
Online access to MEDLINE^{®*} in clinical settings: impact of user fees[†]

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The effect of introducing user fees on the frequency and quality of MEDLINE searching with GRATEFUL MED[‡] by physicians in clinical settings was tested. After training and free use (prior study), consenting participants were randomly allocated to pay searching costs (pay group) or continue without fees (no pay group). Fifty-nine physicians participated. Among the prior study's frequent searchers, the pay group searched at less than one third of the rate of those assigned to no pay. For less frequent searchers in the prior study, only 48% of those assigned to pay did any searches, compared with 85% for the no pay group ($P = 0.006$), and for those who did search, their frequency was almost half. However, there was no significant difference in the quality of searches; both groups demonstrated about equivalent recall ($P = 0.77$), but significantly lower precision ($P = 0.03$) than for the librarian's independent searches. Similarly, there was no difference in the proportion of searches affecting clinical decisions for the two groups. Thus, imposing user charges for online searching in clinical settings after a period of free use adversely affects searching quantity, but not quality. MEDLINE providers should consider whether user fees will undermine its benefits.

INTRODUCTION

The number of clinicians who conduct their own on-line searching of MEDLINE and other electronic bib-

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‡ GRATEFUL MED is a registered trademark of the National Library of Medicine.

liographic databases has grown rapidly in recent years. In 1986, in the authors' institution, 7% of full-time faculty and 3% of part-time faculty reported conducting their own online searching of MEDLINE [1], and just three years later, these figures had increased to 37% and 18% respectively [2]. In addition, it has recently been shown that no-charge, self-service, on-line literature searching by physicians in clinical settings can affect their clinical decisions [3].

In another investigation, the authors found substantial differences in the cost and amount of time required for different MEDLINE access routes in

searches performed by research librarians [4]. Introducing a charge for mediated online searching decreased mediated searching by about a quarter at the Indiana University School of Medicine Library (IUSML) [5]. End-user online searching at IUSML appeared popular at introduction when supplied without charge, but dropped when fees were introduced, with a rebound to half of baseline search frequency when fees were reduced by 50%. The effect of user fees on search proficiency was not assessed.

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To determine the effect of introducing user fees on the frequency and quality of self-service searching of MEDLINE through GRATEFUL MED software in clinical settings, the authors completed a randomized trial of charges for clinical users after a period of free use.

METHODS

This study was a sequel to an observational study described in detail elsewhere [6]. In the prior study, all attending physicians, house staff, and clinical clerks with clinical responsibilities in the study areas were invited to participate. Following informed consent, participants were offered a three-hour training program and up to two hours of free connect time to MEDLINE on the study computers. Microcomputer online access to MEDLINE using GRATEFUL MED (version 2.0) was made available in the emergency room, intensive care unit, mixed service ambulatory care clinic, and two acute care adult medicine wards of McMaster University Health Sciences Centre, a 300-bed primary through tertiary care teaching hospital. The software could be accessed only through a supervisor program designed to collect data on the identification of the user, the question to be answered by the search, and whether the question was about a specific patient. The supervisor program also recorded the time for all steps in the searching process and recorded the search formulation. The user received an immediate printout of any or all citations retrieved, as desired, while complete searches were stored automatically on the computer's hard disk and collected daily for analysis.

At the end of the prior study, subjects were randomly allocated either to pay for their online MEDLINE charges (pay group) or to continue searching

without charge (no pay group) for a period of six months. Ten subjects from the prior study reached two hours of searching time and were eligible for the pay/no pay study. One-hundred-forty-eight others reached the end of the observational study with less than two hours searching. Eighty-five of these were potentially eligible for the pay/no pay study, as they remained on the medical services of the study hospital; the remainder consisted primarily of clinical clerks and house staff who moved to other services or sites. Participants were randomized by pairs, using a coin toss.

For a one-third random sample of consecutive searches for each group, the searcher was interviewed to determine which citations were found to be useful, whether any full-text articles were retrieved, and whether any clinical decisions were influenced. The searcher's competence was also assessed by analyzing the last search episode from thirty-nine of the forty-one persons who searched in the study period (the search question was unclear for the remaining two). The question stated by the end user at the beginning of the search was sent, without the end user's search strategy or results, for independent searching to one of three qualified librarian searchers. The authors analyzed these duplicated searches for the number of articles retrieved, the relevance of the citations to the clinical question, and overlap of the retrievals among the searches. Relevance was determined by placing each citation (including indexing terms and abstract, if available) from each of the duplicate searches on a separate page, placing the pages in random order, and then sending the package for review to a clinician with expertise in the content covered by the question. The clinician was asked to rate the relevance of each citation to the clinical question on a seven-point scale: 1 = definitely not relevant; 2 = probably not relevant; 3 = possibly not relevant; 4 = possibly relevant (likely to have indirect or peripheral relevance at best); 5 = probably relevant ("letters to the editor" not to be rated higher than this, even if directly relevant); 6 = definitely relevant (including reviews that were directly relevant); 7 = directly and highly relevant original evidence from a major clinical study (not a review article).

"Recall" was defined, for a given search, as the number of relevant citations (five or greater on the scale) retrieved by that search divided by the total number of relevant citations retrieved by both the original and the librarian search on the same question. "Precision" was defined as the number of relevant citations retrieved by a given search divided by the total number of citations retrieved by the same search.

Tests of significance were performed using non-parametric procedures with the critical level of statistical significance set at 5%. The X^2 test was used for

categorical comparisons. The Wilcoxon rank sum test was used for unpaired rank-order comparisons, and the Wilcoxon signed-ranks test, for paired rank-order comparisons.

RESULTS

Baseline features

The ten participants in the earlier observational study who reached two hours of search time agreed to randomization (six to pay group, four to no pay group). Forty-nine of the other 85 eligible subjects also agreed to participate (23 to pay, 26 to no pay). There was no significant difference in the frequency of searching in the earlier observational phase for the participants in the pay/no pay study compared with those who were ineligible or declined.

The two groups participating in the randomized trial (pay and no pay) were comparable in level of medical training, computer use before the study, number of searches conducted before the study, and number of searches conducted by others (e.g., librarians) for them during the observational study.

The two groups participating in the randomized trial (pay and no pay) were comparable in level of medical training, computer use before the study, number of searches conducted before the study, and number of searches conducted by others (e.g., librarians) for them during the observational study (Table 1). The pay group appeared to have conducted more searches on nonstudy computers ("Searched outside study" in Table 1).

Effect on search frequency

During this pay/no pay study, the number of participants who conducted searches was significantly less among those assigned to pay (Table 2, 52% for pay versus 87% for no pay, $P = 0.004$). The median number of searches was also somewhat less in the pay group (2.0 versus 4.0, $P = 0.22$). The difference in the median number of searches was more marked among those who had searched more than two hours in the prior study (10.5 versus 36 searches). Of the 15 pay group members who searched, 7 paid by personal check, 6 from a university account, and 2 failed to pay despite reminders.

Effect on search proficiency

Duplicate searches were conducted independently by experienced librarians for each participant's final

Table 1
Comparison of baseline data

	Study group	
	Pay number (%)	No pay number (%)
All participants	29 (100%)	30 (100%)
Training level		
Clinical clerk	2 (7%)	3 (10%)
Intern/resident	11 (38%)	12 (40%)
Clinical fellow	3 (10%)	4 (13%)
Faculty	13 (45%)	11 (37%)
Computer use before study	16 (55%)	11 (37%)
Searched outside study	18 (62%)*	10 (33%)*
Median number of searches prestudy	9	8.5
Median number of mediated searches	2.5	0

* χ^2 (1 df) = 4.88, $P = 0.027$.

search during the study period. The median number of citations retrieved was slightly lower for the pay group but not significantly so ($P = 0.28$) (Table 3). However, the time per search connected to the MEDLINE database and the National Library of Medicine online cost per search were significantly lower for the pay group (Table 3). Assessment of quality of search results, based on the sample of thirty-nine final searches (Table 4), showed no significant differences in recall or precision among the two groups, although the trends showed slightly worse performance by the pay group. Pooling the results of the two study groups, recall was slightly lower than for the librarians (0.57 and 0.63 respectively, $P = 0.77$), while precision was significantly less (0.50 and 0.57 respectively, $P = 0.03$).

Table 2
Search frequency

	Pay number (%)	No pay number (%)
Participants who searched ≥ 2 hours in prior study		
Number	6 (100%)	4 (100%)
Number who searched in study	4 (67%)	4 (100%)
Median number of searches among those who searched	10.5	36
Participants who searched < 2 hours in prior study		
Number	23 (100%)	26 (100%)
Number who searched in study	11 (48%)*	22 (85%)*
Median number of searches	2.0	3.5
All participants		
Number	29 (100%)	30 (100%)
Number who searched in study	15 (52%)*	26 (87%)*
Median number of searches among those who searched	2.0	4.0

* $P < 0.05$ by χ^2 (1 df).

Table 3
Citation yield, connect time, and cost per search

	Study group		Statistics	
	Pay	No pay	t*	P
Total number of searches	71	251	—	—
Median number of citations per search	11	14	1.07	0.29
Connect time (minutes)	3.6	4.8	2.17	0.03
Online charge	\$2.64	\$3.37	2.03	0.04

* Wilcoxon rank sum test (320 df).

Use of information from searches

The authors conducted interviews after a one-third random sample of consecutive searches for each of the two groups, for a total of twenty-seven searches in the pay group, and seventy-two in the no pay group. The reasons prompting the searches were comparable in both groups, with 41% of the searches for patient problems, and the remainder for rounds, for research, for own interest, because someone else asked, or for unknown reasons. Decisions were affected (spawned, confirmed, or changed) in 18.5% of the interviewed search episodes in the pay group, and

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27.8% in the no pay group (not significant [NS]). In 8 search episodes (32% of 25 in which decisions were affected), abstracts alone affected the clinical decision (1 of 5 pay, 7 of 20 no pay, NS); in 16 search episodes one or more full articles were retrieved (4 of 5 pay, 12 of 20 no pay, NS); and in only one search (no pay) was a decision affected without either an abstract or full article. These figures were similar to those found in the observational study [7].

DISCUSSION AND CONCLUSIONS

This study shows that introducing user fees, after a period of free searching, reduced the frequency of searching by clinical end users considerably, but the quality of searches was not significantly affected. The effect of user fees on novice searchers was not examined. However, when one compares the rate of participation in the study that preceded this one (158

Table 4
Search recall and precision for the two study groups

	Study group		Statistics	
	Pay	No pay	t*	P
Number of searches sampled	13	26	—	—
Recall	50%	57%	-0.46	0.65
Precision	50%	52%	-0.61	0.55

* Wilcoxon rank sum test (37 df).

of 188, 84%) with the participation rate among those eligible for the current study (59 of 95, 62%), it is likely that user fees would totally deter many from using online searching facilities in clinical settings.

Although the no pay group searched considerably more frequently on study computers during the study, it is possible that more participants assigned to the pay group searched outside the study. Even if this did occur, however, the searching would have had to occur at a site distant from the clinical setting because the study computers provided the only MEDLINE access route in the clinical setting. Presumably, any such searching would have been subsidized, as well.

Users in academic and hospital/clinic settings were cost conscious (36% and 35% respectively rarely or never considered cost). However, it is not clear whether respondents were paying for searches from their own pockets or simply guarding research or institutional accounts.

While the searches by the pay group cost less, they retrieved a similar number of citations with almost equivalent precision and recall, with performance similar to an experienced research librarian (Tables 3-4). This performance was also similar to that in large text databases on CD-ROM, where a typical query retrieves only about 50% of the relevant texts and returns about the same percentage of irrelevant texts [8].

In a recent survey of U.S. users of MEDLINE, 68% indicated that cost rarely or never kept them from performing a search [9]. Users in academic and hospital/clinic settings were cost conscious (36% and 35% respectively rarely or never considered cost). However, it is not clear whether respondents were paying for searches from their own pockets or simply guarding research or institutional accounts.

In a survey of MEDLARS®§ use in 1982, 87% of academic medical sites charged a fee for searching, while only 16% of hospitals did so [10]. It has been suggested that consideration be given to reimbursement of search costs for patient care [11]. Information services such as provision of pharmacokinetic dosing information have been recognized as reimbursable by some third-party providers [12]. Because searching by physicians appears to have an impact on decision making, and user fees may inhibit searching, user fees could also be seen to undermine patient care. However, it has not yet been shown that the decisions physicians make with the aid of online searching are better than those without, nor that physicians who make decisions without the aid of online searching do so without consulting other appropriate sources. Nevertheless, providers of access to online searching can be certain that their pricing policies will affect use and should consider whether online services should be treated differently than print services.

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REFERENCES

1. HAYNES RB, MCKIBBON KA, WALKER CJ. Planning for the information age: a survey of microcomputer access and use in a faculty of health sciences. *Can Med Assoc J* 1987 May 15;136(10):1035-7.
2. HAYNES RB, MCKIBBON KA, WALKER CJ, RAMSDEN MF. Rapid evolution of microcomputer use in a faculty of health sciences. *Can Med Assoc J* 1991 Jan;144(1):24-8.
3. HAYNES RB, MCKIBBON KA, WALKER CJ, RYAN N, ET AL. A study of the use and usefulness of on-line access to MEDLINE in clinical settings. *Ann Intern Med* 1990 Jan 1;112(1):78-84.
4. HAYNES RB, MCKIBBON KA, WALKER CJ, MOUSSEAU J, ET AL. Computer searching of the medical literature. An evaluation of MEDLINE searching systems. *Ann Intern Med* 1985 Nov;103(5):812-6.
5. BRAHMI FA. The effect of CD-ROM MEDLINE on online end user and mediated searching. *Med Ref Serv Q* 1988; 7(4):47-56.
6. HAYNES, A study, op. cit.
7. *IBID.*, 81.
8. COLVIN G. The current state of text retrieval. CD-ROM: the new papyrus. Redmond, WA: Microsoft Press, 1986: 131-6.
9. WALLINGFORD KT, SELINGER NE, HUMPHREYS BL, SIEGEL ER. Survey of individual users of MEDLINE on the NLM system. National Library of Medicine Information Services 1988. Springfield, VA: National Technical Information Service (PB 89-133-722).
10. FAZZONE N, DESIMONE MG. MEDLARS utilization profile in New England. *Bull Med Libr Assoc* 1984 Jan;72(1):6-11.
11. DAVIES NE, DEVIerno AA. Reimbursement for computer-assisted literature searches for patient care [letter]. *N Engl J Med* 1988 Oct 13;319(15):1021.
12. MOORE TD, SCHNEIDER PJ, NOLD EG. Developing reimbursable clinical pharmacy programs: pharmacokinetic dosing service. *Am J Hosp Pharm* 1979 Nov;36(11):1523-7.

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FROM THE BULLETIN – 25 YEARS AGO

The *Index Medicus*: why it works and when it doesn't

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Forty-nine respondents found the *Index Medicus* the most useful of the tools in question. It is, of course, obvious that direct comparisons should not be drawn between noncomparable services; that is, between indexes showing citation only and abstracting services, whether indicative or informative in nature.

All of you have received verbal or written comments both pro and con concerning the *Index Medicus*. The ones gleaned from this survey ranged from enthusiasm, "the greatest advance in modern clinical investigation," to indifference, "occasionally very useful." Features which received special and favorable notice were the medical review articles, the separation of English language articles from those in other languages, and the usefulness of using accepted bibliographical form and periodical title abbreviations. Some of the general criticisms, which may be of interest to this group, certainly are not surprising, but I will mention a few: frequent misprints, alphabetization errors, and small size of print were cited as physical production problems.

Bull Med Libr Assoc 1966 Oct;54(4):326