Evaluation of a Program To Teach Health Professionals To Search MEDLINE*

BY SUSAN S. STARR, *Head, Public Services*

BEVERLY L. RENFORD, *Reference/Instructional Services Librarian*

Biomedical Library
University of California, San Diego
La Jolla, California 92093

ABSTRACT

This study analyzes the search behavior of end users who had taken a class in searching MEDLINE on the National Library of Medicine's MEDLARS system. Of the class alumni, 58% obtained passwords. Most of these were still conducting their own searches twelve to eighteen months later. Telephone interviews and search observations indicated that these end users were satisfied with their results and felt they had mastered the basic mechanics of searching. However, appropriate use of explodes and subheadings, as well as locating appropriate search terms, still presented difficulties for them. Further training in these areas may be required.

DURING THE LAST few years, online search systems originally designed for trained intermediaries have begun to be marketed to end users. Some system vendors, such as BRS and DIALOG, have designed special interfaces that make their systems more accessible to end users, thereby partially eliminating the need for lengthy training. Other vendors, such as the National Library of Medicine (NLM), have merely modified their policies; new policies give end users access to the system without the help of intermediaries.

With this change in marketing strategies, librarians, as experienced searchers, have been asked to play a new role. Potential end users ask if they should, in fact, do their own searching; experienced end users ask librarians to assist them in improving their search skills. Fulfilling this new advisory role requires that librarians design instructional programs to assist end users in searching and in selecting appropriate search systems. To design such programs adequately, librarians need more information on the search behavior of end users, including the problems they encounter, the techniques they use, and the degree to which they have been able to achieve satisfactory search results.

Prior research on end users sheds some light on these issues. Studies suggest that end users of NLM [1–3] and other [4, 5] databases do not take full advantage of system features; they tend to perform simple searches. Some studies also indicate that many end users do not search regularly after their initial exposure to a search system. However, the results of these earlier studies may not be applicable to end users now beginning to search. End users in the earlier studies were usually a select group who were motivated to participate in such studies (at least initially) by the promise of free connect time. Often, little training was provided. End users beginning to search now are generally responding to vendor advertisements or word-of-mouth reports from colleagues; they pay for all their own searching, use their own equipment, and some attend vendor-sponsored training sessions. Fidel reports that motivation, cost, and training all affect search results [6]; therefore, end users beginning to search now may well behave differently from those in previous studies.

The University of California, San Diego, (UCSD) research reported here was designed to provide information on the search behavior of a specific portion of this new group of end users—those using MEDLINE on the MEDLARS system who were trained in an NLM course taught by librarians. Information on search behavior was collected through telephone interviews and search observations.

TELEPHONE INTERVIEW

A telephone interview was conducted with individual participants six months after they completed an eight-hour course in searching. In this course they were taught to search MEDLINE through the National Library of Medicine's MEDLARS sys-

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tem [7]. (At the time of this study, such a class was mandatory for end users who wanted an NLM password.) The interview, a set of short-answer questions, was designed to answer these larger questions:

1. Had participants actually obtained passwords and begun to search?
2. If not, why not? Did they encounter problems in getting passwords or in obtaining equipment? Did they decide it was too expensive, time-consuming, or complicated?
3. If they did begin searching, how frequently did they search? What types of questions did they use MEDLINE to answer? How satisfied were they with their results? What problems did they encounter?

The questionnaire is available from the authors on request.

Six to twelve months later, a follow-up call was made to those who had received their passwords at the time of the initial interview. They were asked whether they were still searching and, if so, how frequently they searched.

Forty-five individuals took the first six search classes offered. All thirty-seven who were still in the San Diego area six months later were interviewed. Most of the interviewees (thirty-three) were affiliated with this university, and most were from the medical school (twenty-nine). A majority (twenty-five) were male, and slightly less than half (seventeen) had used UCSD's search services during the previous year. Twenty-two of the interviewees (59%) had obtained a password by the time of the interview.

Nonsearchers

No important differences were found between the twenty-two individuals who had obtained a password after taking the class and the fifteen who had not in sex, faculty status, affiliation with the university, or the specific course taken. Nor did the interviewees differ in the extent to which they had previously used UCSD's search services: ten of the nonsearchers had used them during the previous year, compared to seven of the searchers.

Among the reasons nonsearchers gave for failing to obtain a password (Table 1), difficulty in obtaining the password from the National Library of Medicine was the most frequently mentioned, followed closely by cost, difficulties in obtaining appropriate equipment, and lack of time. When asked which of all the problems mentioned was the most important, participants ranked the problem of obtaining a password highest. During this period, NLM took several steps to make it easier and quicker to obtain a password, but there was no relationship between the time at which an individual took the class and whether or not he cited problems in obtaining a password. When asked if having equipment available in the library would make them more likely to obtain a password, 60% of nonsearchers answered yes. Despite their failure to get a password, these nonsearchers exhibited great enthusiasm for the course; all thought that the library should continue to offer it.

TABLE 1

NONSEARCHERS' REASONS FOR NOT OBTAINING PASSWORDS (RESPONDENTS = 15)

Reason	No. Responses (%)*
Problems getting a password	5 (33)
Cost too high	4 (29)
Lack of equipment	4 (29)
No time to search	4 (29)
No interest in searching	0 (0)
Searching too complex	2 (14)
Easier to use intermediary	1 (7)

*Percentage does not equal 100 because each respondent was permitted to give multiple answers.

Searchers

Among the twenty-two individuals who had obtained a password, twenty were actually searching at the time of the interview (two had not used their passwords). Of the searchers, nineteen (95%) were searching MEDLINE, three (15%) BIOSIS (two of these also used MEDLINE), and one (5%) another database. Seventeen (85%) were using NLM as their vendor, while three (15%) used BRS, and four (20%) DIALOG. At the date of the interview, the median time since obtaining a password was five and a half months. However, there was considerable variability in the sample. One individual had had his password for less than a month; another, who had used someone else's password prior to taking the course, had been searching for two years. Likewise, there was great variability in search experience. Half the sample said that they searched at least once a week, 35% once a month, and 15% bimonthly. Search experience among those who had obtained passwords ranged from no searching at all to more than fifty searches at the time of the telephone interview. The median was twelve searches.

When asked about their search experiences,

—All searchers said they searched for material by subject; 65% also searched by author. Only 15% ever used their password to locate incomplete citations. Searching by subject was the most frequent use of online databases, 85% said.

—Twenty-five percent said they always found what they wanted and an additional 50% said they almost always found what they wanted.

—None found all material relevant to their searches all the time, but 55% said they almost always found all relevant material, and an additional 20% usually did.

—Most reported using MEDLINE for research rather than for patient care purposes.

—The greatest problem (reported by over 50% of the respondents) was remembering the correct commands (Table 2).

—Sixteen (80%) reported that they used MeSH tools to find subject headings, one (5%) used the online MeSH file, eight (40%) used keywords to find subjects, and five (25%) reported checking the indexing of relevant citations. Thirteen (65%) had purchased the MeSH trees, seventeen (85%) the annotated MeSH, and eleven (55%) the permuted MeSH.

—Only five reported that they almost always, or usually, exploded MeSH terms. Ten reported that they always, almost always, or usually used subheadings.

—There was no significant relationship between whether these end users said they found what they wanted and whether they used MeSH tools, explodes, or subheadings.

—Participants who had obtained a password at the time of the initial telephone interview were contacted again twelve to eighteen months later. This second telephone interview included sixteen of the original twenty-two individuals who obtained passwords. All but one were still actively searching. Searching frequency had increased to at least a few times per month.

—Only two of the twenty-two individuals who obtained passwords requested searches from the library after taking the course, as opposed to eight of the fifteen who had not obtained passwords. One of these two searchers continued to receive an SDI from the library and the other one asked for a search on a new topic.

Summary of the Telephone Interview Results

In comparison with previously reported end-user training sessions [8–10], the UCSD course achieved a high success rate. Fifty-eight percent of the participants obtained passwords and 54% were searching at the time of the interview. More important, those who began searching continued to search; more than a year later, those contacted were still searching, some more frequently than at the time of the initial interview. Among the searchers there was a high level of satisfaction with results; indeed, they were so satisfied that they no longer used the library's search services. A large majority of the searchers felt that they were finding what they wanted and retrieving most of the relevant literature. This is somewhat surprising, because few of them used MEDLINE's explode capability and only half used subheadings or even owned all the major MeSH tools.

In a sample so small and homogeneous, demographic differences could not explain why some

TABLE 2

PROBLEMS SEARCHING (RESPONDENTS = 19)

Problem	Frequency			
	Almost Always	Usually	Rarely	Never
Equipment difficulties	2	1	8	8
Logging on/off	0	1	1	17
Remembering commands	1	8	3	7
Typing in commands	0	0	2	17
Finding subject headings	1	3	8	7
Using Boolean logic	1	1	5	12
Too large a retrieval	0	4	7	8
Too narrow a retrieval	1	3	6	9

participants began searching after the class and others did not. Those who did not obtain a password mentioned a variety of problems, some of which will no doubt be remedied as NLM streamlines its application procedures and as equipment becomes widely available. All participants had to follow the same procedure to get a password, and the steps NLM took to facilitate password assignment during this period had no effect on the degree to which the nonsearchers blamed their inactivity on trouble in procuring a password. Time, cost, and lack of interest may have been the underlying reasons why those who did not search failed to overcome equipment and password difficulties.

Even among those who did not begin to search, there was considerable praise for the course. Many commented that they had learned a great deal from the course and that they had been impressed by the librarians' training and expertise. All felt that the course was useful, even those who had not pursued searching.

Search Observations

The telephone interview established that more than half of the class alumni had begun searching and that most were satisfied with their results. Most used MeSH, although few of them employed explodes and fewer than half used subheadings. The interview, however, did not provide much information on end users' actual search strategies or on the problems they encountered. To provide this information, five interviewees volunteered to be subjects in observed end-user searches. These observed searches were viewed as case studies, not as a source of statistically valid information.

All but one of the observation sessions, which lasted about an hour each, were conducted in the library, with the library's equipment and password, about two months after the telphone interviews. Using the case study technique described by Fidel [11], the observer made notes on the end user's strategy and behavior throughout the session; the observer also questioned the end user when the strategy was unclear. All the comments of both observer and searcher were taped, and these tapes, in addition to the search printouts and the observer's notes, were used to analyze search behavior.

All five participants were asked to select their own search topic. They were given the permuted and annotated MeSH and the MeSH tree structures to use if they wished. The topics were

1. Effects of aspirin on protein absorption or any information on enhancers of protein absorption
2. Haemophilus influenza vaccine
3. Arthritis in cancer patients
4. The relationship between gynecomastia and breast carcinoma or breast hyperplasia in the human male, especially *in situ* or intraductal carcinoma
5. Drug overdose in the elderly

After they completed the search on their own topic, they were asked to formulate and execute three additional searches on topics preselected by the authors. These three searches were run on the closed 1980–1982 file, to eliminate variations in retrieval due to file size. The preselected searches were designed to evaluate the end users' ability to search by authors' names; to use Boolean operators, MeSH headings, explodes, preexplodes, subheadings, and age tags; and to limit their searches to English-language articles.

The three preselected topics were these:

1. According to a colleague, the first author of the attached article wrote some articles between 1980–1982 that might be relevant to my current research. Please search for any papers written by him during that period.

   The title page of the article read:

   > Decreased total and active urinary kallikrein in normotensive Dahl salt susceptible rats
   >
   > Leonard A. Arbeit and Susan R. Serra
   > [first page of text followed]
2. Find any articles on "liver transplantation in infants and children under 12 years." This search should be limited to English-language articles.
3. Find any articles on the use of biofeedback, relaxation techniques, or yoga with patients who have cancer. Limit search to English-language articles.

When all five observation sessions were completed, a trained intermediary was given the five volunteers' topics, plus the three topics preselected by the authors, and asked to formulate and execute a search on each. In the sections below, the results of the intermediary's searches are compared to those of the end users, first for the three preselected topics and then for the topics selected by the participants.

Preselected Topics

For the three preselected topics the trained intermediary used the following strategies:

1. Author search:
   1. Arbeit la

2. Arbeit 1 (au)
3. 1 or 2

2. Liver transplantation:
   1. Exp liver/tr
   2. Exp transplantation and exp liver
   3. 1 or 2
   4. 3 and child or 3 and child, preschool or 3 and infant or 3 and infant, newborn
   5. ts (1a) eng
3. Biofeedback:
   1. Biofeedback or yoga or relaxation technics
   2. 1 and neoplasms (px)
   3. ts (la) eng

An analysis of the approaches the five end users took to these same searches showed that all displayed a basic knowledge of searching MEDLINE on NLM (Table 3). They were all able to log on and off without difficulty. Only one experienced a problem with Boolean logic (see below). All, aware that the default on NLM is to MeSH headings, consulted the MeSH tools before beginning to search.

The end users and the intermediary used similar strategies and similar vocabulary in approaching Topics 1 and 3. For Topic 1, one end user did not know the correct format for searching an author's name, but all the others searched for the author with both initials just as the intermediary had done. Three end users also looked for the author both with and without middle initial. For Topic 3, biofeedback, all used the same vocabulary terms as the intermediary: "biofeedback," "relaxation technics," "yoga," and "neoplasms." Three of the five made appropriate use of the cross-reference from "cancer" to "neoplasms" (the other two already knew that "neoplasms" was the MeSH heading). All but one successfully used the preexplode for neoplasms and all were able to limit their search results to English-language articles. One end user obtained fewer citations than the intermediary because he used "and" to combine the three relaxation terms instead of "or."

The end users seemed to find Topic 2, liver transplantation in children, more difficult. They had problems selecting the appropriate MeSH headings. None of the five end users included the age term "infants, newborn"; after locating the term "infants" in MeSH, they neither scanned the other terms beginning with "infants" nor followed the implications of the note under "infants." Two end users also neglected the term "transplantation." More important in overall effect on search retrieval, three end users did not use the subheading "transplantation." While the transcripts show that these three read the MeSH note under "trans-

TABLE 3
CONTROLLED SEARCH RESULTS (FIVE END USERS AND ONE INTERMEDIARY)

Searches	End Users					Intermediary
	1	2	3	4	5	
Author Search						
Logged on correctly	Yes	Yes	Yes	Yes	Yes	Yes
Used correct format	Yes	No	Yes	Yes	Yes	Yes
Citations retrieved (no.)	2	0	3	2	3	3
Biofeedback Search						
Used preexplode	Yes	Yes	Yes	Yes	No	Yes
MeSH terms (no.)	4	4	4	4	4	4
Used correct logic	Yes	Yes	Yes	Yes	No	Yes
Limited cites to English	Yes	Yes	Yes	Yes	Yes	Yes
Consulted MeSH	Yes	Yes	Yes	Yes	Yes	Yes
Citations retrieved (no.)	25	25	25	25	15	25
Liver Search						
Terms exploded (no.)	1	0	1	2	0	2
Subheadings (no.)	0	1	0	1	0	1
MeSH terms (no.)	1	1	2	2	2	2
Check tags (no.)	1	3	3	3	3	4
Used correct logic	Yes	Yes	Yes	No	No	Yes
Consulted MeSH	Yes	Yes	Yes	Yes	Yes	Yes
Citations retrieved (no.)	15	29	20	37	4	38

plantation" instructing them to use the subheading, they did not fully understand it. The note, which reads "prefer/transpl with organs," is perhaps a somewhat cryptic message to an end user.

Two end users also used faulty search logic. One used transplantation as a "floating subheading" instead of restricting it to the liver (the concept of "floating subheadings" is not taught in class, and the transcripts are unclear as to whether this use was intentional or accidental). The other end user began by exploding "transplantation" and then switched to the subheading, without combining the two approaches.

In approaching these preselected topics, the end users appeared to be comfortable with the basic mechanics of searching. They were able to locate MeSH terms that matched the entry vocabulary or a cross reference. However, MeSH arrangement, indexing notes, and the concepts of explodes and subheadings and search logic presented difficulties for them. Of course, a sample of three searches is very small, but it is interesting that these were the same problems that occurred when end users were asked to perform searches on topics of their own choice.

Unrestricted Searches

As with the preselected topics, the end users' searches on their own topics were compared to those of our trained intermediary. Only four end users' topics were analyzed. The fifth end user asked the observer so many questions that her search probably did not truly represent her own efforts. This search, on drugs in the elderly, was eliminated from the evaluation.

Comparison of the end users' strategies with those of an experienced intermediary (Table 4) showed

1. The intermediary and end users frequently employed different terminology.
2. The end users sometimes did not explode the same terms.
3. The intermediary used subheadings in three of the four searches; the end users used none.
4. The intermediary retrieved substantially more citations in two of the searches.

Review of the end users' strategies indicates that these differences reflect gaps in the education of the end users, particularly in search strategy and terminology.

Topic 1: Effects of aspirin on protein absorption.
The end user's strategy:

1. dietary proteins and absorption (8 retrievals)
2. 1 and adjuvants, pharmaceutic (0 retrievals)
3. Salicylates and 1 (0 retrievals)
4. Proteins and absorption (tw) (64 retrievals)
5. 4 and adjuvants, pharmaceutic (0 retrievals)

The intermediary's strategy:

1. Exp dietary proteins/me (956 retrievals)
2. 1 and absorption (12 retrievals)
3. 1 and intestinal absorption or 2 (75 retrievals)
4. 3 and ad or 3 and pd or 3 and tu (19 retrievals)
5. 3 and adjuvants, pharmaceutic (0 retrievals)
6. 3 and aspirin (0 retrievals)
7. 4 or 5 or 6 (19 retrievals)
8. 7 and all enhanc: or 7 and all potentiat: or 7 and all increase: (10 retrievals)

Print 8 and 6 (if any found).

Problems with both terminology and strategy were evident in this search. First, the end user chose the MeSH heading "absorption" while the intermediary selected "intestinal absorption," which more closely expresses the concept and would be more likely to retrieve relevant citations. The transcripts indicate that the end user was unaware of the existence of this heading. Second, the end user did not explode "dietary proteins," "proteins," or "salicylates." "Proteins" and "salicylates" were introduced by the end user to broaden his search, but by failing to explode them, he unintentionally eliminated the most relevant citations. Finally, the

TABLE 4

RESULTS OF FOUR UNRESTRICTED SEARCHES (FOUR END USERS AND ONE INTERMEDIARY)

Results	End User 1	Intermediary	Both*	End User 2	Intermediary	Both*	End User 3	Intermediary	Both*	End User 4	Intermediary	Both*
Headings	5	5	3	3	2	2	3	2	1	3	4	2
Explosions	0	1	0	2	2	1	1	0	0	0	0	—
Subheadings	0	4	0	0	1	0	0	1	0	0	0	—
Citations	0	10		0	49		62	54		18	13	

*Cases in which both end user and intermediary used the same term.

end user introduced no subheadings, whereas the intermediary tried several and thereby was able to increase retrieval of relevant citations. Because there is so little literature on this topic, this was a difficult search; it is hardly surprising that the end user found little of interest. However, the difficulty of the topic was compounded by the end user's evident lack of knowledge about explodes and subheadings.

Topic 2: Arthritis in cancer patients.
The end user's strategy:
1. arthritis (1213 retrievals)
2. neoplasms (px) (87949 retrievals)
3. 1 and 2 (66 retrievals)
4. 2 and exp joint diseases (573 retrievals)
5. eraseback 4
6. 2 and * joint diseases (46 retrievals)
7. 5 and arthritis (tw) (3 retrievals)

The intermediary's strategy:
1. Exp arthritis (6536 retrievals)
2. 1 and *neoplasms (px) (331 retrievals)
3. exp * arthritis (4890 retrievals)
4. 3 and *neoplasms (px) (118 retrievals)
5. exp *arthritis/co (628 retrievals)
6. 5 and *neoplasms (px) (49 retrievals)

This end user experienced problems similar to those of the first subject. Again, he seemed not to understand the use of explodes. Having retrieved sixty-six articles with his initial strategy, he was dissatisfied with the relevancy of the sample he printed and went on to other approaches. He did not realize that he had eliminated much of the relevant literature by failing to explode "arthritis." The end user also failed to use the subheading introduced by the intermediary. It was clear from his description of the topic that he was interested in arthritis as a complication of cancer, but he did not realize that the subheading "complications" could be used to obtain the relevant literature.

Topic 3: Vaccine for haemophilus influenza.
The end user's strategy:
1. Haemophilus influenzae (143 retrievals)
2. influenza vaccine (215 retrievals)
3. 1 and 2 (1 retrieval)
4. explode vaccines (4343 retrievals)
5. 1 and 4 (62 retrievals)

Print statement 5.
The intermediary's search strategy:
1. Haemophilus influenzae/im (143)
2. 1 and bacterial vaccines (54 retrievals)
3. ts (la) eng (54 retrievals)

Print statement 3.

The third end user had a different problem; he had difficulty comprehending the indexing notes. His problem was reminiscent of the trouble all five end users experienced in understanding the "transplantation" note in the preselected search topics. This end user looked up "haemophilus influenza" in the annotated MeSH and read the note "coord im with bacterial vaccines (im); not influenza vaccine." However, he did not understand that the note was instructing him to use "bacterial vaccines." He used "influenza vaccine," thereby eliminating the relevant literature from his results. This end user, however, unlike the first two, understood explodes; by exploding "vaccines" he was able to retrieve "bacterial vaccines" and so obtain the citations he needed.

Topic 4: Gynecomastia and breast cancer.
The end user's approach:
1. Gynecomastia and breast neoplasms (18 retrievals)
2. Gynecomastia and hyperplasia (1 retrieval)
3. Gynecomastia and hyperplasia (tw) (2 retrievals)
4. Gynecomastia and intraductal (tw) (0 retrievals)
5. Gynecomastia and in situ (tw) (0 retrievals)
6. Gynecomastia and situ (tw) (1 retrieval)
7. Gynecomastia and carcinoma (tw) (13 retrievals)

Print statements 1, 2, 3, 7.
The intermediary's strategy:
1. Gynecomastia (132 retrievals)
2. 1 and breast neoplasms (18 retrievals)
3. ts (mh) human and males (13 retrievals)
4. 3 and situ (tw) (0 retrievals)
5. 3 and intraductal (0 retrievals)

Print statement 3.

In this case, the end user and the intermediary achieved similar results. They made some different assumptions about vocabulary; the end user simply assumed that gynecomastia applied only to human males, while the intermediary limited her search results specifically to human males, eliminating five articles on animals or women. The end user tried to combine hyperplasia with gynecomastia, while the intermediary did not (believing that gynecomastia is by definition hyperplasia and therefore would not be indexed to hyperplasia as well). The retrievals indicate that both her assumptions were correct. The intermediary's greater experience with MeSH produced somewhat more precise search results, but the results were essentially the same.

Summary of Search Observation Results

In searches of both preselected topics and those of their own choosing, the end users demonstrated the familiarity with search language and search logic they had attested to in the telephone interviews. They could log on and off, move through the file, and print their results. They understood that use of MeSH terms is the key to searching on NLM, because the system defaults to the MeSH vocabulary. They were generally successful with simple searches.

However, an analysis of their search strategies, especially in dealing with more complex topics, indicated difficulties with terminology, indexing notes, explodes, and subheadings. All missed some relevant terms and all found the notes obscure. Some eliminated highly relevant citations by failing to explode terms, and none employed the subheadings used by the intermediary.

Because this sample of end-user search observations is so small, the results must be interpreted cautiously. To the extent that these results reinforce the telephone interviews, they probably do reflect the search behavior of the majority of the end users trained in these classes. Both the search observations and the interviews indicated that end users did not regularly employ explodes or subheadings when searching. On the telephone, the interviewees did not acknowledge selection of MeSH headings to be a major problem. However, search observations showed their problems with the MeSH vocabulary, particularly in understanding the annotations. While it is possible that using MeSH vocabulary was problematic only for those who participated in the search observations, this seems unlikely. It was expected that only the more confident and experienced end users would volunteer for observation. It seems more plausible that most end users interviewed did have trouble locating MeSH headings, but they did not realize that they were missing relevant literature because of the subject headings they selected for their searches.

Implications and Conclusions

There are several implications of these findings for librarians who teach end users. First, a course such as this can be successful in training end users. More than half the participants in this course went on to search, and most expressed satisfaction with their results. In considering whether this success rate justifies the investment of staff time, it is important to note that satisfied end users are only one product of such a course. Even the participants who did not obtain passwords said that they learned much from the course. They also felt that they would be able to phrase their search requests better as a result, and they urged the library to continue to offer it. Moreover, many of the participants in the course were senior faculty; the course thus provided an opportunity to contact users who are often hard to reach. Finally, the library reaped positive publicity merely from offering the course. This publicity has allowed it to establish and expand other programs.

A second, less positive implication is that not all the course concepts were successfully taught. The last third of the course concentrated on explodes, subheadings, and limiting by age. These still appear to be elusive concepts for many end users. Perhaps the course tried to teach too much in too little time. Or perhaps these more sophisticated search techniques can be absorbed only after the end user (or intermediary) has dealt with actual search topics, so that the techniques can be related to past experiences. An advanced course that focuses on strategies for handling difficult search topics may be needed to allow additional exposure to the more difficult techniques. Alternatively, teaching a simpler system, like PaperChase, which prompts users for explodes and subheadings, might be a better strategy. The problems in understanding indexing notes are perhaps to be expected, since these notes were not written for searchers. However, these results indicate that an annotated MeSH may be needed for end users not trained as librarians or indexers.

Earlier studies of end users searching MEDLINE documented problems similar to these. Because these earlier studies [12–14] evaluated programs that provided much less classroom training than this one, the results prompt an evaluation of whether six to eight hours of training is really necessary to teach end users even a complex system such as MEDLINE on NLM. Another research study would be required to compare the results of a classroom training program to one with minimal training but ample free practice time; matched groups of end users would need to be trained in two different programs and the results compared. However, the real benefit of classroom instruction to end users in the format used here may not be the amount of classroom instruction offered, but instead, the opportunity it gives busy health professionals to set aside enough time to learn the fundamentals of a search system adequately. This set-aside time may account for the relatively high percentage of end users in these classes who went

on to become searchers after taking the course. End users may not learn more in six to eight hours of class than in a brief class and six to eight hours of practice, but they may find it more efficient to come to one class than to find time in their busy schedules to practice.

The most puzzling aspect of these results is that a large majority of end users claimed to find what they wanted in their searches, even though both interviews and observations indicated that they frequently failed to use the MeSH vocabulary or the searching techniques that an intermediary would consider crucial to an effective search. A recent article on searching by patent attorneys points out that end users and intermediaries may place a different value on information [15]. The intermediary sees information as an end in itself; the aim of a search is to provide the best, most accurate answer to a search inquiry. The end user, on the other hand, sees information as a means to an end; he or she needs only enough information to answer a specific question. The intermediary would not consider a search that missed much of the relevant literature to be successful, but an end user might be satisfied with a few crucial articles, even if many more relevant materials are missed because of faulty vocabulary or strategy. Thus, many of our end users seem to be satisfying their information needs with only the basic search techniques. More sophisticated techniques may just not be required.

In considering this issue, it is important to bear in mind that these end users were, for the most part, using MEDLINE for research rather than patient care. There were a few clinicians in this sample, but they were at a large medical center where other clinicians were always available to advise them if information recovered from MEDLINE was insufficient. Whether clinicians or researchers in remote areas, more dependent for information on MEDLINE, would be similarly satisfied with their search results is a question deserving future study.

This study indicates that end users being trained in a course established by the National Library of Medicine are learning the fundamentals of searching MEDLINE on the MEDLARS system. Judging from these results, at least half of those trained in such a program will become searchers and they will be fairly satisfied with their search results. However, both interviews and observations show that many of those trained do not fully understand explodes, subheadings, or MeSH terminology. Although end users are satisfied, they are also missing relevant literature that could be important. Librarians need to develop methods to assist end users to improve their search techniques so that they can better retrieve the literature they seek.

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