



## ***Issues and problems for librarians' conducting research - an example of a randomised controlled trial comparing the effect of e-learning, with a taught workshop, on the knowledge and search skills of health professionals***

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### **Background**

Searching for evidence is an essential skill for any health professional wishing to apply evidence to practice. Training health professionals to search databases is thought to improve their skills and knowledge, but evidence of this in the literature is not extensive. A systematic review in early 2003 found that there is some evidence of a positive impact of search skills training for health professionals<sup>1</sup>; however, the studies included were small or methodologically poor. A randomised trial published in late 2003 found that a 3 hour educational workshop was more effective than no training in improving question formulation and use of databases by doctors<sup>2</sup>.

Health librarians regularly teach directional search workshops, but do not know whether these social cognitive learning methods are more effective than other educational methods. Self-directed online, or e-learning, is becoming more widespread, but there is little evidence to show whether this is an effective training method. In 2005, a qualitative study looking at a randomised trial comparing directed learning and self-directed learning, found no statistically significant differences between the two groups in terms of evidence-based knowledge, skills, and attitudes of medical students<sup>3</sup>.

As the literature on this subject is not extensive, the author decided to design and conduct a research study. A research proposal was developed and a grant awarded by the Research in the Workplace Award (<http://www.ifmh.org.uk/RIWA2003-4.html>)

This paper presents the methods and results of a randomised controlled trial comparing two different educational interventions for teaching search skills to health professionals, and outlines the experience of conducting the study from the perspective of a practicing librarian with a limited research background.

### **Objectives**

The aim of the trial was to establish whether there is a significant difference in terms of knowledge and skills, between self-directed learning using a web-based resource directed by participants, compared with a classroom based interactive workshop directed by a librarian, for teaching health professionals how to search.

The two hypotheses are:

i) *there will be no difference in terms of a health professionals' knowledge of databases and study designs, and the skills of formulating a question, designing a search strategy and selecting appropriate citations, before and after an educational intervention*

ii) *there will be no difference between those health professionals receiving an online learning intervention using a web-based resource, and those receiving a classroom based workshop intervention, in terms of knowledge of databases and study designs, and the skills of formulating a question, designing a search strategy and selecting appropriate citations*

Testing these hypotheses involves a comparison of the effectiveness of two different interventions, so a randomised controlled trial (RCT) was chosen as the most appropriate study design.

### **Ethical and management approval**

As this was an educational trial recruiting only professionals, with no obvious risks associated, ethical approval was expected to be easy to obtain. However, due to changes in the ethical application process in the UK, all applicants were required to complete a 68 page COREC form, containing three sections (<http://www.corec.org.uk/>), and supply other documentation which were not readily available, such as a peer review of the proposal. In addition to the length of the form, some sections seemed irrelevant or were difficult to complete, and help had to be sought from more experienced research colleagues. The form did not differentiate between a multi-million pound drug trial involving patients and a team of investigators, and a small educational trial involving only professionals with one researcher. As well as ethical approval, management approval from the hospital Trust was required, which involved completion of additional forms and letters. Obtaining ethical approval took nearly 4 months in total, and delayed recruitment for the trial.

Articles published in the British Medical Journal (BMJ) suggest this is not an isolated experience<sup>4-8</sup>; clinical researchers have reported that the ethical committee application procedure can impede, delay or distort their research, or prevent them from starting altogether. One editorial from a Director for Public Health states:

*"...bureaucratic barriers, such as the length and complexity of the COREC forms and the dual hoops of research ethics and governance, are putting off those considering starting smaller locally based studies."*<sup>7</sup>

### **Methods**

The study population was a convenience sample – health professionals working for the Oxfordshire Radcliffe Hospitals NHS Trust (ORHT). Recruitment was by invitation letter, sent by post to departments and/or by email. Contact details were obtained from the Trust intranet; however, these intranet pages were considerably out of date. The most recent paper directory of staff available was also over 3 years old. Posters and leaflets about the trial were displayed in the hospital library. Inclusion criteria were very broad – participants must work within the ORHT, and have access to the Internet either at work or home.

## **Recruitment**

One reason why a large number of studies comparing the effectiveness of search skills interventions for healthcare professionals are not available, may be the fact that clinical staff are particularly difficult to recruit. Issues such as the difficulty of obtaining up-to-date contact lists for staff, plus the perceived importance of the outcomes by the health professional can affect the recruitment<sup>9-11</sup>. Consequently, the group of people of particular interest to health librarians is actually one of the most difficult to study. Unfortunately this proved to be the case for this study - recruitment numbers were very low. Only 17 participants registered and were deemed eligible for inclusion. The reasons for low recruitment in this trial were specifically:

- many staff names and contact details were incorrect, out-of-date or unavailable
- email addresses of Trust staff were not readily available
- clinical staff reported that they found it difficult to obtain permission to attend non-mandatory training
- some staff did not have the time or interest to participate in a trial
- the ethical approval process reduced time available to recruit participants
- training rooms were not always available on the hospital sites

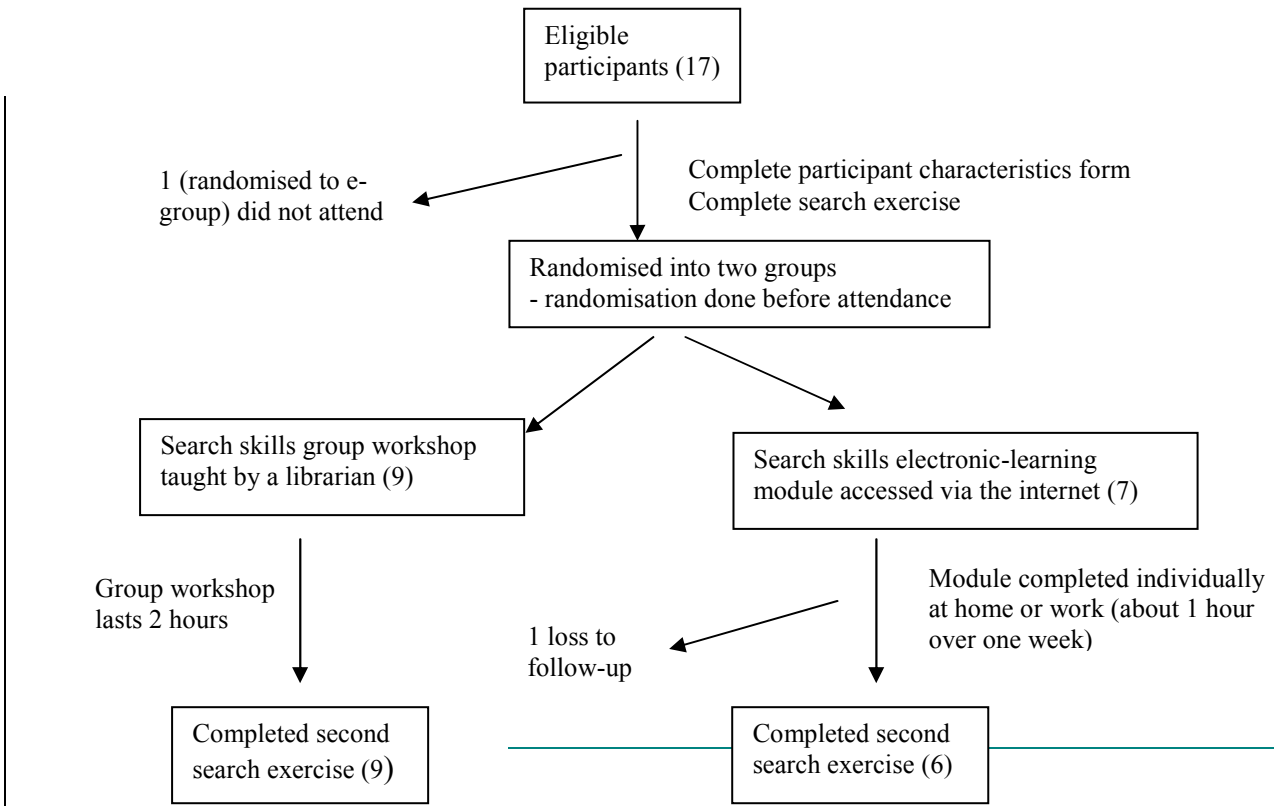
It is significant that learning how to search and use good quality health information, in order to assist and improve patient care, is not considered mandatory! When time has been spent developing the methodology for a trial, it is extremely frustrating to have so few participants. Published studies with small sample sizes can be easily criticised due to their lack of statistical power, but the reasons why recruitment is so difficult became apparent during this trial.

## **The trial**

On arrival all participants completed a "search exercise" using a computer. The search exercise had two sections – the first contained multiple choice questions about databases and study designs (MCQs). The second section involved a practical search using PubMed ([www.pubmed.com](http://www.pubmed.com)) to structure a search on a given scenario. An example of the search exercise is contained in Appendix 1.

Participants were randomly assigned to one of two groups, using computer generated random numbers. Those participants allocated to the workshop group (WG) then attended a 2 hour search skills workshop taught by a librarian. Those participants allocated to the e-learning group (EG) were shown how to access and use the online learning module, and asked to complete as much of the module as they could, in one week. One week later, participants were sent (via post and/or email) the second "search exercise" containing a different scenario, and asked to complete and return. In order to minimise the possibility that one scenario was easier to search for than the other, the order in which participants completed the search exercises was assigned randomly, again by computer generated random numbers.

Flow chart showing trial stages and numbers of participants



### Interventions in more detail

The online learning resource was designed by the author. It was made available on the web, but was password protected so that only EG participants could access it. The content included question formulation, study design, free text, thesaurus and Boolean searching, and examples of searching PubMed and the Cochrane Library. One problem encountered while designing this module was that search databases are in a

Introduction and Objectives (3 pages)

ASKING QUESTIONS

- Formulating a question
- The 4-part question (4 pages)
- Types of question (5 pages)
- Types of study (2 pages)
- Quiz (5 questions)
- Summary

FINDING EVIDENCE

- Principles of searching (14 pages)
- Quiz (3 questions)
- PubMed (26 pages)
- Cochrane Library (11 pages)
- Summary

Welcome to our Finding the Evidence trial - you have been randomised to receive the online learning module

This online module has been designed as part of a randomised controlled trial, to test how effective different learning styles are at teaching health professionals to search the medical literature. For more information about this Trial, please click on the menu item above "About the Trial".

The module has been based partly on the [Critical Appraisal Skills Programme \(CASP\)](#) elearning module, which will be freely available on the Internet after completion of the Trial period. For information about CASP, please visit their website.

To return to this Welcome page at any time, click on the CASP arrows, which you will find at the top left of each page.

For help on using the module and navigating around the pages, click on "How to use the module" in the menu above.

We estimate that it will take about 1 hour to complete the whole module. We appreciate your cooperation in completing this module, and hope that you will find it useful.

[Start the module](#)

a constant state of flux - both PubMed and the Cochrane Library were updated/changed just as the module was nearing completion; this resulted in the learning resource having to be re-written in places.

Before the trial, the online learning module was piloted on a general practitioner and a nurse. They were asked to comment on the usability, the time taken to complete the module, and the content covered. These suggestions were then incorporated into the module ready for use in the trial.

The WG was taught by an experienced librarian, who used methods such as presentations, live internet demonstrations and interactive group work. The workshop was carefully planned by the librarian and author to deliver content on exactly the same topics covered by the online learning resource. Teaching examples were also the same as those contained in the online learning module. Participants were able to practice their own searching during the session, with help and advice from the librarian.

## Results

*Table 1: baseline participant characteristics*

		WG (n=9)	EG (n=6)
<b>Gender:</b>	Female	6	4
	Male	3	2
<b>Age (years):</b>	21 - 30	0	4
	31 - 40	1	2
	41 - 50	6	0
	51 - 60	2	0
<b>Job:</b>	Doctor	3	3
	Nurse	4	2
	Allied Health	0	1
	Manager	2	0
<b>Attended previous search session?</b>	Yes in last 3 months	1	1
	Yes > 1 year ago	2	1
	No	6	4

## Marking of the search exercises

The author was 'blind' as to which search exercises had been completed by a particular person or to which group they had been allocated. Also, there was deliberately no indication on the search exercises as to which had been completed before or after the interventions. This reduced any inadvertent bias when marking the exercises. Scenarios and score charts for testing search skills are available<sup>12-16</sup>, but no one tool appeared to fit the study requirements exactly. The author collaborated with two other librarians to develop a 'gold standard' for formulating a question from a scenario, developing a search strategy and selecting appropriate citations. This information was used in conjunction with the tools in the literature to develop a score chart (see Appendix 2); the exercises were graded in each of the categories above according to a scale Excellent, Good, Fair, Poor. Each exercise received a grading for question formulation, search strategy

and citation selection, plus a mark for the number of correct MCQs (see Tables below). A random selection of the search exercises were marked by another librarian in order to validate the marking; no differences in scores were observed.

### **Statistical analysis**

Analysis was carried out using a statistical software package. The Mann-Whitney test (a nonparametric method testing the significance of the difference between the distributions of two independent samples) showed there were no significant differences in any of the outcomes ( $p > 0.05$ ), between the WG and the EG. Thus, the null hypothesis ii) is accepted, although due to the small numbers of participants in this trial, the statistical analyses have limited value.

To test hypothesis i), the Wilcoxon Signed-Ranks test (a nonparametric test for the significance of the difference between the distributions of two non-independent samples involving matched pairs), was used. However, if the number of signed ranks ( $n_s/r$ ) is less than 5, there are no possible values of  $W$  that would be significant. The paired t-test could be used for the multiple choice questions, as the data consisted of interval variables. However, due to the small sample number, statistical analysis was not possible for most of the EG results.

For devising a search strategy, the WG performed significantly better ( $p = 0.01$ ) after receiving the librarian-taught workshop. This group also preferred to search using MeSH after receiving the workshop ( $p = 0.02$ ). There was no significant difference in citation selection or knowledge of databases and study designs before and after receiving either intervention. The null hypothesis i) is therefore accepted, except for the outcome of devising a search strategy, where the WG performed significantly better after the intervention. Again, these statistical analyses only have limited value owing to the small sample size.

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Table 2: question formulation (Excellent = 4 Good = 3 Fair = 2 Poor = 1)

Workshop Wilcoxon test ns/r <5

E-group Wilcoxon test ns/r <5

Participant No.	Before	After	Difference	Participant No.	Before	After	Difference
001	3	3	0	003	4	4	0
002	3	3	0	004	3	4	1
005	4	4	0	006	3	4	1
007	3	4	1	010	4	4	0
008	2	3	1	014	3	4	1
009	4	4	0	015	3	4	1
011	3	4	1				
012	4	4	0				
013	4	4	0				

Mann-Whitney test z = -1, p = 0.32

Table 3: search strategy (Excellent = 4 Good = 3 Fair = 2 Poor = 1)

Workshop Wilcoxon test W= -36, ns/r = 8, p=0.01

E-group Wilcoxon test ns/r <5

Participant No.	Before	After	Difference	Participant No.	Before	After	Difference
001	2	3	1	003	2	3	1
002	1	3	2	004	2	4	2
005	2	2	0	006	2	2	0
007	1	3	2	010	2	2	0
008	2	3	1	014	2	2	0
009	1	2	1	015	2	2	0
011	1	3	2				
012	1	2	1				
013	2	4	2				

Mann-Whitney test z = 1.71, p = 0.09

Table 4: citation selection (Excellent = 4 Good = 3 Fair = 2 Poor = 1)

Workshop Wilcoxon test W= -11, ns/r = 5, p>0.05

E-group Wilcoxon test W= -8, ns/r = 5, p>0.05

Participant No.	Before	After	Difference	Participant No.	Before	After	Difference
001	3	4	1	003	3	4	1
002	2	2	0	004	1	3	2
005	3	3	0	006	4	4	0
007	3	4	1	010	4	2	-2
008	3	3	0	014	1	4	3
009	3	3	0	015	1	2	1
011	1	4	3				
012	1	4	3				
013	4	3	-1				

Mann-Whitney test z = -0.29, p = 0.77

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Table 5: multiple choice correct answers (maximum 6)

Workshop Paired t-test  $t = 2.29$ ,  $df = 8$ ,  $p = 0.05$

E-group Paired t-test  $t = -2.08$ ,  $df = 5$ ,  $p = 0.09$

Participant No.	Mark Before	Mark After	Difference	Participant No.	Mark Before	Mark After	Difference
001	2	2	0	003	1	4	3
002	3	1	-2	004	3	3	0
005	2	3	1	006	1	2	1
007	2	3	1	010	1	5	4
008	1	3	2	014	0	3	3
009	2	4	2	015	2	1	-1
011	0	3	3				
012	0	2	2				
013	4	5	1				

T-test for independent samples  $t = -0.06$ ,  $df = 13$ ,  $p = 0.95$

Table 6: did the participant use appropriate study design limits? (Yes or No)

Workshop

E-group

Participant No.	Study limits before?	Study limits after?	Participant No.	Study limits before?	Study limits after?
001	No	No	003	No	No
002	No	No	004	Yes	Yes
005	No	No	006	No	Yes
007	No	Yes	010	No	No
008	Yes	Yes	014	No	No
009	No	No	015	No	Yes
011	No	Yes			
012	No	Yes			
013	Yes	Yes			

Table 7: searching preference - when I search Medline, I prefer to use MeSH (thesaurus) rather than keywords (Yes = 3 Neutral = 2 No = 1)

Workshop Wilcoxon test  $W = -28$ ,  $ns/r = 7$ ,  $p = 0.02$

E-group Wilcoxon test  $ns/r < 5$

Participant No	prefer MeSH (before)	prefer MeSH (after)	Difference	Participant No	prefer MeSH (before)	prefer MeSH (after)	Difference
001	2	3	1	003	2	1	-1
002	1	3	2	004	2	3	1
005	1	3	2	006	3	3	0
007	1	3	2	010	1	3	2
008	1	3	2	014	1	3	2
009	1	2	1	015	1	1	0
011	2	2	0				
012	2	3	1				
013	3	3	0				

Mann-Whitney test  $z = 0.82$ ,  $p = 0.41$

## Discussion

This paper has presented the methods and results of a randomised trial seeking to compare two interventions for teaching search skills to health professionals, and has outlined the issues and problems encountered by a novice researcher. The question of whether a taught workshop and an e-learning module are of equal effectiveness in teaching search skills, is an important one for health librarians involved in user education, and was a justifiable topic to propose and conduct research. The fact that the results are mainly inconclusive due to the small sample size is disappointing, but does not diminish the importance of conducting the study.

This study has suggested a number of important issues to consider when planning research:

- conduct a thorough literature search; your question may already have been answered
- read books on research methods to try and get an overview of the subject
- apply for ethical and management approval as soon as the study is initiated, and try to obtain help in completing it; this will reduce delays in the process, but some frustration is inevitable
- the population that practitioners' would like to study are often the most difficult to engage or recruit; this does not mean they should be ignored
- recruitment of staff, especially clinical staff, will always be difficult, but start the recruitment process early, use different contact methods and make the inclusion criteria as wide as possible
- collaborate with other librarians or researchers where possible; conducting a research study individually while also maintaining a full-time job is very time consuming
- don't feel inadequate when things go wrong; often you have no control over them
- don't give up; without research into the issues that matter, evidence-based librarianship would not be possible

By discussing the main issues and problems experienced during this study, it is hoped other practitioners' intending to undertake research will have a clearer picture of the processes involved, be able to learn from any mistakes made in this study, and have a realistic idea of the problems that may be encountered, some of which may be insoluble. Additionally, it is hoped other researchers' will build on the methodology used in this study to conduct further research into the effectiveness of interventions for teaching search skills to health professionals.

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## Appendix 1: Search exercise (osteoporosis search)

### Multiple choice questions (5 mins)

1. The most appropriate study type to answer a question about harm is a cohort study  
Yes    No    Don't know
2. The most appropriate study type to answer a question about diagnosis is a randomised controlled trial.  
Yes    No    Don't know
3. When I search Medline, I prefer to use MeSH (thesaurus) rather than keywords.  
Yes    No    Don't know
4. The Cochrane Library is freely available online to everyone in the UK  
Yes    No    Don't know
5. All UK users can obtain the full text of Cochrane Reviews for free  
Yes    No    Don't know
6. The Cochrane Library uses a different thesaurus from Medline  
Yes    No    Don't know
7. The Cochrane Library contains all the good quality randomised controlled trials in Medline  
Yes    No    Don't know

### Practical searching (15 mins)

*A 65 years old post-menopausal lady with osteoporosis has been referred to you. She is currently taking Alendronate for her osteoporosis, but has had some gastrointestinal side effects and is not keen to carry on taking this drug. You consider giving her Raloxifene instead, but don't know whether this will help to prevent fractures.*

8. Write this scenario in the form of a question: .....

9. Use Medline (PubMed) to structure a search on the above problem\*. From the references you find, print out two that you think are of an appropriate study design and are relevant to the question. Print out your search strategy also (in PubMed, your search strategy can be found by clicking on the History tab).

**Thank you! Please remember to hand-in your completed exercise and print outs.**

*\* Note: if you have no searching experience or have not used PubMed before, please still have a go at structuring this search, and print out whatever you manage to do.*

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## Appendix 2: score chart

Participant number/letter:

Exercise question (diabetes or osteoporosis):

*Three main concepts - the patient (postmenopausal women with osteoporosis), the intervention (Raloxifene) and the outcome (fractures).*

8. Question formulation	Comments
<b>Excellent</b> – all relevant concepts included	
<b>Good</b> – at least two of the relevant concepts	
<b>Fair</b> – at least one relevant concept	
<b>Poor</b> – no concepts included or no attempt to formulate a question	

### “Gold standard” search

- #17 Search #16 Limits: Randomized Controlled Trial (also Limits: Meta-Analysis or Review)
- #16 Search #8 AND #11 AND #14 Limits: Aged: 65+ years, English, Female, Humans
- #15 Search #8 AND #11 AND #14
- #14 Search #12 OR #13
- #13 Search "Fractures"[MeSH]
- #12 Search fracture\*
- #11 Search #9 OR #10
- #10 Search "Raloxifene"[MeSH]
- #9 Search raloxifene
- #8 Search #6 OR #7
- #7 Search "Osteoporosis, Postmenopausal"[MeSH]
- #6 Search #4 AND #5
- #5 Search osteoporos\*
- #4 Search #1 OR #2 OR #3
- #3 Search postmenopaus\*
- #2 Search post-menopaus\*
- #1 Search post menopaus\*

Limits e.g. Publication Type of Randomized Controlled Trial, Review, Meta-Analysis, or free text terms such as *random\** or *randomised controlled trial* may be used.

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9. Practical searching	Comments
<p><b>Excellent</b>                      Appropriate free text and MeSH for each concept, similar concepts combined with OR, different concepts combined with AND</p>	
<p><b>Good</b>                      Must include at least one search term for each concept – at least one MeSH must be included somewhere in the search, different concepts combined with AND</p>	
<p><b>Fair</b>                      Must include at least two of the concepts in the search, either text or MeSH.                      Different concepts combined with AND</p>	
<p><b>Poor</b>                      Searches that do not reach the minimum requirements of Fair, will be classified as poor</p>	

**Was the search limited to an appropriate study design? Yes/No**

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From the citations that the three librarians selected as being of an appropriate study design (i.e. an RCT, systematic review or meta-analysis of trials) and relevant to the question, a list of 18 citations was compiled.

Citation selection	Comments
<b>Excellent</b> – both citations selected appear on “ideal” list	
<b>Good</b> – one citation appeared on ideal list	
<b>Fair</b> – neither citation appeared on list, but both citations deemed relevant to question (i.e. citations were subject specific, but not of an appropriate good quality study design)	
<b>Poor</b> – citations that fail to reach the minimum requirements of Fair will be classified as Poor	

### Summary

Three scores given plus study design limits:

Question formulation:

Practical search:

Citation selection:

Study design limits?: