Health Information and Libraries Journal

DOI: 10.1111/j.1471-1842.2011.00933.x

Evidence-based information-seeking skills of junior doctors entering the workforce: an evaluation of the impact of information literacy training during pre-clinical years

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Abstract

Objectives: To investigate the extent to which junior doctors in their first clinical positions retained information literacy skills taught as part of their undergraduate education.

Method: Participants drawn from different training cohorts were interviewed about their recall of the instruction they had received, and their confidence in retrieving and evaluating information for clinical decision making. They completed a search based on a scenario related to their speciality. Their self-assessment of their competency in conducting and evaluating a search was compared with an evaluation of their skills by an experienced observer.

Results: Most participants recalled the training they received but had not retained high-level search skills, and lacked skills in identifying and applying best evidence. There was no apparent link between the type of training given and subsequent skill level. Those whose postgraduate education required these skills were more successful in retrieving and appraising information.

Conclusion: Commitment to evidence-based medicine from clinicians at all levels in the profession is needed to increase the information seeking skills of clinicians entering the work force.

Keywords: doctors, education and training, evidence-based practice, literacy, information, research, qualitative.

Key Messages

Implications for Practice

- Ability to formulate a clinical question, search for best evidence, critically appraise and apply evidence remains an essential skill for clinicians.
- In this study, junior doctors did not appear to have retained skills in searching and appraising the literature taught in their undergraduate education.
- Confidence of junior doctors in their ability to search and evaluate evidence-based resources is not reflected in evaluations of their search skills.
- Those whose specialist training included further information literacy training had higher level skills.

Implications for Policy

- Skills need to be introduced and reinforced in both undergraduate and clinical training years.
- The attitude of senior clinicians is paramount in influencing junior clinicians to develop and apply these skills.

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Introduction

The ability to formulate a clinical question, search for best evidence, critically appraise and apply evidence is an essential skill for clinicians delivering evidence-based healthcare. In 1997, the Wellington Medical Library initiated a programme of instruction in MEDLINE searching and critical appraisal given to fourth year undergraduate medical students. These students have since graduated and are completing their final years as house surgeons/senior house officers and registrars of between 3 and 8 years of advanced training in a variety of speciality areas. In subsequent years, further cohorts of medical students received similar training from library staff, with components being added to the training by both academic and library staff. As they move into roles as junior doctors, entering specialist training and general practice, a number of research questions arise:

1. What are the information retrieval and appraisal skills of these junior doctors when answering queries that arise during their clinical practice?
2. What level of skills do they retain from training given during their undergraduate years?
3. Has the training they received had an impact on their current ability to search, retrieve and evaluate information relevant to their clinical practice?

The training intervention was first reported at the Eighth International Conference of Medical Librarians (ICML8) in London in 2000. This report outlined the first phase of this longitudinal study examining the efficacy of a programme designed to teach medical students MEDLINE information retrieval skills.[1] The present work reports the follow up of the students over a longer period of time through a qualitative study that investigates whether the skills and knowledge gained during the intervention continue into clinical practice.

The need for training in searching and evaluating information

Throughout the 1990s, it was not uncommon to find clinicians uninterested or even hostile to evidence-based medicine (EBM).[2] The 21st century has seen a broader acceptance of EBM, defined as 'the integration of best research evidence with clinical expertise and patient values'.[3] EBM skills need to be developed as a routine part of medical training. Although information resources for clinical decision making have proliferated, the primary resource for evidence-based clinical decision making remains MEDLINE. As Holtum notes, the ability to source relevant, reliable and current information from MEDLINE, in addition to the numerous other resources supporting clinical decision making, requires greater practice and skill, not less.[4] Haynes and Wilczynski[5] note that although MEDLINE is now very accessible online through PubMed, very few clinicians are able to search it well. Recent research from the Health Informatics Research Unit at McMaster University shows that family physicians asked to search for information to resolve a clinical problem, and provided with access to appropriate resources, are only able to find correct information about 40% of the time.[6]

Optimal ways of delivering training

Research suggests that medical students learn the skills of information retrieval and critical appraisal better when they use them frequently. Burrows *et al.* reported that an integrated approach to learning EBM skills involving library and academic staff is more effective in developing students' skills.[7] Brown and Nelson show that student enthusiasm is increased when the teaching process is integrated within the curriculum with support of faculty and library staff.[8] For this successful integration, Tuttle argues[9] that in their assessments students should be expected to find relevant articles and produce evidence for decisions or actions they propose. However, Dorsch *et al.* reported that medical residents rated their searching skills, and their ability to apply evidence-based research to practice higher than did their programme directors. They comment on the difficulty of fitting EBM training into the medical curriculum, and note the importance of senior clinicians modelling EBM practice alongside more formal training sessions.[10]

Anecdotal evidence suggests that medical students seldom search the literature to answer clinical questions until their more advanced clinical training years. However, as Rosenberg *et al.*[11] report, when training is provided at this point,

students comment that they wished MEDLINE training had been delivered during their pre-clinical years. Many medical school curricula now include library staff delivering MEDLINE sessions as part of an EBM course during the third and fourth years of training.[12] Holloway[13] outlines problems encountered assessing students' skills levels in MEDLINE in EBM courses at Miami: 'the lack of test-retest reliability suggests it was difficult to distinguish between student skill levels' (p. 876). West and McDonald[14] also highlight the difficulty of creating assessment tasks that mirror the real-world environment.

As well as developing competence in searching and critical appraisal, students should develop competence in applying evidence-based information to patient care. Bergus[15] reports 'most of our medical students are able to critically appraise research articles about diagnostic testing but few are able to apply this information at the patient level' (p. 4). Like Holloway, Bergus identifies negative student reactions to information literacy and EBM instruction.

Finally, the information literacy literature suggests that training is most effective when conducted as part of an assessed programme integrated into other learning programmes. Although previous research suggested that stand-alone sessions have little impact,[16] the Rosenberg study[13] suggested that a stand-alone training session on formulating questions and searching databases could improve students' searching performance and the quality of evidence retrieved (p. 557). Other studies show that training medical students to search MEDLINE has a positive impact on their ability to locate relevant literature for clinical decision making.[17,18] Whether as a formal part of their curriculum or a single training session, it can have a significantly positive effect on students' short-term EBM literature searching outcomes, although this has not been tested over time.[18]

Objectives of the current study

The objectives of the current study were to investigate whether information literacy training by librarians, ranging from basic MEDLINE searching, to advanced EBM instruction during the first clinical year of training would enhance searching skills, support evidence-based practice and facilitate lifelong learning.

The context. In New Zealand, medicine is taught as an undergraduate programme at the University of Otago and the University of Auckland. The participants in this study were University of Otago students entering their fourth year of training (first clinical year) between 1994 and 2004. These students were all based at the Wellington Medical School of the University of Otago, with which the Wellington Medical Library is associated.

From 1997 onwards, fourth year medical students at the Wellington Medical School were provided with instruction in searching, retrieving and evaluating information for clinical decision making. They were tested on the basic skills of:

- Selecting a database,
- Use of subject headings,
  - Term mapping,
  - Alternative terms, and
  - Use of subheadings
- Use of limits and system features, and
- Critical evaluation of the search process, refining the search and evaluating the results retrieved.

The library staff, in consultation with academic staff, continually evaluated and developed this Information Literacy programme over the years.

The cohorts. There are five cohorts of students in the study, each of which received different levels of training. Cohort 1, the control group of fourth year students from 1995 to 1996 received no formal training in searching as part of their undergraduate programme (Table 1).

The training was a collaboration between library and academic staff, the searching component being taught by library staff and the critical appraisal component primarily by academic staff. Assessments were made jointly between library and academic staff.

Method

During 2008 and 2009, the research team made contact with as many cohort graduates as possible. Those contacted were invited to participate in the study as part of their ongoing information literacy skills development. Participants were given an

Table 1 Training received by each cohort

Cohorts	Introductory tutorial on searching MEDLINE (one off hands-on). Tested but not graded	Self-paced MEDLINE module (compulsory, assessed, online)	Advanced EBM MEDLINE module in EBM course (compulsory, assessed 1.5-hour hands-on tutorial)
1 (1995–1996)	x	x	x
2 (1997–1998)	√	√	x
3 (1999)	√	√	x
4 (2000)	√	√	√
5 (2001–2004)	x	√	√

EBM, evidence-based medicine

information sheet detailing the purpose and confidential nature of the study, and signed a consent form, approved by the Victoria University of Wellington Human Ethics Committee. A total of 38 participants were recruited, representing cohorts 1–5.

Structured interviews and observations were conducted by one of two medical librarians. Participants were asked a series of initial questions (Q1–6) about what they recalled of the literature searching instruction they had attended in their early clinical training; what techniques they used when searching for information for clinical decision making; which databases they normally used when searching for this information; what techniques they used to evaluate this information; if they had attended any continuing medical education (CME) or other sessions since graduating in which they developed their searching or evaluation skills (including informal exchanges with peers).

Questions 7–9 focused on the participant's searching, retrieval and critical appraisal skills. Question 7 asked them to describe a recent instance when they had sought information for patient care. Question 8 asked them to rate their skill level (none, some skills, highly skilled) on the following seven tasks: selecting a source to search; identifying appropriate search terms; combining terms using Boolean operators; using 'limits' appropriately; using 'explode' and 'focus' appropriately; critical appraisal of articles in relation to context.

In question 9, participants were asked to conduct an independent search under observation, based on one of four scenarios. All had access to standard resources such as OVID MEDLINE, PubMed, the usual resources available on their local intranets, and Internet access. The observer noted the participants' choices and strategies and rated the same seven tasks using the same criteria, 'No skills', 'Some skills', or 'Highly Skilled'. Once the search was completed, the adequacy of sources retrieved and selected was noted, and strategies that would have been more effective were discussed with participants.

Findings

Initial questions. These questions focused on what participants recalled from their training sessions, what search techniques and databases they currently use, and how they evaluate information found. Responses to these questions were analysed within the five cohorts in the study, and the data is presented in Tables 2–6.

The majority reported reasonable recall of the sessions, but their current strategies indicated that they had broadened their search strategies beyond those formally taught. Few had returned to medical library staff for assistance since that time (see Table 3).

Participants used a range of information sources, often labelling as databases sources (such as Google) that information professionals would not necessarily call 'databases'. Discussion revealed general uncertainty about what constituted a database, but those so-named have been included so as to give an accurate picture of sources used. Responses from the control group (cohort 1) and cohort 4 have been further analysed (see Table 4)

Evaluating information. The focus of the training received by cohorts 2 and 3 was on selecting the

Table 2 Extent to which participants in each cohort recall IL instruction given in their first clinical year of training

Cohort	Years	Number	Do not remember	Vaguely remember	Remember
1	1995–1996	5	1	4	0
2	1997–1998	8	1	0	7
3	1999	5	0	2	3
4	2000	5	0	2	3
5	2001–2004	15	0	2	13
Total		38	2	10	26

IL, information literacy.

Table 3 Strategies employed by participants when searching for information (participants could select more than one)

Cohort	Number in cohort	Ask a librarian	Search Google	Search Journals	Use broader strategy	Go to known website
1	5	1	3	1	5	3
2	8	0	6	1	7	3
3	5	1	2	1	5	0
4	5	0	4	4	3	3
5	15	0	5	2	15	10
Total	38	2	20	9	35	19

Table 4 Databases used by participants

Database	Number of all participants who report using	Number of cohort 1 using	Number of cohort 4 using
Cochrane	14	4/5	3/5
Google	11	3/5	1/5
PubMed/ MEDLINE incl OVID	26	4/5	4/5
Other*	11	3/5	1/5

*across all participants, includes UpToDate, NICE, various Guidelines, BPac, Clin-e-Guide, EMBASE, Ballière's, e-journal websites.

appropriate database, and the structure and mechanics of searching. By cohort 4 the emphasis had shifted to the principles of critical appraisal, based on criteria such as sample size, methodology, and elimination of bias. Table 5 identifies ways in which participants evaluated items retrieved from their searches. Evaluation based on what is presented within the article II (i.e. applying the principles of critical appraisal) is defined as *intrinsic*, and that based on factors such as publisher, journal reputation, authoritative web site etc. is defined as *extrinsic*.[19]

Responses categorised as 'other' include: 'check against other sources to see if the reference makes sense', 'discuss with a colleague', 'colleague's learned opinion', 'check on the Internet'. Evidence-based resources such as the Cochrane databases, Clin-e-Guide, UpToDate and BPac, (an independent organisation sponsored by New Zealand government agencies) were also cited under 'other' as being known to be reliable. Despite the inclusion of critical appraisal techniques in the training of cohorts 4 and 5, these respondents still relied on external assurances of the quality of the evidence (extrinsic factors).

Participants were also asked about attendance at CME courses, or other forms of instruction, involving information literacy training. The majority of respondents in cohorts 1 and 2 reported some relevant instruction since graduating; this was less common in later cohorts. The instruction often formed part of an advanced qualification, conferences, journal clubs, or voluntary attendance at a library session, rather than formal CME.

Table 5 Criteria used for evaluating sources retrieved

Cohorts	Number in cohort	Extrinsic	Intrinsic	Currency	Relevance	Other
1	5	4	4	1	1	0
2	8	7	5	3	6	4
3	5	3	3	2	2	2
4	5	4	2	0	3	2
5	15	10	6	0	6	7
Total	**38**	28	20	6	18	15

Table 6 Comparison of self-assessment scores and observer scores

Cohorts	Number in cohort	Sum of average of indiv. scores across all skills in self-assessment	Sum of average of indiv. scores across all skills in observer assessment
1	5	7.67	6
2	8	8.4	7.4
3	5	6.2	5
4	5	7.2	5.6
5	15	8.13	5.53
Total	**38**		

(Cohorts 1 and 2 had possibly entered a career phase that encouraged further engagement in information literacy.) Participants were also asked how often they consulted a librarian when looking for information. Eleven of the 38 participants stated that they never consulted a librarian, the remaining 27 did so only 'occasionally' or 'rarely'. Reasons given were:

- no access to a medical library,
- family constraints on their time,
- felt that they should be self-sufficient and find their own information on the Internet or in textbooks.

Search skills evaluated

Participants' self-assessed scores on the seven skills (Q8) varied considerably. Skill levels were scored as 'No skills' = 0, 'Some skills' = 1, and 'Highly skilled' = 2, giving a possible range from 0 to 14. Individuals' total self-assessed scores ranged from 4 to 14, with an average of 7.79. Appendix 1, which averages scores for each competency in each cohort, shows that the competency *Able to search and find randomized controlled trials (RCTs) and systematic reviews* was the most highly rated (1.9 average), and *Able to use 'explode' and 'focus'* the lowest (0.68 average), one participant commenting they would not use strategies such as 'focus' as they 'did not want to miss anything'.

The assessment of skills in the observed searches resulted in lower scores. Scores ranged from 2 to 13, with an average of 6.09. Appendix 2 shows that the highest scoring skill was *Knowing which source to search* (average 1.42), and the lowest *Able to search and find RCTs and systematic reviews*, (0.33), followed by *Able to use 'explode' and 'focus'* (0.39). Differences between these two sets of scores are highlighted in Table 6, showing the average of the final score of all the individuals in each cohort, and compares self-assessed and observer scores.

A comparison of the scores of cohort 1, and the other cohorts suggest that training alone was not a key factor in later skills, and that other factors such as postgraduate training in information literacy may play a significant role in the development of information retrieval, evaluation and evidence-based practice skills in junior doctors.

Discussion

As Table 2 shows, the majority of students remembered the training they had received, recalling the session and sometimes the content. Some

remembered terms such as 'explode' and 'subject heading' but could not recall how to apply the technique. For their observed search, almost all participants chose Ovid MEDLINE, the interface they had been taught, rather than PubMed, which would have been the version available to them in their workplace. Many who had not used Ovid MEDLINE since graduating felt lost, as there had been significant changes to the database's interface.

It was clear from responses to Questions 2–5 that participants used a wide range of information sources, especially Google, and participants showed no awareness that Google may include some PubMed references among its top results. The cohort which had the most intensive evidence-based training (cohort 4) made less rather than greater use of evidence-based sources (Table 3). Nearly all hospital participants had workplace access to UptoDate and this was their preferred information source. Clin-e-guide was also considered a good starting point. Those training for family practice found synthesised products (e.g. BPac) their preferred starting point for evidence-based information for patient care.

Although Table 4 shows PubMed was used by twice as many respondents as any other source, in reality, this use was infrequent. Few of the participants were regularly searching the primary literature (via PubMed or OVID MEDLINE), and their skills had diminished, a finding consistent with Dorsch.[6] The ability to search MEDLINE for evidence-based information using 'Clinical Queries' was retained by few and only one had learnt it subsequently. However, they remained confident in their ability to retrieve evidence-based information, such as RCTs and systematic reviews, rating their skills higher (an average of 1.0 across all cohorts) compared with the markedly lower scores from the observer assessment (average 0.35; see Appendices).

The participant with the highest level search skills attributed this to their registrar training, focused on evidence-based practice, with weekly evidence-based presentations required. Another competent searcher had received further training in evidence-based practice through their postgraduate study. Search skills were greater in those who had nearly completed their specialist training, whereas more junior clinicians relied on synthesised sources, e.g. UpToDate. In general, the clinicians in this study were more confident in their abilities than their performance would merit (another finding endorsing Dorsch). They did not routinely search MEDLINE, and many were diffident about their ability to use it. Some expressed a level of guilt that they retained so little of the earlier instruction. This may be related to negative attitudes towards information literacy training identified by Holloway[16] and Bergus[18] and familiar to the staff involved in this study.

Most participants were able to identify a suitable database, and select appropriate search terms, though it is clear from other data, that in practice, they would choose easier search options than MEDLINE. A good proportion of participants were able to use OVID mapping to choose their terms, but fewer were able to use the MeSH screen, and few recalled the tree structures or sought further information about their terms. A few typed in whole phrases or sentences as in Google. Despite this being unsuccessful, they showed no awareness of why this had failed or how to improve their strategy. The power of the MeSH thesaurus was poorly understood, as was the more simple technique of typing a single search term at a time and combining the terms.

Evaluation and critical appraisal skills were not well developed. Few were able to refine their strategies, and most relied on extrinsic criteria when evaluating what they found; for many, currency mattered most. Despite this, nearly all felt confident in critically appraising articles, and applying findings to patient care. Applying information was not tested in our study, but if Dorsch[6] and Bergus[18] are correct, participants may well be overrating their skills. Observations made by trained searchers raised concerns that clinicians often identify and apply what they believe to be reliable and relevant information from a set of sources that does not truly represent the best evidence available. The resources found and applied to the scenario did not, in the views of the expert searchers, represent best evidence. However, confidence in their skills was such that none of the participants readily sought help from medical library staff and few sought any further training in evidence-based practice skills.

Conclusion

It is disappointing that the level of instruction received in undergraduate training has no clear correlation to the current skills of participants in this study, and that little of that training has been retained. Not all clinical questions can be immediately answered through packaged evidence-based resources, and our junior doctors, some of whom were going into family practice, did no better at finding evidence-based answers to real-life clinical queries than the family practitioners in McKibbon and Friedsma's McMaster study.[6] Clearly, developing skills essential to the practice of EBM needs to be given far greater priority in both medical training and by practising clinicians.

In this study, the detailed nature of the interviews/observations helped overcome shortcomings in other studies, identified by West,[15] Bergus[16] and others, related to the nature of the assessment task. The assessment was carefully designed to reflect real world scenarios, and clearly showed that instruction introduced during undergraduate training did not result in continued use of that knowledge to the extent that was hoped at the beginning of the study. Embedding training in the curriculum, and including it in course assessment does not appear to have overcome this problem, despite recommendations to this effect.[4] While the study's limitations (its small sample size, potential for sample bias and recall bias, and the difficulty inherent in comparing a general self-rating with observed scores) must be acknowledged, the study is a step towards a broader understanding of whether clinicians continue to use the skills they were introduced to as medical students, and which they need throughout their professional careers. Lack of any clear evidence in the data to show the impact of more intensive and course related training in information searching, retrieval and appraisal on current skill levels suggests that acquiring these skills is a more complex matter than simple interventions during undergraduate training. Choice of specialist field, further training within specialist courses, and the influence of supervisors and instructors may have more impact on the skill levels of junior doctors than early course-based training itself. The impact of senior clinicians reinforcing the importance of EBM training, shown in the results of those whose advanced study programmes required them to search for evidence-based resources, highlights the need for the commitment of senior clinicians to the application of evidence-based sources of knowledge to clinical practice.

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Received *26 August 2010*; Accepted *17 February 2011*

Appendix 1

Average scores of participants in each cohort, based on self-rating

(0 = no skills; 1 = some skills; 2 = highly skilled)

Cohort (number)	Knowing which source to search	Able to identify appropriate search terms	Able to combine terms using Boolean operators	Able to limit search using publication type, date, age, categories etc.	Able to search and find RCTs and systematic reviews (using clinical queries, or alternative)	Able to use 'explode' and 'focus' appropriately	Able to critically appraise articles on basis of patient group, intervention, comparison of outcomes, relevance of findings etc.	Average for each cohort
1 (5)	1.20	1.20	1.20	1.20	1.00	.60	1.20	1.09
2 (8)	1.25	1.25	1.13	1.75	1.25	.63	1.38	1.23
3 (5)	1.00	1.20	0.80	0.80	0.60	0.60	1.20	0.89
4 (5)	1.20	1.20	0.80	1.20	1.00	0.40	1.40	1.03
5 (15)	1.27	1.27	1.20	1.40	1.00	0.73	1.27	1.16
Average for skill	**1.21**	**1.24**	**1.08**	**1.34**	**1.00**	**0.63**	**1.29**	

RCT, randomised control trial.

Appendix 2

Average scores of participants in each cohort based on observer rating

(0 = no skills; 1 = some skills; 2 = highly skilled)

Cohort (number)	Knowing which source to search	Able to identify appropriate search terms	Able to combine terms using Boolean operators	Able to limit search using publication type, date, age categories etc.	Able to search and find RCTs and systematic reviews (using Clinical queries, or alternative)	Able to use 'explode' and 'focus' appropriately	Able to critically appraise articles retrieved on basis of patient group, intervention, comparison of outcomes, relevance of findings etc.	Average for each cohort
1 (5)	1.40	1.00	1.20	1.00	0.60	0.60	1.20	1.00
2 (8)	1.63	1.38	1.25	0.75	0.25	0.43	1.50	1.04
3 (5)	1.20	1.00	1.00	0.50	0.25	0.40	0.80	0.76
4 (5)	1.40	0.80	0.60	0.80	0.40	0.20	1.20	0.77
5 (15)	1.40	1.07	0.80	0.87	0.33	0.27	1.00	0.82
Average for skill	**1.42**	**1.08**	**0.95**	**0.81**	**0.35**	**0.35**	**1.13**	

RCT, randomised control trial.