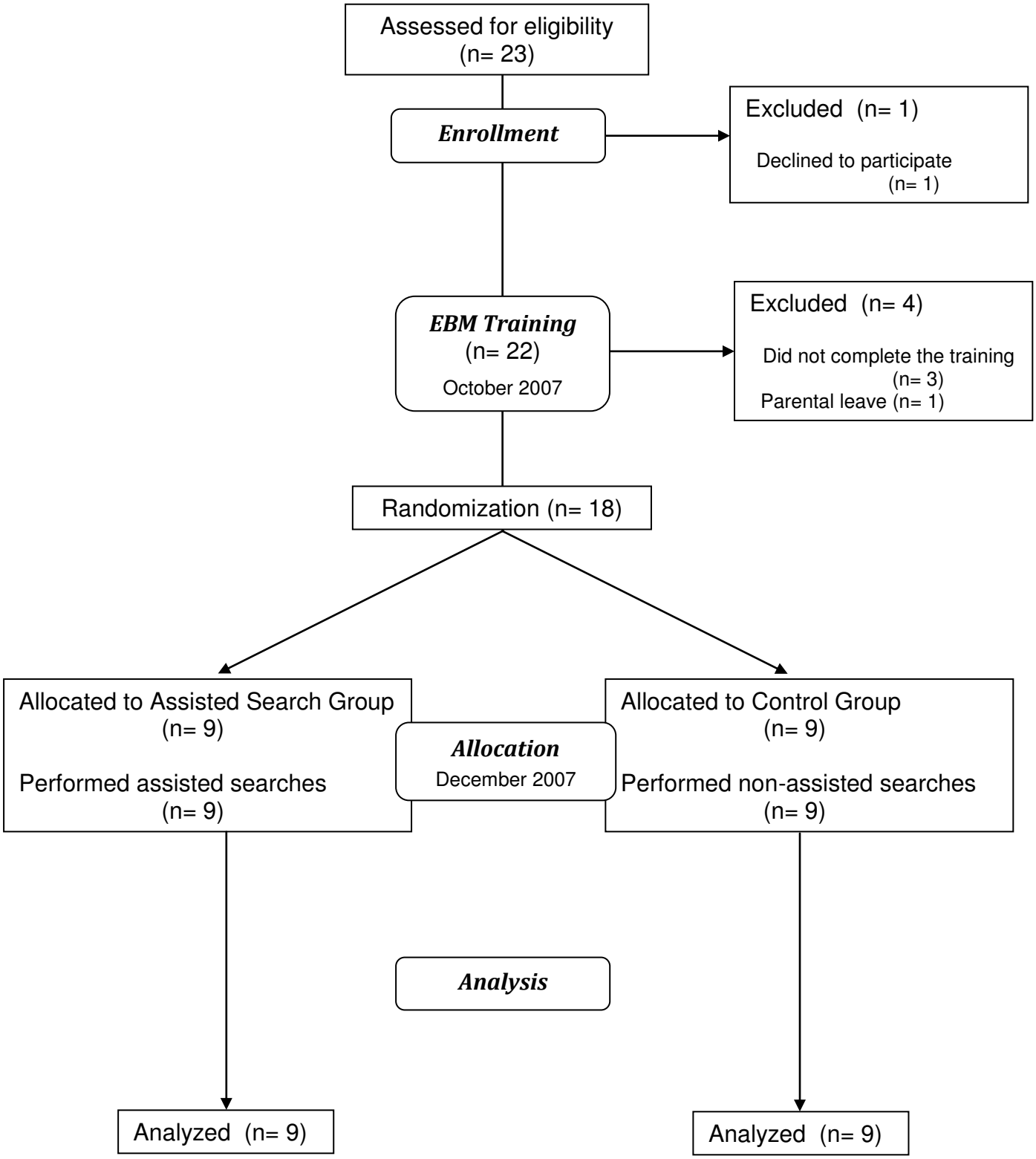
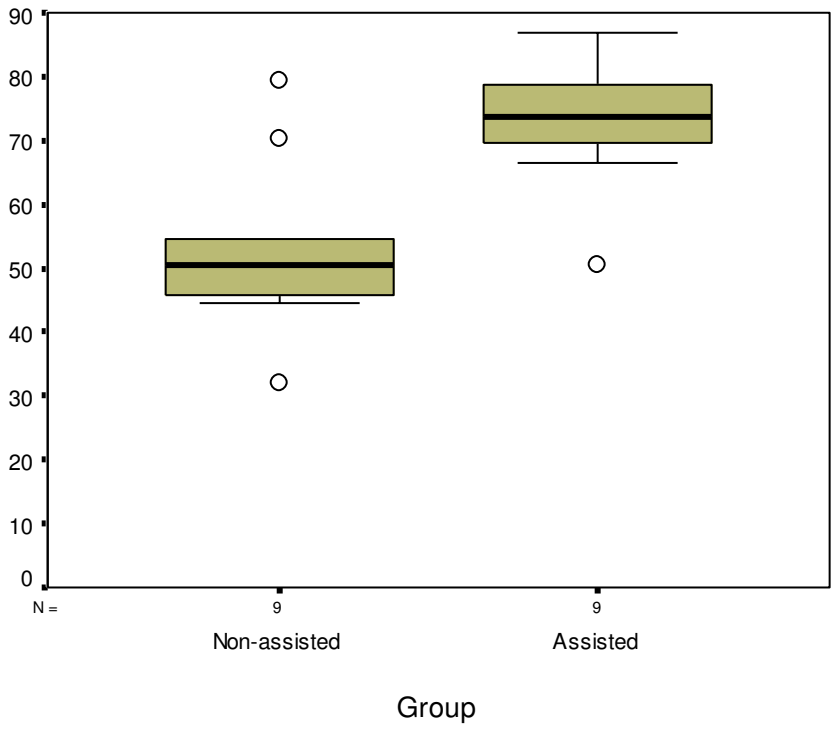


Figure 2. Boxplot of final score for assisted vs. non-assisted group



Thick black line in the boxes = Median value. **Lower and upper limit of the boxes** = 25th and 75th percentile. **Lower and upper limit of the whiskers** = Limits for values lying between 1.5 IQR of the lower quartile and 1.5 IQR of the upper quartile. **White circles** = Outliers
The difference between the median scores was statistically significant, according to the Mann-Whitney U Test ($P = 0.013$).

Appendix A. Clinical scenarios with gold standards of best available evidences

No.	Content	Clinical question	Gold standard (retrieved in PubMed to 21/12/2007)
1	Gaia is a 9-month-old girl with serious sleep disorders. Her parents bring her to the paediatrician for the first time to evaluate the situation. Gaia is not able to sleep for more than half an hour at a time, causing restless nights to all the family. Her parents, being visibly in trouble, ask for a definitive solution. It seems that they have tried everything to reassure their child and to promote quiet nights, without positive results. They ask if it is possible to administer a drug that they have heard may resolve sleep disturbance in children.	Is treatment with niaprazine effective in improving nocturnal sleep in children with sleep disorders?	PMID: 1354861; 1837245; 12038875
2	Mark, a 4-1and-a-half-year-old boy, comes to the paediatrician with snoring problems, which have persisted since he was 2 years old. For the last 3 months, he has repeatedly stopped breathing in his sleep, while tossing a lot. His parents are very worried because an otorhinolaryngologist has diagnosed adenotonsillar hypertrophy, highly recommending removal of adenoids and a tonsillectomy to solve sleep apnoea. They ask for the possibility to avoid surgery by administering a drug to reduce the number of sleep apnoeas.	Which treatment is more effective in reducing the number of apnoea episodes in children with sleep apnoea syndrome?	PMID: 11391326; 7551385; 16213930
3	Ann, a 7-year-old girl, shows symptoms of upper respiratory tract infection and fever (38.8° C for the past 2 days) treated with paracetamol, 12.5 mg/kg every 6 hours by rectal administration. After each dose her body temperature drops to subfebrile values for less than 1 hour before rising again. Her mother asks the paediatrician if it is possible to administer an alternative therapy for a more effective fever control.	Is ibuprofen more effective alone or in combination with paracetamol in controlling fever in children?	PMID: 16464962; 16515705; 15184213; 14998225; 12061352; 9403646; 8660083; 7884951; 1621669; 1621668; 1506123; 1941390; 2279802; 2663318
4	Louis, a 2-year-old boy, comes to the ER for barking cough started suddenly during the night and worsened in the early morning. His body temperature is 37° C and he looks quiet, but during the visit he starts crying, while breathing deteriorates. Laryngitis is diagnosed.	Which therapy is more effective: inhaled corticosteroids, adrenaline by inhalation or a combination of both?	PMID: 8628614; 8439075; 3285638
5	Martha, a 2-and-a-half-year-old healthy girl, has had a temperature for the past 2 days (< 39° C) and rhinitis treated with paracetamol (15 mg/kg). A few hours before, she had a 1-minute generalized tonic-clonic seizure. Clinical examination reveals good general health, T =	Is long-term drug prophylaxis useful after the first onset of simple febrile seizures?	PMID: 9794981; 8223808; 9427902; 17156694; 15120684; 7776115; 8510706; 2202804; 3907504; 6424041; 6116084;

	37.8°, little evidence of neurological deficits, no meningeal irritation signs, swollen pharynx. Personal and family medical histories record no previous instances of similar diseases. A diagnosis of simple febrile seizures is made. Her worried parents ask for a therapy to prevent further episodes.		7381637; 361000; 15684445, 8282390, 3973786; 14762586
6	Andrew, a 17-month-old infant, for the past few days has had a cold with runny nose, cough and fever up to 38.8° C, treated with paracetamol until the day before. His parents report that he is more irritable than usual and that he wakes up crying several times during the night. At the moment his body temperature is normal. Physical examination does not find particular symptoms, except for a slight reddening of the left tympanic membrane without middle ear fluid, and an extroversion of the right tympanic membrane with white liquid inside. Otitis media is diagnosed.	Is antibiotic therapy indicated in such a child?	PMID: 14973951; 10198511; 9183201; 8806290; 8120703; 1533027; 1505094; 15684116; 11483783; 17055944; 16968847; 15930204; 10657332
7	Laurence is a 5-year-old boy. His parents have noticed a non-symptomatic lump on the side of the neck. Clinical history does not report any significant problems nor recent infectious episodes. The paediatrician detects the presence of a 5 X 6 cm lymph node package and some small palpable lymph nodes respectively on his neck's right and left side, without other findings.	Is antibiotic therapy indicated in a child with isolated lymphadenopathy, or is simple observation to be preferred?	PMID: 16616313; 16095089; 15214745; 12545419; 8578023; 11121496; 14722499; 9728192; 7987628; 6720492; 15037835; 959081; 17097154; 16928650; 9742904; 12619339; 17210478; 4011475
8	Albert, a 7-year-old boy, has been suffering from skin lesions at the back of his right hand for a few days. Clinical examination reveals crusted yellow-brown lesions, without fever or lymphadenopathy. The paediatrician diagnoses impetigo, prescribing topical antibiotic therapy with mupirocin. Albert's mother, worried about possible contagion, asks whether the prescribed ointment is sufficient, or oral antibiotic is to be preferred.	Is topical therapy with mupirocin effective for clinical recovery in a school-aged child with impetigo?	PMID: 12939895; 1605593; 2121951; 2502950; 3149884; 15106198; 3102167
9	Lisa, a 5-year-old girl, comes to the paediatrician because her mother has noticed nits in her hair. She was treated twice for head lice 2 months ago (once with permethrin and once with malathion), and after each treatment she was found free from insects and eggs at inspection before coming back to school. Also the current episode has occurred a few days after returning to school, with the usual signs and symptoms (live insects, eggs and itching). The paediatrician detects the presence of only 1 live insect and some eggs attached to the hair base, behind the ears and the neck, with reddened and peeled-off scalp. Lisa usually complains about burning and itching after	Is treatment with physical/chemical agents a valid alternative to conventionally used insecticides (permethrin, malathion, pyrethrins) in children with recurrent head lice?	PMID: 16085658; 15951310; 12389342;11822849

	applying head lice products. Her mother is worried about possible toxicity of these compounds and asks for a less irritating but equally effective treatment.		
10	Eileen, a 3-year-old girl, comes to the ambulatory centre for a probable urinary tract infection (UTI), with fever and urination pain. The urinary stick analysis shows white blood cells, nitrites and blood. The paediatrician decides to start a 7-10 day oral antibiotic therapy immediately after urine collection for microscopy and culture. As Eileen recently underwent antibiotic therapy, her parents ask if a shorter course (2-4 days) can have the same efficacy.	Is short course antibiotic therapy (2-4 day) as effective as long course (7-14 day) in children with UTI?	PMID: 16854569; 12535494; 12138060; 11986476; 12603890
11	Julia, a 1-month-old infant, for a few days has been presenting with inconsolable crying of variable duration, with leg retraction toward the abdomen as if suffering from abdominal pain. She is breast-milk-fed and her growth is regular; no pathological findings are observed. Her mother reports having tried fennel infusion, that the child doesn't seem to like. A friend, who had the same problem with his son, has suggested some drops of simeticone. Julia's mother asks for advice.	Is simeticone effective in significantly reducing colic in infants with gas in the abdomen?	PMID: 8008333; 3890465; 9596593; 10543581
12	Luke is a 6-year-old boy allergic to dust mites and cat dander. He has been suffering from allergic asthma for about 1 and a half years, with periodic exacerbations treated with beta-2 agonists and inhaled corticosteroids. Due to recent increase in asthma episodes, his mother asks the paediatrician if it is possible to administer a drug in order to prevent the attacks. The paediatrician prescribes montelukast (one 5-mg tablet in the evening for 2 months), trying to reassure her.	Is a leukotriene receptor antagonist therapy such as montelukast effective in reducing attack recurrence in a child with recurrent allergic asthma?	PMID: 15106175; 16061590; 16387583; 14980192; 12877449; 12775136; 12704354; 12089089; 11485708; 11422148; 10922144; 9555757; 12630509; 12649233; 16157732