The impact of information literacy training on clinicians entering the workforce

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Abstract

The ability of clinicians to search the medical literature, retrieve relevant research, and critically evaluate the findings and their applicability to their own practice are key skills in developing evidence–based practice in the health work force. The Wellington Medical Library (University of Otago), offers this training for students, as a required part of their coursework in the 4th year of their Medical training. Cohorts of 4th year students from 1994-2003 have now graduated and are completing their final years as house surgeons and registrars in a variety of specialty areas. In a longitudinal study, following on results reported at ICML8, the research team has followed up with these cohorts, in order to investigate the following issues:

1. What are the information seeking behaviours of these young clinicians in relation to queries that arise during clinical practice?

2. How much do they retain of the training undergone during their clinical training 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?

interviewed a number of clinicians from each of these cohorts, and asked them to complete a search, based on a scenario related to their discipline. This paper reports on the findings, factors affecting the effectiveness of the initial training, and the ongoing use of evidence based information practice by this group of young clinicians.

Introduction

The ability of clinicians to search the medical literature, retrieve relevant research and reviews, and critically evaluate the findings and their relevance to their own practice are key skills in developing evidence–based practice in the health work force. In 1999 staff at the Wellington Medical Library[1] conducted a study investigating the outcomes of their instruction on Medline searching and critical appraisal given to 4th year medical students in their library. The instruction was a required part of the coursework for these students, and test scores were used to assess learning outcomes of the group.

These students have since graduated and are completing their final years as house surgeons[2] and registrars[3] in a variety of specialty areas. In the intervening years further cohorts of medical students have received similar training from medical library staff, with additional components being added to the training intervention by both medical faculty and library staff. As they move

[1] Clark, M. and Breton, A. 2000, Library instruction for medical students: teaching critical thinking along with Medline search skills. 8th International Medical Librarianship Congress, London.

[2] A first year House surgeon is a New Zealand medical graduate in their first post-graduate year. They can also be referred to as Interns or house officers. These doctors work under supervision in an accredited hospital. House surgeons also do a second Postgraduate year once they move from a provisional scope of practice to a general scope of practice and gain full registration with the New Zealand Medical Council. House surgeons are also known as House Officers and in their third year are called Senior House Officers.

[3] Registrars are doctors who have entered a vocational training programme of the respective medical college of choice. This ranges from 3-8 years of advanced training.

into roles as young clinicians, entering specialist training and general practice, a number of research questions arise:

1. What are the information seeking behaviours of these young clinicians in relation to queries that arise during their clinical practice?
2. How much do they retain of the basic, and any additional training undergone during their clinical 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 on at ICML8 in London in 2000 with a paper reporting on the first phase of this longitudinal study to examine the efficacy of a programme to teach medical students effective Medline information retrieval skills and at a meta-cognitive level to improve their critical thinking skills. This paper discusses the follow-up of the students over a longer period of time to see if the skills and knowledge gained during the intervention continue into clinical practice especially when as practicing clinicians they are faced with making clinical decisions about patient care. Reidelbach (1) and Bradigan and Mularski (2) separately reported that pre and post testing scores show that student performance and confidence improves after tuition. Our goal was to find out if this performance and confidence continued once they graduated from Medical School.

The need for training in searching and evaluating information

In the past decade the amount of clinical literature available online has increased. In the past the problem was to persuade clinicians, especially those outside medical schools and the main hospitals to make better use of services offered by medical libraries (3). In 2002, Cullen writes, the problem now is the ability of clinicians to cope with the proliferation of information available online, and develop strategies to identify and evaluate the specific information that will be useful to them in their clinical decision-making (4).

These abilities need to be developed as a routine part of medical training, and have, in recent years, become crucial to effective medical practice. As G.O. Barnett, a leader in medical informatics, noted in 1995, medical students need to develop a good understanding of and have extensive experience with the use of Medline, asserting “maintaining a current awareness of the medical literature is essential to the effective practice of medicine”(5).While computers make finding information faster, he argued, they can also make it more difficult. Medline today contains bibliographic citations from more that 4,600 biomedical journals and contains over 18 million citations. As Holtum (6) observes, the ability to source relevant, reliable and current information from this resource, plus the numerous other resources that have developed to specifically support clinical decision making, require greater practice and skill, not less. In this context it is more important than ever that medical students should gain a deep understanding of database searching.

These vital skills do not, however, appear to be well mastered by clinicians. Haynes and Wilczynski (7) show that although medical literature is very accessible through online databases such as PubMed, very few clinicians are able to search them well. A study by Ely et al (8), which identified some of the obstacles that prevent clinicians from answering clinical questions with evidence-based sources, suggests some of the reasons for this. Of the six major obstacles Ely identified, two were the time taken to find information and difficulties with devising the best search strategies.

Optimal ways of delivering training

Ongoing research has focused on the best ways, and the best point at which to deliver this training within a busy medical curriculum. Central issues are whether the skills can be taught in one off stand alone sessions or whether they should be integrated into a longer course (9, 10) and at what stage in a student's medical education these skills should be taught (11, 12).

At present in the University of Otago medical curriculum, students often don't identify a need to search the literature for answers to clinical questions they are faced with until their trainee intern year (6^{th} year). At this point, anecdotal evidence suggests they begin realise how necessary information seeking skills are, but become aware that they may not have the necessary skills because this material was taught when they were not ready. This view is counterbalanced by the findings of the Rosenberg study (9), which reports comments by students that they wished the Medline training they had received in their later clinical training years had been delivered during their preclinical years. A study by Burrows and Tylman (13) at the Miami School of Medicine endorses this view, and recommends that:

> …required searches with evaluation and feedback be incorporated into the third and fourth years to give students the proactive and individual instruction necessary for them to become proficient at retrieving highly specific articles with information valid for patient care decision making (p475).

Following the lead of the Michael G. DeGroote School of Medicine at McMaster University, which led the way with its innovative method of problem-based medical education, a focus on self-directed, life-long learning, and the development of evidence-based medicine, the Miami School of medicine students start to use their Medline searching skills in real cases with patients by the end of the first semester (11). As other medical schools seek to incorporate more problem-based learning into their curriculum, the introduction of information literacy (IL) skills along with self-directed learning will see a need for these skills to be introduced earlier and earlier in the curriculum.

Medline as part of an Evidence Based Medicine course for medical students

Many medical schools teach Medline searching as part of their Evidence Based Medicine (EBM) course with library staff offering extra sessions in searching skills in tandem with the course or independently of the course. Holloway (14) discusses problems with grading and assessing Medline success and student skill levels within an EBM course. Holloway writes "the lack of test-retest reliability suggests it was difficult to distinguish between student skill levels" (14, p876). He also notes a lack of student diligence and negative reactions to these parts of the EBM module. He advises that further research is needed on the issue of evaluating search assignments, arguing that this could be widened to include a range of search engines and evidence sources and that students should be rewarded for their search outcome rather than just the process. West also discusses the issue of assessment tools for testing searching skills and the difficulties faced in creating assessment task that mirror the real world environment, stating that tasks commonly set "[do] not allow students to demonstrate their real time ability to perform EBM tasks such as generating a clinical question or searching literature databases" (15, p1059).

There is, in addition, some research looking at the ability of students to apply information they have found information to their clinical question. It is critically important that they develop competence in appraising the information they do locate and then apply the knowledge to the care of the patient before them. Bergus in his research on appraising and applying evidence about a diagnostic test concludes "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"

(16, p4). Like Holloway (14), Bergus (16) also identifies negative student reactions to information literacy and EBM instruction.

Are stand alone sessions effective?

The majority of the literature ion Information Literacy suggests that it is most effective when conducted as part of an assessed programme integrated into other learning programmes, and offered once a need has been identified. Erickson and Warner (10) conducted a study to evaluate the impact of individual stand alone one-hour Medline tutorial sessions among obstetrics and gynaecology residents and although the sessions were rated well by the participants, no improvement in search outcomes was proven. However research by Rosenberg et al. shows that training in formulating questions and searching databases can improve students' searching performance and the quality of evidence retrieved: "a three-hour interactive training session improved the student's ability to search databases and retrieve evidence and was well received by the students" (9, p557).

More recent studies have continued to 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 or not this is a formal part of their curriculum. Further, this study found evidence that a single training session had a significant positive effect on the students' short-term EBM literature searching outcomes. However Gruppen et al also acknowledge that their study could not prove an improvement in skills beyond the four-week elective of their intervention and they suggest that "testing students again during their residencies would provide valuable information on this question" (18, p943). Even more effective, possibly, would be training integrated into the curriculum, at a point when the skills start to be really needed.

The current study

The objectives of this study were to investigate whether this kind of intervention by librarians during the first clinical year of training by medical students would enhance their searching skills, provide skills useful when making clinical decisions affecting patient care, and help form the basis of life long learning. The original intervention investigated was Information literacy instruction focusing on searching skills using Medline on the OVID platform. This was developed in subsequent years as an integrated IL programme within the Health Informatics or EBM modules that the students were required to take.

In New Zealand all medical programmes are undergraduate programmes taught in two Universities; The University of Otago and The University of Auckland. The University of Otago medical students are based in Dunedin for three years of pre clinical study and then move to one of three clinical schools for their three years of clinical training. The participants in this study were students entering their 4th year of training (their first year of clinical training) between 1994 and 2004. These students were all based in the Wellington Clinical School of the University of Otago, the northern most clinical school of the University.

From 1996 on, medical students at the Wellington Medical School have been provided with some tuition in searching, retrieving and evaluating information for clinical decision-making early in their 4th year. As part of this training they are then tested against agreed standards in the basic skills of:

- Selecting a database
- Use of subject headings
    - Term mapping
    - Alternative terms
    - Use of subheadings

- Use of limits and system features
- Critical evaluation of the search process, the ability to refine the search and evaluate the results retrieved.

This information literacy programme was constantly being evaluated and improved upon as the Library staff developed it over the years of the study, in consultation with Medical School staff, and participants can therefore be divided by cohort depending on the type of intervention received.

The Cohort Groups:
Cohort 1: These students received no formal training in searching from Library staff as part of their undergraduate programme. (This group is used as the control group in the study reported here.)

Cohort 2: The students in this group were 4th year students over the years 1996-1998. This group of students were given a 1 hour tutorial during their orientation week. The orientation programme introduced students to clinical examination skills and history taking skills, thus introducing them to patients in "real life" with real problems. The searching skills tutorial was followed by a test to assess their learning but the results did not go toward their final marks.

Cohort 3: In 1999 the Wellington School of Medicine introduced a 4th year Health Informatics (HI) programme that all 4th year medical students participated in. Cohort 3 consists of students from this class only. This group received their introductory tutorial in their first week and this was followed by a self paced module for their Health Informatics course. This module was compulsory and the assessment formed part of their final marks.

Cohort 4: In 2000 the Wellington Medical School introduced a second thread in the form of an EBM programme for 4th year students. This group of students received an introductory tutorial in their first week followed by a self paced module for their Health Informatics course and an advanced Medline tutorial introducing Clinical Queries, as part of their EBM course. The Critically Appraised Topics assignments the students submitted required them to include their search strategy as part of the assessment criteria.

Cohort 5: In 2001 it was decided the Introductory Module was now superfluous, as the HI Medline module was introduced early in the academic year, and the Introductory Module was dropped from the programme. Students from 2001 to 2003 therefore participated in the HI and EBM programmes where searching skills were assessed as part of their final grade. This year a prize was introduced for the student who performed the best in the HI programme.

The training intervention within the HI thread involved collaboration between Library staff and Faculty staff. This collaboration continued with the introduction of the EBM thread in 2000. The searching component was taught by Library staff and the critical appraisal component was taught primarily by Faculty staff. The assessments were made jointly between Library and Faculty staff.

During 2008 and 2009 the research team made contact with as many of these students as possible in order to ascertain what they recalled of their early training, and what level of skill in searching and evaluating the literature they had either retained or developed since.

Method
Participants were contacted and asked to participate in the study, and encouraged to do so as part of their ongoing information literacy skills development. Participants were given an information

sheet detailing the purpose and confidential nature of the study, and signed a consent form, according to the permission which had been granted for the study by the VUW Human Ethics Committee. Each participant was interviewed in a medical library by a senior medical librarian, with full resources available, including: OVID Medline as well as PubMed. They also had access to all the resources normally used to find information for clinical decision making. A total of 34 participants were recruited, with at least some from each of the cohorts outlined above.

Stuctured interviews and observations were conducted as outlined below, with the research team taking detailed notes. Participants were asked a series of initial questions (Q1-6) concerning: what they recalled of the Medine or information searching training sessions they had participated in during 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 the information they found; if they had attended any continuing medical education (CME) or other sessions since graduating in which they learned more about searching or evaluating the medical literature since their basic training (including informal exchanges with peers);

Questions 7, 8 and 9 in the interview focused on the participant's searching, retrieval and critical appraisal skills. Question 7 asked them to recall a recent search and explain how they had gone about it, and Question 8 asked them to rate their skills on a set of tasks: knowing which source to search; ability to identify appropriate search terms; ability to combine terms using Boolean operators; ability to limit a search using publication type, date, age categories etc; ability to use 'explode' and 'focus' appropriately; ability to critically appraise articles retrieved on the basis of patient group, intervention, comparison of outcomes, relevance of findings to patient care, etc. Each individual was asked to rate their skill level as 'None', 'Some skills', or 'Highly Skilled'.

Subsequent to this, participants were presented with a set of four scenarios (see Appendix 3), and asked to conduct a search under observation. (The scenario they were asked to focus on was selected, where possible, according to the specialist area they were currently working in.) They had access to standard resources such as OVID Medline, PubMed and the usual resources available on their local intranets as well as internet access. Their search, retrieval and appraisal skills were then noted by a trained medical searcher, who noted which databases were chosen, what key concepts were identified for the search, and who rated their ability against the set of 7 skills using the same criteria, 'No skills', 'Some skills', or 'Highly Skilled'. Once the search was completed, strategies that would have been more effective were shown to participants, who were thus able to benefit from some one on one coaching, as promised in the invitation to participate.

Findings

Initial questions

The initial questions in the structured interviews focused on what participants recalled from the training sessions, what search techniques and what databases they currently use, and how they evaluate information they find. Responses to these questions were analysed according to the 5 cohorts in the study, and the data is presented in Tables 1-5, below .

Cohort	Years	Number	Don't remember	Vaguely Remember	Remember
1	1995	3	1	2	3
2	1996-98	10	1	2	7
3	1999	5	0	2	3
4	2000	4	0	1	3
5	2001-4	12	0	2	10
Total		34	2	9	26

Table 1. The extent to which participants in each cohort recall IL instruction given in their 1st clinical year of training.

The majority reported that they had 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 2).

Cohort	Number in cohort	Ask a librarian	Search Google	Search Journals	Use broader strategy	Go to known website
1	3	1	3	1	3	0
2	10	0	6	1	10	4
3	5	1	2	1	5	0
4	4	0	3	3	3	2
5	12	0	4	1	12	7
Total	34	2	18	7	33	13

Table 2. Strategies employed by participants in the various cohorts when searching for information

Participants stated that they used a range of information sources to search for information, but were generally uncertain about what constituted a database. Their responses therefore include some sources that information professionals would not necessarily call 'databases' but these have been included so as to give an accurate picture of sources used. Two key cohorts have been further analysed to identify any differences between them.

Database	Number of all participants who report using	Number in pre-training cohort	Number in HI/EBM training
BestBETs*	2	0/3	0/4
Cochrane	13	3/3	2/4
Google	11	2/3	1/4
PubMed/Medline incl OVID	25	3/3	3/4
Other**	11	1/3	1/4

* BestBETs is a database of Best Evidence Topics, produced by the Manchester Royal Infirmary.
** includes MDConsult, UptoDate, NICE, various Guidelines, e-medicine, OMEN, Clin-e-Guide, EMBASE, Ballieres, e-journal web sites

Table 3. Databases used by participants

Evaluating information

While in the training sessions received by the earlier cohorts the focus of evaluation was on selecting the right database, as the evidence-based component of the training courses was

developed, the focus shifted to the principles of critical appraisal - based on a set of criteria, such as sample, methodology, and elimination of bias. These criteria can be described as intrinsic (Cullen, 1997) since they assess the quality of information based on what is presented within a research or review article, compared with evaluation based on extrinsic criteria such as publisher, journal reputation, authoritative web site etc. These distinctions have been found useful in categorising ways in which clinicians evaluate sources they use. Table 4 identifies ways in which participants in the various cohorts evaluated the items they retrieved from their searches.

Cohort	Number in cohort	Extrinsic	Intrinsic	Currency	Relevance	Other
1	3	3	3	1	1	0
2	10	8	6	3	6	4
3	5	3	3	2	2	2
4	4	3	1	0	2	1
5	12	7	5	0	5	5
Total	34	24	18	7	33	13

Table 4. Criteria used for evaluating sources retrieved

. Responses categorised as 'other' included a number of irrelevant asides, along with "check against other sources to see if the reference makes sense', 'discuss with a colleague', 'check on the internet'.

Participants were also asked about their attendance at CME course involving information literacy training or some other form of instruction that had advanced or reinforced their knowledge. Table 5 summarises responses to this question.

Cohort	Number in cohort	Yes	No
1	3	3	0
2	10	8	2
3	5	1	4
4	4	0	4
5	12	1	8
Total	34	13	18

(Yes responses include some form of instruction included in advanced papers/qualifications, specialty training, session at conference attended, journal club, or voluntary attendance at library session, rather than formal CME)

Table 5. Attendance at CME or training session dedicated to IL

The final question in this section asked participants how often they consulted a librarian when looking for information.

Cohort	Number in cohort	Never	Rarely	Occasionally
1	3	0	3	0
2	10	3	5	2
3	5	2	2	1
4	4	1	1	2
5	12	1	5	6
Total	34	7	16	11

Table 6. How often do you consult a librarian when looking for information?

Search skills evaluated

In their responses to Question 8 (asking participants to rate their skill level on 7 search and appraisal skills) the self-assessment of skills reported by participants varied considerably. The skills levels were scored as no skills=0, some skills=1, and highly skilled = 2, giving a possible range of scores from 0-14. Individuals scored themselves from 4 through to 14, with an average score of 8 (see Appendix 1 for details). Over all participants, the ability to search and find randomized controlled trials (RCTs) and systematic reviews was the most highly rated (with an average score of 1.9, and the ability to use 'explode' and 'focus' the lowest rated, at .68, one participant commenting they would not use such techniques since they "did not want to miss anything."

In the assessment of skills in the observed search, when asked to search for information to address a problem in the scenario given to them, participants scored less well. Individual scores across all 7 skills ranged from 2-13, with an average of 6.2. The highest scoring skill across all participants was 'Knowing which source to search,' and the lowest 'Able to search and find RCTs and systematic reviews,' at .33, followed by 'Able to use 'explode and focus' at .39.

When the data is analysed according to cohort, differences between self-assessment and expert assessment become clear, but not differences between cohorts. See table 7 below.

Cohort	No in cohort	Av of indiv scores across all skills in self-assessment (Q8)	Av of indiv scores across all skills in expert assessment (Q9)
1	3	7.6	6.0
2	10	8.4	7.4
3	5	5.8	5
4	4	8.0	5.5
5	12	8.8	6
Total	34		

Table 7. Comparisons between self-rated scores and expert evaluation of skills, in each cohort*[4]

Looking at individuals from key cohorts, (comparing the first and the 4th), there appears to be little difference between the cohorts, even at the individual level.

From Cohort 1 (no training):

1st case (13): judged self some skills in 4 categories; expert evaluation some skills in only 2 categories.

2nd case (9): judged self some skills in 6 categories; expert evaluation some skills in only 5 categories;

3rd case (31) judged self highly skilled in 6 categories, some skills in 1 category; expert evaluation highly skilled in 4 categories, some skills in 3 categories.

Total scores for the three participants for self evaluation/expert evaluation 4/2; 6/5; 13/11.

[4] It should be noted in all the analyses by cohort that one participant only partially completed the observed search, but had shown in the preparation search, (choice of database, keywords etc.) minimal understanding of the task. In Table 7, when this participant's scores in the expert evaluation are removed, the average score for that cohort is 6.5

From cohort 4 (HI and EBM training):

1st case (21): judged self highly skilled in 1 category, some skills in 6 categories; expert evaluation: some skills in 6 categories, no skills in 1 category;

2nd case (25): judged self some skills in 6 categories, no skills in 1 category; expert evaluation: highly skilled in 1 category, some skills in 3 categories, no skills in 3 categories;

3rd case (34): judged self highly skilled in 1 category, some skills in 3 categories, no skills in 3 category; expert evaluation: highly skilled in 1 category (the same one), some skills in 1 category, no skills in 5 categories;

4th case (24): judged self highly skilled in 6 categories, some skills in 1 category; expert evaluation: highly skilled in 2 categories, some skills in 4 categories, no skills in 1 category (this was the same skill, *able to use 'explode' and 'focus' appropriately*, the participant had graded herself at only *some skills*.)

Total scores for the four participants for self evaluation/expert evaluation 8/6; 5/3; 13/8; 6/5.

The most highly skilled participant (Case no 8) came from Cohort 2, and apart from one aspect (*ability to use 'explode' and 'focus' appropriately* - this participant's scenario did not require this skill), the self-evaluation and the expert ratings were matched.One participant (Case no 5 in that same second cohort), however, consistently rated herself as less skilled than the experts judged her to be. In general participants had a realistic idea of their skills levels compared with others, all participant self-rating scores. However, all participants' self-rating scores, apart from the one example noted, are higher than expert evaluation scores.

Discussion

As Table 2 shows, the majority of the former students remembered the training they had received. They remembered that it happened and sometimes remembered the content, in terms of what was covered. They might remember the terms such as 'explode', and 'subject heading' but when they came to do a search they did not recall how to apply the technique. When asked to carry out a search in response to a specific scenario almost all the former students chose to search the OVID interface, which was the interface they had been taught to use, rather than use PubMed which might have been the version available to them in their work place. 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 their responses to Questions 2-5 (see Tables 2 and 3) that participants are habitually using a wide range of information sources (in Table 2, Google,rather than Google Scholar, is a favourite, and the 'broader strategy' referred to often included Google amongst a range of other sources.) The cohort which had the most intensive evidence-based training (cohort 4) did not make greater use of evidence-based sources. Table 3 shows them to be using these less than others in the study. Nearly all the hospital clinicians in our study had access to UptoDate in their work place and this was the preferred information source for many participants in the study. Those who had stumbled across another electronic textbook Clin-e-guide found this a good starting point, in fact more useful than UptoDate. Those training for General Practice found the synthesised products their preferred starting point for patient care.

Although Table 3 shows Medline (PubMed) used by twice as many respondents as any other source, in reality, this use was infrequent. Few of the participants were searching the primary literature (via PubMed or OVID Medline) on a regular basis and therefore their skills have become poorer. The ability to search Medline for evidenced based information using the pre set filters (Clinical queries) is a skill few retained and only one had learnt it subsequently. One

former student who did registrar training under the tutelage of a consultant well versed in the need for quality evidence proved the most skilful searcher, and reported that he had to use evidence-based sources on a weekly basis when presenting case histories to fellow registrars and consultants during his training. Another competent searcher had completed a Masters in Public Health and as part of that course had had further training in searching the literature for the best evidence.

Evaluation and critical appraisal skills were not well developed. Among those who critiqued the results list from their search, few were able to refine their strategies to improve the results returned. When evaluating articles retrieved, more participants relied on extrinsic than intrinsic criteria when evaluating what they found, although some were selecting items primarily on the basis of currency. Despite this, however, nearly all felt their critical appraisal skills were good and felt they were able to apply the results of their findings to patient care. This was not tested thoroughly in our study, and if Bergus (16) is correct, participants may well be overrating their skills in this area. Certainly, the quality of the searches conducted by the participants in the study raises concern that they may often be identifying relevant information and appraising and applying it from a rather inadequate list of sources. However, despite their lack of skill, this was a confident group, and not one who readily turn to medical library staff for assistance (as shown in Table 6). Few of the group had received or sought any further training in searching skills or evidence based medicine skills since graduating. What reinforcement of skills they had received came though informal channels.

In the self-assessment of their search skills, and the independent ratings given by trained medical database searchers, the discrepancies between individuals' scores, and between self-assessment and expert scores show how wide the range of skills in this group is (despite the importance of searching and evaluation skills in the delivery of quality patient care.) Our notes on individual's searches show that participants were able to identify a suitable database, and select keywords on which to search though it is clear that in normal circumstances they would probably choose easier search options than Medline. A good proportion of the participants were able to go through to the mapping screen to choose their terms, but few recalled the concept of tree structures or sought further information about their chosen terms. A small number tried typing in whole phrases or search sentences as one might in a Google type search box. Despite not getting any results they didn't show any awareness of why this strategy was unsuccessful and how to improve their search strategy. There was a general lack of understanding of the power of the MeSH thesaurus, or that simple concept that typing a single search term at a time and combining the terms at the end would produce a more effective result.

In general the clinicians in this study felt confident in their abilities to search for and utilise information for patient care. However, the sources they used did not regularly include a Medline search, and many were diffident about the their ability use Medline as they felt they remembered little about the teaching they had had and that this would reflect badly on them as clinicians. There was even a level of guilt expressed by some that they retained so little of the teaching.

What is disappointing is that there is no clear correlation between the level and complexity of the instruction given in the 4th year of training, and the level of skill shown now. In some cases (because of testing done in the past) it was possible to identify a student who showed aptitude in searching in their training, who had continued to be a more effective searcher, and vice versa - poor search skills in the training years tended to be reflected in poor skills demonstrated in the present.

The 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 in 4th year, and that there are many other factors impacting on the level of skills shown by clinicians. Anecdotal evidence gathered during this study suggests that the choice of field in which to specialize, further training in specialist courses, the influence of supervisors and instructors, and natural aptitude for searching may have more impact on the skill levels of clinicians that the training itself. This is not to suggest that this training should be in any way cut back, but perhaps repeated in later years, as the need for it becomes more urgent. In the interests of developing the future effectiveness of these young clinicians, and the well being of their patients, a collaborative team of medical librarians, senior faculty and course directors should consider how to further develop and reinforce these critical skills as young clinicians enter the workforce.

In conclusion, we also note that the study, ambitious and only partially successful as it is, has attempted to address a shortcoming in the literature noted by Brettle (19) in her review of evaluations of instructional programmes for clinicians, when she comments: “a number of studies purported to measure skills, but a closer examination of the outcome criteria and measures used (e.g. using multiple choice test or true/false to assess literature searching skills) suggests that they are more likely to be measuring knowledge or cognitive domains of learning rather than the behavioral domains” (p26). In this study, our assessment covered both the cognitive domain, in our questions about recall, and the behavioral domain, when we actually observed the searching techniques and strategies used. Despite its limitations, it is a step towards a broader understanding of the way in which clinicians learn to use the skills they were introduced to as medical students, and which they will need throughout their professional careers.

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Appendix 1.

Scores of participants, self-rating on search, retrieval and critical appraisal skills.
0 = no skills; 1 = some skills; 2 = highly skilled

Case ID no	Knowing which source to search	Able to identify appropriate search terms	Able to combine terms using Boolean operators	Able to limit search using pub type, date, age categories etc.	Able to search and find RCTs and systematic reviews	Able to use 'explode' and 'focus' appropriately	Able to critically appraise items retrieved acc patient group, intervention, comparison of outcomes, relevance of findings to patient care, etc.	Case total (8)
13	1	1	1	0	0	0	1	4
19	1	1	1	1	0	1	1	6
31	2	2	2	2	2	1	2	13
Avg for cohort	1.33	1.33	1.33	1	0.67	0.67	1.33	
3	1	1	1	1	1	0	1	6
5	1	1	1	2	2	1	1	9
10	1	1	2	2	1	0	2	9
17	1	1	1	2	1	0	1	7
2	2	2	1	1	1	1	2	10
8	2	2	2	2	2	2	2	14
1	1	1	0	2	2	0	1	7
11	1	1	1	1	1	0	1	6
4	1	1	2	2	1	1	1	9
6	1	1	0	2	1	1	1	7
Avg for cohort	1.2	1.2	1.1	1.7	1.3	0.6	1.3	

12	1	1	2	2	0	1	0	5
16	1	1	0	1	1	1	1	6
18	1	1	1	0	0	0	1	4
28	1	2	1	1	1	1	2	9
32	1	1	0	0	1	0	2	5
Avg for cohort	1.0	1.2	0.8	0.8	0.6	0.6	1.2	
21	1	1	1	2	1	1	1	8
25	1	1	0	0	1	0	2	5
34	2	2	2	2	2	1	2	13
24	1	1	1	1	1	0	1	6
Avg for cohort	1.25	1.25	1.0	1.25	1.25	0.5	1.5	
23:	1	1	1	1	1	0	1	6
14	1	2	0	1	1	1	2	8
7	1	2	1	1	2	1	1	9
22	1	1	2	2	2	0	2	10
15	2	1	1	2	1	2	2	11
20	1	1	1	1	0	0	0	4
26	1	2	2	2	1	2	1	11
27	2	2	2	2	2	1	2	13
9	1	1	1	1	0	0	0	4
29	1	1	1	1	1	1	1	7

30	2	1	2	2	2	1	2	12
33	2	2	1	2	1	1	2	11
Avg for cohort	1.33	1.42	1.25	1.5	1.17	0.83	1.33	
Avg for all cohorts	1.24	1.29	1.12	1.38	1.9	0.68	1.32	8.05

Appendix 2.
Scores of participants rated by experts on search, retrieval and critical appraisal skills

0 = no skills; 1 = some skills; 2 = highly skilled
N/A is used where this skill was not relevant to the clinical specialty of the search

Case ID no	Knowing which source to search	Able to identify appropriate search terms	Able to combine terms using Boolean operators (AND, OR, NOT)	Able to limit search using pub type, date, age categories etc.	Able to search and find RCTs and systematic reviews	Able to use 'explode' and 'focus' appropriately	Able to critically appraise items retrieved acc. patient group, intervention, comparison of outcomes, relevance of findings to patient care, etc.	Case totals (Q9)
13	1	0	0	0	0	0	1	2
19	1	1	1	1	0	0	1	5
31	2	2	2	2	1	1	1	11
Avg for cohort	1.33	1	1	1	0.33	0.33	1	
3	1	1	1	0	0	0	1	4
5	2	1	2	2	2	2	2	13
10	2	2	1	0	0	0	2	7
17	1	1	1	1	0	0	1	5
2	2	1	1	1	0	0	1	6
8	2	2	2	2	2	N/A	2	12
1	2	2	1	1	0	1	2	9
11	1	1	2	0	0	0	1	5
4	1	1	1	1	0	1	1	6
6	2	1	1	0	0	1	2	7

Avg for cohort	**1.6**	**1.3**	**1.3**	**0.8**	**0.4**	**0.56**	**1.5**	
12	2	1	2	1	0	1	1	8
16	1	1	1	1	1	0	1	6
18	1	0	1	0	0	0	0	2
28	1	2	1	N/A	N/A	1	1	6
32	1	1	0	0	0	0	1	3
Avg for cohort	**1.2**	**1**	**1**	**0.5**	**0.25**	**0.4**	**0.8**	
21	1	1	1	1	0	1	1	6
25	1	0	0	0	0	0	2	3
34	2	1	1	1	1	0	2	8
24	2	1	1	1	0	0	0	5
Avg for cohort	1.5	0.75	0.75	0.75	0.25	0.25	1.25	
23	1	1	1	1	0	0	1	5
14	0	0	0	0	0	0	0	0
7	2	1	1	1	0	0	1	6
22	2	2	1	0	0	0	1	6
15	2	0	0	0	0	0	2	4
20	1	1	0	1	0	1	0	4
26	2	2	1	1	1	0	1	8
27	2	2	2	2	1	1	2	12
9	1	1	0	1	0	0	1	4

29	1	1	1	1	0	1	1	6
30	2	2	2	1	2	1	1	11
33	2	1	1	1	0	0	1	6
Avg for cohort	**1.5**	**1.17**	**0.83**	**0.83**	**0.33**	**0.33**	**1**	
Avg for all cohorts	**1.47**	**1.12**	**1**	**0.79**	**0.33**	**0.39**	**1.15**	**6.2**

Appendix 3
Scenarios used in participant interviews

Scenario one

You learn that a 54 year old man with NIDDM (on oral hypoglycaemics) whose myocardial infarction you treated 6 months ago has died suddenly at home. Wondering whether you could have done more for him, you review his notes and confirm that he was, in fact, a low risk inferior MI with no complications whose blood sugar was elevated on admission (13 mmol/L) but settled down within three days.

In view of the success of "tight control" of IDDM in preventing or postponing retinopathy and neuropathy, you wonder if a more aggressive treatment of his NIDDM might have postponed his untimely death. On the other hand, you well recall how one of your Profs back in medical school insisted that insulin was atherogenic and how you should back off insulin doses when diabetics developed angina pectoris.

So you form the clinical question:

"Among patients with NIDDM who are having MI's, does tight control of their blood sugar reduce their risk of dying?"

Scenario two

A 70 year old man sustained a myocardial infarction three years ago. He experienced some heart failure after the infarction, but has done well while taking captopril, furosemide, aspirin, and a beta blocker. He was free of symptoms or signs of heart failure, or angina, until approximately one month ago. He reports that at that time he began to feel increasingly fatigued. He denies shortness of breath, othopnea, paroxysmal nocturnal dyspnoea, ankle swelling, weight gain, or chest pain. He just feels that he doesn't have the energy he did, and needs to take frequent rests and a nap in the afternoon. Physical examination reveals no sign of heart failure, and no other abnormalities. Initial laboratory examination shows a haemoglobin of 10.0 g/dl, with notable findings on the blood film, and a mean cell volume of 82. Serum ferritin is ordered.

While waiting for it to return, you ask yourself whether serum ferritin is really the best way to determine iron deficiency in such a patient.

Scenario three

You are an SHO on a new assignment in the medical out-patient department. Your first patient for the afternoon is a 69 year old white woman, a retired high school teacher, who you are seeing back today to review her test results. A month ago she presented with symptoms and signs of congestive heart failure. She has had long-standing essential hypertension, but had been otherwise healthy until now.

A 12-lead ECG shows left ventricular hypertrophy. A transthoracic echocardiogram shows left ventricular dilatation and hypertrophy. Both diastolic and systolic function are impaired; the estimated ejection fraction is 35%.

You review with the patient the test results, her medication use and how she's done since you last saw her. Then she asks you, "Heart failure sounds serious - is it? What do I have to look forward to?" You excuse yourself and find your Consultant.

Together, you and your Consultant form the clinical question: In a patient with heart failure and poor left-ventricular function, what is the average survival time?

Scenario four

Mrs. Jennifer Vaughan, a 37 year old nurse, is admitted for emergency appendectomy. Post operatively, she develops a wound infection which grows Bacillus fragilis. She is treated with IV ciprofloxacin and metronidazole (a combination selected by the house officer), and recovers uneventfully after six days.

You ask the question is antibiotic prophylaxis after emergency appendectomy clinically effective in preventing wound infections?