

Factors Affecting Students' Use of MEDLINE

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MEDLINE search transcripts by a class of third-year medical students were analyzed. The 184 students were divided into three groups according to their search experience in terms of the number of sessions logged at the time of a search assignment. A strong relation was found between the level of search experience and the frequency of use in the subsequent 5 months. Over 80% of the students were able to retrieve a few useful items for an emergency clinical situation. More experienced searchers were able to retrieve more relevant items than less experienced searchers. However, no relation was found between search effectiveness and clinical knowledge as indicated by two scores derived from the University of Michigan's Comprehensive Clinical Assessment examination and Part II of NBME. Similarly, clinical knowledge also did not appear to relate to MEDLINE search experience. More exposure to MEDLINE during medical school could play an important role in developing effective literature searching skills for lifelong learning, which is essential for today's health professionals. © 1993 Academic Press, Inc.

I. INTRODUCTION

For the past decade, academic health sciences librarians have been reporting their efforts in preparing students to be lifelong learners. These efforts are the result of recommendations of the GPEP Report (1) and the IAIMS initiatives generated by the 1982 Matheson Report (2). They have generally centered on training students to search the MEDLINE database.

There is ample evidence that the ability to identify and critically appraise the medical literature is essential for today's health professionals to keep up with and incorporate new health information into their practices (3-5). In their oft-cited study, Covell *et al.* (6) reported that most questions arising in the office practice settings are questions of medical fact or opinion (83%) and, therefore, could be answered by the medical literature. Practicing physicians face a number of barriers in accessing information when they need it. The majority self-reported a reliance on print sources, textbooks, and journals, available in their offices even though they frequently "had no organized method

for storing and retrieving journal articles and the textbooks they relied on most heavily are often out of date." Covell found that two-thirds of all questions which arose during the course of this study went unanswered. Both primary sources of information take time to utilize and lack of time was the most frequently cited barrier to finding needed information.

It has been suggested that these barriers could be overcome by providing access to and encouraging use of MEDLINE in the practice setting. More recent research into the type of information needs which arise in the clinical setting, with the exception of family physicians (7), reveal that the quantity and type of questions that arise have not changed very much since Covell's 1985 study (8, 9). Although much has changed in terms of the availability of personal computers, electronic information resources, and computerized information management capabilities, the use of these resources, while increasing among some members of the biomedical community (10), is still not a widespread practice among clinicians (4, 11). Increasingly, however, MEDLINE is being integrated into the curriculum by health sciences educators with the expectation that its regular use should become standard operating procedure for new graduates.

The majority of academic health sciences libraries now provide some form of access to MEDLINE, and end-user search training became common practice during the 1980s (12-15). As a result, there are already some indicators that the expectation that recent and future graduates are more likely to incorporate MEDLINE into their practice of medicine is well founded. The National Library of Medicine (NLM) in its study of individual user code holders found that the typical respondent was a young physician who searched MEDLINE about once a week to satisfy an immediate information need (16). Of note is the fact that more than half of the respondents in the NLM study attended some form of MEDLINE training.

II. BACKGROUND

At the University of Michigan, medical students, as do all faculty, staff, and students of the University, have unlimited access to the full MEDLINE file 24 hr a day, 7 days a week at no cost. The system is known as UM-MEDLINE and is accessible from any computer connected to the campus network via secondary communications processor, ethernet, or modem. Currently more than 2000 microcomputers access the network and UM-MEDLINE from various offices and labs in the Medical School, not to mention those in the homes of faculty, staff, and students. In addition, the University provides over 1100 public access microcomputers on campus for student use. Terminals connected to the University Hospital's information system (>2000) can also be used to directly access UM-MEDLINE. The search interface is actually PaperChase, which has been judged one of the easiest to learn end-user systems for accessing MEDLINE available (17, 18). Through the 1992 academic year, no formal MEDLINE training was provided to first-year medical students, although our

records show that nearly 100 first-year students have accessed and used the database at least occasionally. Formal training was provided during the second year, but not everyone attended the sessions. In addition to the curriculum-based instruction, the library schedules a large number of MEDLINE classes throughout the year which are open to anyone. Approximately 1000 attended these sessions during the 1992 academic year, but few of them were students. A few members of the medical school faculty did require students to complete assignments during the second- and third-year courses or rotations in which pertinent literature would be needed as supporting evidence. As a result of all these factors, some students finish their third year with quite a bit of search experience while others have done very few searches.

At the end of the 1991 academic year the faculty members responsible for devising and administering the Comprehensive Clinical Assessment examination, given to students at the beginning of their fourth year of training, decided to include patient scenarios which required students to quickly search the literature for information to diagnose and treat patients in a clinical emergency situation. The instructors believed that the mere fact that a MEDLINE search was included in the examination sent a strong signal to the students that the ability to identify and critically appraise the medical literature is an integral part of their medical education. Effective information seeking skills is critical for keeping abreast of new medical knowledge. Even though formal MEDLINE training was not required of every student, research done at McMaster by Haynes and his colleagues (18-20) found that over 85% of the novice searchers in their study were able to obtain relevant citations from MEDLINE using Grateful Med, another user-friendly, menu-driven search interface. Therefore, given the free and easy access to MEDLINE provided on the University of Michigan campus, all students would be aware of it and know that MEDLINE can provide answers to immediate information needs. The instructors believed that even the less experienced searchers would be able to find needed information given PaperChase's user-friendly, menu-driven search interface as long as they understood the clinical problem.

III. RESEARCH QUESTIONS

Given the information and technology-rich environment at the University of Michigan and the reinforcement of having the clinical competence examination testing for the ability to locate and identify relevant medical literature using UM-MEDLINE, we hypothesized that students would tend to continue using this resource independently to satisfy their information needs in the months following the examination. Further, we propose that students who had searched prior to the examination would be even more likely to continue searching during their remaining clinical year, thus reinforcing the behavior.

Specifically, the following questions were posed:

(1) Is there evidence to support the belief that the more search experience the students have on an easy-to-use search system, such as UM-MEDLINE,

the more s/he would develop higher levels of search skills in terms of more extensive usage of search and system's features?

(2) As medical students accumulate more experience in searching MEDLINE, would they improve on retrieval effectiveness? In other words, would medical students experienced on MEDLINE actually have a better chance of retrieving more useful papers?

(3) Is there any relationship between search effectiveness and levels of clinical knowledge? In other words, are students with higher levels of clinical knowledge better at translating their understanding of a clinical problem into a more effective search strategy to retrieve more relevant items from the database?

(4) Does subsequent searching frequency relate to prior levels of search experience?

(5) Is it reasonable to expect that, given barrier-free access to the MEDLINE database, student MEDLINE users can obtain useful information to aid in a clinical decision?

IV. MATERIALS AND METHOD

1. Search Topics

Search results from 184 students were collected. At the time of the search assignment in July 1991, the students had just started their fourth year. The students were divided into three groups. Each group was assigned a different clinical situation based on an actual patient problem. In each case, a written patient scenario was presented to the students. The students were instructed to search the MEDLINE database and print several abstracts containing relevant information to confirm a point raised or to help make a treatment decision.

The three actual patient scenarios where MEDLINE was used to make treatment decisions were as follows:

Topic 1. You are a physician working in an emergency room in a small northern Michigan community. Mrs. X, a 39-year-old nulligravid woman who lives in Ann Arbor, is vacationing in your area and comes to the emergency room where you are on duty complaining of severe abdominal pain. Upon taking a history you find that Mrs. X has had ovulation induction with gonadotropins at the University within the last four weeks. On physical examination you find that she has marked ascites and that when she is supine, she is somewhat hypotensive. She reports about 20 pounds of weight gain in the last 5 days. What treatment modalities have been recommended in these circumstances?

Topic 2. A patient on cyclosporin post-renal transplant presents to the emergency room with symptoms and findings classic for mycoplasma pneumonia. Since it is 3:30 AM, you decide to defer calling the infectious disease consultant and initiate therapy with erythromycin. Prior to starting therapy, your M3 suggests that she vaguely remembers an interaction between cyclosporin and erythromycin. Is there any evidence in the literature to substantiate her statement?

Topic 3. A 52-year-old patient with a history of chronic alcohol abuse and

alcoholic cirrhosis is admitted to your service with mental status changes and laboratory findings suggesting acute hepatic injury. The patient's family adamantly denies that the patient had any recent alcoholic binges. They state that he had complained of a cold for the last 3–4 days. Further questioning reveals only that he had taken three or four Extra Strength Tylenol (acetaminophen, 500 mg) per day for the 3 days prior to admission. You postulate that potentially that the Tylenol led to his picture of acute hepatic injury. Is there any evidence in the literature to support or refute this hypothesis?

2. Variables

Search experience. This study is designed to examine whether early and more frequent MEDLINE searching is positively linked to search skills, search effectiveness, clinical knowledge, and/or subsequent usage of this online resource. The study design compares these variables among groups of searchers with different levels of search experience. Search experience, therefore, was the independent variable. Using an approach similar to one employed by King (21) at the same institution 2 years earlier, the 184 searchers were divided into three groups according to the total number of online sessions they had accumulated at the time of the assignment.

Search experience may be interpreted as the number of topics searched (22–24), the number of successful searches conducted, or the number of online hours accrued. In this study, search sessions, not number of search topics, were used as the unit of analysis. The number of topics searched may be inflated by using search sessions as the measure of search experience, since one could log on several sessions before satisfactorily completing a single search topic. On the other hand, it also could be an underestimation of the actual topics searched, since two or more topics may be searched in one session. We found through an analysis of the transaction logs for this assignment that over 95% of the 184 students performed a one-topic search in a single online session.

Using King's findings (21) that advanced users searched at least twice each month, the following categories of searchers were identified. "Advanced searchers" were those who had accumulated over 40 sessions in the preceding 30 months, the period UM-MEDLINE had been available. They averaged 2.64 search sessions a month for the 30-month period. "Beginner searchers" were those who had logged 0–20 online sessions on UM-MEDLINE in the 30-month period. Students in this group searched once every 3 months on average. "Intermediate searchers" had logged 21–40 sessions, averaging one search a month.

Search skills. In this study, search skills were interpreted as the use of selected features offered by the PaperChase system or of the MEDLINE database itself. Two types of features are discernible. The first type consists of simple systems features displayed in the basic menu. These features are displayed repeatedly whenever terms are selected and they include the options "AND," "OR," and "display/scan." The Boolean AND allows two concepts to appear in the same paper; the OR pools papers each with at least one of the two specified concepts.

The more advanced features are less obvious to naive searchers. These include use of subheadings and limiting by language or year of publication.

Search effectiveness. Effectiveness of searches was operationalized by the two measures used in retrieval experiments in information retrieval literature. They are relative recall and precision. Relative recall is computed as the quotient of the number of relevant items retrieved by each student to the total number of relevant items retrieved by experts. Precision is the ratio of the number of relevant items retrieved by the student searcher to the total number of relevant or nonrelevant items retrieved. In this study, the denominator of the relative recall ratio is derived from the pooling of the search results of two experts. Our experts included an experienced librarian searcher, who performed a high-recall search for the three assigned topics, and two subject domain experts who conducted high-precision searches on the topics. The result sets for each of the three search topics were merged. After a few weeks, the subject experts were asked to rate the retrieved citations in the merged sets. An item could be relevant, partially relevant, or not relevant. Since each of the 184 student searchers performed one search, the number of searches analyzed for recall and precision equaled the number of searchers.

In clinical settings when key information is needed for decision making in either diagnosis or treatment planning, the ability to retrieve at least one item of definitive relevance is crucial. In the information retrieval literature, a distinction has been made between normal and strong relevance (25, 26). Items judged either relevant or partially relevant are the basis for recall and precision computations using *normal relevance*. *Strong relevance*, however, is applied when only items judged to be of definite relevance are used for comparison. The latter obviously represents a more rigorous requirement. Strong relevance is probably the more appropriate standard to compare an average search conducted for clinical purposes.

Clinical knowledge. Two scores were used as indicators of clinical knowledge. The first was the overall score that the student received on the University of Michigan Medical School's Comprehensive Clinical Assessment (CCA) examination given at the beginning of the fourth year of medical school. This examination involves 13 stations of 15 to 30 min each. Participants in the examination include standardized patients, faculty members, monitors, and medical students. The students rotated through the 13 stations over a period of 4 hr. Examples of the stations included history-taking from a patient with chest pain, performance of a breast examination, interpretation of pediatric videotapes, interpretation of radiographs, interpretation of psychiatry videotapes, and a literature search. The developers of this Comprehensive Clinical Assessment included a literature search station to emphasize the clinical importance of this tool, which was considered on par with the ability to take a history or use of the stethoscope.

The students' score on NBME-Part II was the second measure of clinical knowledge used in this study. The objective of Part II of the NBME is to evaluate the student's clinical knowledge against a norm or standard and to

TABLE 1
MEASURES OF SEARCH SKILLS

	Topic 1	Topic 2	Topic 3	Total
Search statements	12.0 (2-32)	5.7 (2-15)	10.3 (2-28)	9.5 (2-32)
Display/scan	32.8 (1-227)	19.3 (0-135)	40.1 (0-213)	32.2 (0-227)
Retrieved/printed	7.4 (0-15)	9.2 (0-20)	9.1 (1-24)	8.6 (0-24)
AND	4.1 (0-14)	1.7 (0-6)	3.3 (0-10)	3.0 (0-14)
OR	1.0 (0-5)	0.4 (0-2)	1.0 (0-4)	0.8 (0-5)

Note. The two values given in each cell are respectively the mean and the range.

compare his/her performance to other students throughout the country. The NBME is administered during the autumn or early in the fourth year at this school.

Subsequent use of MEDLINE. This study also examines the relationship between the frequencies of search sessions and the subsequent usage level. The level of subsequent usage was operationalized by the number of online sessions in the 5 months following the search assignment. Values for this variable were obtained from the system's data.

V. RESULTS

1. Search Skills

The three search topics varied considerably in terms of complexity. Table 1 shows the number of possible search statements used to represent the major concepts in each scenario and the variations in the use of search features in the three search topics. Topic 2 was a relatively straight forward search requiring an average of 5.7 search statements. Each of the other two topics required more than 10 search statements on average. Yet, when looking at the three searches as a composite, the average number of search statements, number of records displayed or scanned, number of records printed, and the use of the two common Boolean operators are similar to those reported by King (21). Almost every researcher in our study found occasion to use AND, while only 52% used OR. No one used NOT.

Use of MeSH terms is preferred for MEDLINE searching, since they are more likely to produce relevant results. Figure 1 shows that PaperChase is effective in directing users to MeSH terms. In fact, all users used at least one MeSH heading even though they may have entered a non-MeSH term initially.

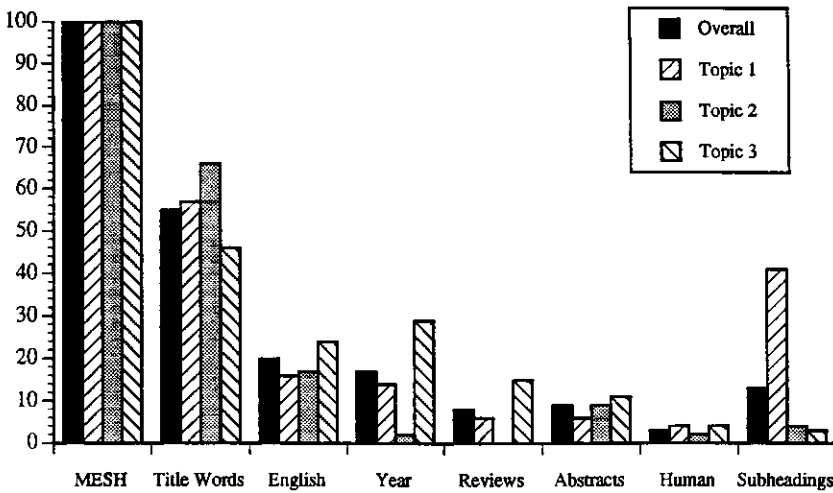


FIG. 1. Percentages of searchers using each of the search features.

However, over half of all the searchers chose to enter title words as well as the MeSH terms PaperChase suggested.

Compared with King's earlier findings at the same institution, fewer searchers made use of limiters such as language, year, review, abstract, or even subheadings. This difference may be due to the fact that our group of searchers had assigned search topics as opposed to the random sample of searchers conducting searches on a wide range of topics used in King's study. Further, features which only appear in PaperChase's secondary menus, i.e., subheadings, major heading designations, and the operator NOT, were rarely used by the searchers. They also did not limit their search output to citations with online abstracts even though the assignment explicitly required they produce a list of articles with abstracts. On the other hand, few students had difficulty selecting from among the retrieved sets those they wanted to print. The range of records retrieved as solutions to the search assignments was 0–24. Seventy-one percent of the searchers printed 10 or fewer records and 89% printed 15 or fewer. We found no statistically significant differences in any of the analyses of variance conducted to detect differences among the three search experience groups in terms of their use of each of the system's features. This confirms King's finding that, for end-users, experience has no effect on use of system features.

2. Search Effectiveness

(a) *Recall performance.* Table 2 shows the relative performance of the subject experts versus the experienced online searcher in terms of recall and precision. The librarian's searches were designed specifically to achieve high recall and, in fact, her recall for items of normal relevance was 81% compared to a mean of 55% from the "quick and dirty" searches conducted by the two clinicians.

TABLE 2
 RECALL AND PRECISION BY SUBJECT EXPERT
 AND LIBRARIAN

	Normal relevance (%)	Strong relevance (%)
Recall		
Subject expert	55	59
Search expert	81	78
Precision		
Subject expert	58	44
Search expert	46	30

Indeed, both physicians took very little time either in planning the search or in their execution of it, but they achieved greater precision, 58%, compared to 46% by the librarian. When the comparison was limited to items of definite relevance, using strong relevance as the criterion, similar results obtained.

Evaluating the recall achieved by students using a high-recall search for comparison has limited value when the number of items retrieved is small. However, comparison of recall values among students within the three levels of search experience is meaningful. This holds true whether using normal or strong relevance as the criterion as can be seen in Fig. 2. The average recall

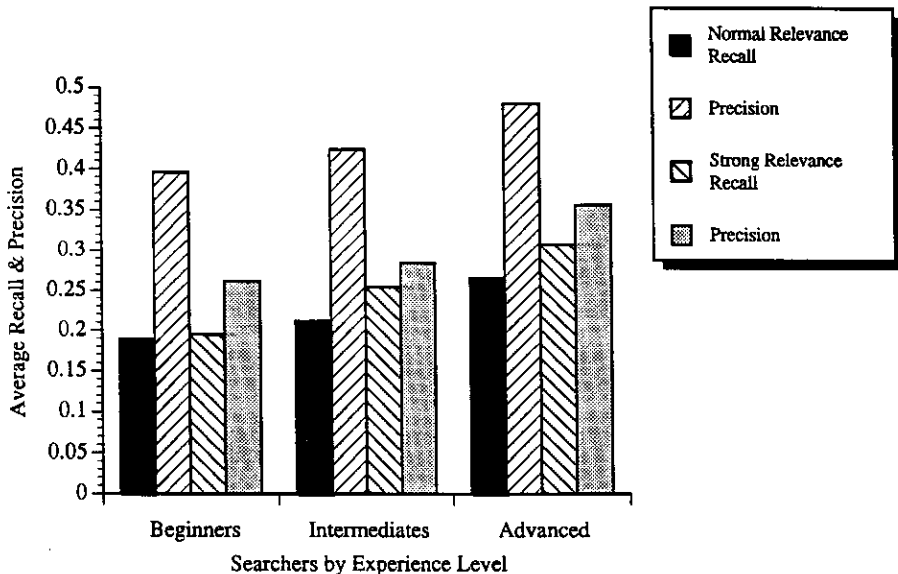


FIG. 2. Average recall and precision in retrieval by experience level.

TABLE 3
ANOVA OF MEAN NUMBER OF RELEVANT RETRIEVAL AMONG THREE SEARCH
EXPERIENCE GROUPS

	Total Number of relevant documents	F	P	Significant?
Normal relevance	48	1.67	0.192	No
Strong relevance	27	4.36	0.014	Yes

ratios, using strong relevance as the criterion, for beginner, intermediate, and advanced searchers were 20, 25, and 31%, respectively. In other words, the ability of frequent searchers to retrieve relevant items is greater than that of less frequent searchers. While the objective of using MEDLINE to support clinical decisions is not to retrieve a large number of papers, nevertheless, this study does show a trend that recall improves with more search experience.

The assignment asked students to print a few abstracts that contain information addressing the patient problem described. This implies that a high-precision search is most appropriate. Overall, the average precision achieved by the students in this study is low. However, precision, too, did rise slightly with an increase in experience level.

(b) *Ability to retrieve relevant items.* The assignment specifically required students to retrieve a few papers which they thought provided information on making a clinical decision. We analyzed their results to see how many were able to actually do this. Eighty-six percent of the class of third-year students were able to retrieve at least one relevant or partially relevant item, and 83% retrieved at least one item of definite relevance. Data were also analyzed to determine if the number of relevant items retrieved differed among searchers in the three experience levels. While there was no statistically significant difference found in the average number of relevant items retrieved, if all relevant items were included, a strong statistically significant difference was found among the average number of definitely relevant items retrieved. ($P = 0.014$) (Table 3).

Furthermore, Table 4 shows that 73.4% of the students were able to achieve

TABLE 4
DISTRIBUTION OF SEARCHERS BY PRECISION RATIOS

Precision ratios	Normal relevance (%)	Strong relevance (%)
0.00	14.1	17.4
0.01-0.24	12.5	22.3
0.25-0.49	26.1	39.1
0.50-0.74	33.2	15.8
0.75-0.99	8.7	0.5
1.00	5.5	4.9

TABLE 5
MEAN SEARCH SESSIONS PER MONTH

	Jan. 1989–July 1991		July 1991–Nov. 1991	
	Mean	Median	Mean	Median
Beginners (<i>n</i> = 66)	0.38	0.43	1.83	1.10
Intermediates (<i>n</i> = 52)	0.99	0.97	2.45	2.00
Advanced (<i>n</i> = 66)	2.64	2.10	4.68	4.30
Total	1.36	0.97	3.02	2.00

a precision level of 25% or more when normal relevance was used as the criterion and 60.3% achieved 25% or more precision using strong relevance. Our data demonstrate that in an environment with few barriers to information use, even with little formal MEDLINE training, most students are able to retrieve a few relevant items.

3. *Clinical Knowledge*

From the 184 students, we were able to obtain 179 scores from the CCA examination and the National Board–Part II (NBME). Both scores were normally distributed. A Pearson correlation coefficient of 0.675 was computed between the two scores. An analysis of variance showed no statistically significant difference among the three levels of search experience with respect to either the CCA or the National Board–Part B scores. Neither the CCA nor the NBME scores correlated with the recall or precision scores computed for the students from the pooled relevant set, nor from the set of definitely relevant items. The correlation coefficients ranged from -0.08 to 0.27 . Of those searchers who achieved high recall (over 25%), no correlation was found with either their CCA or NBME scores. Nor was a correlation found between low scores on these tests and low-recall searches.

4. *Subsequent Use of MEDLINE*

The following data and tests show a strong correlation between more experience searching UM-MEDLINE prior to the search assignment and more online sessions at a later period of observations.

- The number of online sessions logged by each searcher prior to the search assignment was correlated with the number of sessions s/he performed in the 5 months subsequent to the intervention. A Pearson correlation coefficient of 0.53 was found.

- Table 5 shows that the number of online sessions per month steadily increased. Beginners went from 0.38 to 1.83 sessions per month, while advanced searchers went from 2.64 to 4.68 sessions per month in the 5 months following the examination. As was found in the pilot study (26), while searchers in each

experience group conducted more searches per month subsequent to the search assignment, the novice searchers showed more than a fourfold increase in their mean search frequency, although the median increased by 1.5 times.

- The average number of searches conducted by the beginner, intermediate, and advanced searchers in the subsequent 5 months was 9, 12, and 23, respectively. At the 0.95 level of significance, the analysis of variance indicated that there was a strong statistical significant difference among the groups ($P = 0.000$). Statistical differences remained, whether looking at the three searches as a whole or whether looking at searches associated with each topic. Frequent searchers continued to out perform beginner and intermediate searchers.

VI. DISCUSSION

This study was restricted to online topical searching of MEDLINE using the PaperChase system. Aside from that, it differs from other studies (19, 27) in that explicit costs and barriers to accessibility and availability were largely eliminated. The most important finding of this study is that once an individual has successfully used the online system to identify medical literature, there is a good chance that s/he will continue to use the system. That exposure to MEDLINE searching appears to encourage future usage has been suggested by other researchers.

A report by Mitchell (27) and her colleagues at the University of Missouri describes a study in which first-year students were trained in Grateful Med and given free access for 5 weeks in order to complete an assignment. No end-user access was available for the following 6 months, however. During their second year, the students again were given free access to Grateful Med for a specific assignment, but they were encouraged to search for other needed information as well. No decline in their search skills was noted and those who searched tended to use MEDLINE for other needed information about as often as they used it to complete their assignment.

Similarly, a follow-up study of University of Michigan School of Pharmacy graduates who had received end-user search training during their third year of study found that after graduation 72% of the respondents used computerized literature searching to satisfy their information needs. This level of awareness and use of online resources was attributed to the exposure and training they received (13). Further, given exposure to an easy-to-use system with no formal training requirement imposed, experienced searchers have a better chance of retrieving relevant items from the database than the less experienced, even though they are no more likely to use advanced system features than a novice.

In response to the specific research questions posed,

(1) we found strong evidence to support the existence of a relationship between the level of prior search experience and the subsequent use frequency of MEDLINE. If educators are serious about preparing physicians to be lifelong learners, it appears that more MEDLINE usage should be encouraged to maximize their chances of continued usage of this online information resource. Our

study shows that the introduction of a clinically relevant search assignment resulted in significantly more search sessions for all levels of searcher, but especially novice searchers, in subsequent months. Thus, a MEDLINE search assignment introduced in the medical school curriculum as part of their clinical training can be seen as a simple and yet effective means of introducing the concept of lifelong learning and also of encouraging young clinicians to incorporate searching into their patient care routine. Further, given exposure to an easy-to-use system with no formal training requirement imposed, experienced searchers have a better chance of retrieving relevant items from the database than the less experienced, even though they are no more likely to use advanced system features than a novice.

It is most encouraging to note that most students regardless of previous experience were able to complete the search assignment. Eighty-six percent of them were able to retrieve some relevant items even under tight time constraints and the pressure of immediate clinical application and retrieve a few useful items.

(2) We found no relationship between prior search experience and use of features offered by the system or the database. Our findings corroborate with previous reports in that most end-user searchers tend to use simple search strategies regardless of their levels of experience with the system (27–29).

(3) We assumed that a higher level of search experience would produce better search results. We detected a trend that as students became more frequent searchers, they did in fact produce more effective searches. Levels of recall and precision improved with levels of search experience.

(4) We were somewhat surprised to find that no statistically significant difference exists among students with different levels of MEDLINE search experience and their performance in either University of Michigan's Comprehensive Clinical Assessment examination or the NBME–Part II. In other words, the more competent students are not necessarily the students who search most often, nor are they the most likely to retrieve more relevant information. On the other hand, the effective searchers are not necessarily those with high scores in CCA or Part II of the NBME. Given a rudimentary understanding of medical concepts and a basic knowledge of medical terminology, effective search skills may be developed independent of in-depth clinical knowledge. While online access to MEDLINE provides an easy and effective means to obtain pertinent information to support clinical decision making, it is not a requirement for being a good clinician; neither is a high level of clinical knowledge a necessary and sufficient condition for a good MEDLINE searcher. However, the ability to use MEDLINE effectively is clearly one of many important skills essential for effective clinical practice in today's rapidly changing information environment. Our findings must be qualified by the fact that only three search topics were used for this study, and they were not unduly complex search topics. Further studies are needed to verify the reported results.

It is our intention in a subsequent paper to identify and report on the specific level of search experience needed to achieve appreciable improvement in the

chances of success for retrieving relevant items. We also intend to analyze some of the less successful searches in the hope of identifying some of the causes of failed searches. Such data could have important implications for MEDLINE training. Further studies with even better controls are needed to confirm our findings.

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