Can primary care physicians' questions be answered using the medical journal literature?*†

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Medical librarians and informatics professionals believe the medical journal literature can be useful in clinical practice, but evidence suggests that practicing physicians do not share this belief. The authors designed a study to determine whether a random sample of "native" questions asked by primary care practitioners could be answered using the journal literature. Participants included forty-nine active, nonacademic primary care physicians providing ambulatory care in rural and nonrural Oregon, and seven medical librarians. The study was conducted in three stages: (1) office interviews with physicians to record clinical questions; (2) online searches to locate answers to selected questions; and (3) clinician feedback regarding the relevance and usefulness of the information retrieved. Of 295 questions recorded during forty-nine interviews, 60 questions were selected at random for searches. The average total time spent searching for and selecting articles for each question was forty-three minutes. The average cost per question searched was $27.37. Clinician feedback was received for 48 of 56 questions (four physicians could not be located, so their questions were not used in tabulating the results). For 28 questions (56%), clinicians judged the material relevant; for 22 questions (46%) the information provided a "clear answer" to their question. They expected the information would have had an impact on their patient in nineteen (40%) cases, and an impact on themselves or their practice in twenty-four (51%) cases.

If the results can be generalized, and if the time and cost of performing searches can be reduced, increased use of the journal literature could significantly improve the extent to which primary care physicians' information needs are met.

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INTRODUCTION

There is wide agreement that physicians, to keep their knowledge base and clinical practices current with the most recent advances in medical science, should increase their use of the medical literature [1–3]. However, available evidence suggests that practicing physicians make little use of the medical literature to meet their information needs. Using survey methods, Poisson [4] and Williamson et al. [5] found that no more than 8 to 10% of physicians reported searching the journal literature to meet their information needs. In interviews with practicing physicians during office hours, Covell et al. [6] and Gorman et al. [7] observed that although questions about optimal patient care arise frequently while physicians are seeing patients, most of these questions are never pursued. To answer those questions they do pursue, physicians most often turn to colleagues and other human sources of information, or to textbooks and drug information resources such as the *Physicians' Desk Reference.* The journal literature, whether in print or electronic form, rarely is consulted.

Studies of physician information seeking help to explain this behavior. Connelly et al. proposed a rational choice model of physician resource selection, whereby physicians intuitively compare potential information sources and choose the source that offers the greatest potential benefit relative to the costs (in time, effort, and expense) of using it [8]. In the model, in addition to the well-established preference of physicians [9–10] and others [11–12] for human sources of information, the most important determinants of whether a knowledge resource will be used are its availability and its clinical applicability. These findings, which are consistent with other reports of physician information seeking, suggest that use of an information resource by physicians may be increased by improving its availability and applicability to practice.

In keeping with this model, efforts to increase the use of the journal literature by practicing physicians have focused on increasing its availability to them. Because most office-based physicians do not have direct access to the journal literature in print form, attention has been directed toward removing barriers to remote electronic access [13]. These barriers include time, cost, training needs, and difficulty of use. Improved software, such as the National Library of Medicine's GRATEFUL MED computer program for searching MEDLINE, offers greater ease of use and may reduce online time and cost for inexperienced users [14]. Medical libraries in academic centers provide MEDLINE search training, which offers experience with the system and can improve user performance [15]. Reductions in search costs, such as the recent MEDLINE price reduction and programs offering a single annual fee, are aimed at removing financial barriers and have been shown to affect use of such systems by physicians [16].

Although these efforts to remove barriers to access improve the availability of the journal literature, they ignore the issue of its applicability to clinical practice. While medical librarians and informatics professionals often assume the journal literature contains information that is applicable in practice, evidence suggests that practicing physicians do not share this belief. For example, in a Canadian trial of free access to online databases, Marshall found at three-year follow-up that one third of "early adopter" physicians had discontinued use of the system, citing "inappropriate content" and "difficulty of use" [17]. Similarly, in interviews with hundreds of nonacademic practicing physicians, Greer reported that, in the view of most, the literature does not provide the information that is actually needed [18]. "In the end," she states, "the literature is seen as primarily a dialogue among researchers, who can tolerate its meandering route. It is not a guide to action."

Removing barriers to access to the journal literature is thus a necessary but not sufficient step toward increasing its use by clinicians. Just as important as reducing the cost of searching the journal literature is demonstrating its benefit; that is, its direct applicability to clinical practice. Most reports showing the usefulness of literature searching focus on only the small subset of questions that users have chosen to submit for a search. No study has examined whether the journal literature contains answers to the much larger set of questions that either are being answered by other means (25–30% of questions) or are not being pursued at all (about 70% of questions). If clinicians are to make increased use of the journal literature to meet their medical information needs, they must first be convinced that when they do so, they will find useful, relevant information that answers specific questions about their patients' care.

The authors designed a study to investigate the potential benefit of increased use of the literature to primary care physicians. The purpose of the study was to answer the question, "If primary care physicians used the journal literature to pursue *all* of their clinical questions, for how many of these questions could they find an answer, and what would be the cost of finding and providing this information?" To answer the question, the authors submitted a random sample of clinical questions asked by primary care physicians to experienced medical librarians, asking them to search the journal literature for answers. The information retrieved in these searches then was sent back to the clinicians who had posed the questions, who were asked to judge the relevance, usefulness, and potential impact of the information obtained for them.

METHODS

The objective of the study was to determine the proportion of all medical questions arising in primary care practice that could be answered using remote bibliographic retrieval of the journal literature, and to estimate the time and cost of finding these answers. A secondary objective was to compare this proportion to existing information-seeking behavior; that is, the proportion of questions now being answered by physicians using either remote bibliographic retrieval or any available source. The study was carried out in three stages: (1) office interviews, during which clinical questions asked by primary care physicians were recorded; (2) online searches of bibliographic databases, to locate information that might answer these questions; and (3) clinician feedback about the relevance and usefulness of the information retrieved.

Participants and setting

The target population was active, nonacademic physicians providing ambulatory care in a primary care specialty (family practice, general practice, general internal medicine, or pediatrics). Requests for participation were mailed to 966 Oregon primary care physicians. Because of the importance of rural practitioners to the outreach mission of the authors' institution, a stratified random sample of half rural and half nonrural physicians was used. After excluding inactive (less than 50% patient care), academic (address at teaching hospital or less than 50% direct patient care), and subspecialist physicians (greater than 50% subspecialty care, regardless of board certification), there were 154 volunteers for the study. There was no significant difference between volunteers and physicians who declined in terms of mean age (45.2 years), gender composition (13% female), or specialty distribution (63% family or general practice, 26% internal medicine, 12% pediatrics). A stratified random sample of twenty-five rural and twenty-five nonrural physicians was selected from the volunteer group.

Office interviews

The authors interviewed each physician in his or her office during one half day of typical office practice, using a modified version of Covell et al.'s method [19]. After each patient was seen, the physician was asked, "Do you have any questions about the diagnosis or management of this patient's problem?" Any questions that arose were recorded. It is important to note that physicians were asked to state "all the questions which occur to you during patient care, no matter whether you would pursue them or not, nor what source you might consult for an answer." Following is a random sample of these questions.

- At what age is screening prostate-specific antigen [testing] indicated in a low-risk patient?
- What is the exact increase in risk of thrombotic events on oral contraceptives in a woman with family history of myocardial infarction (her grandmother at age forty-nine) and of deep-vein thrombosis?
- Are nonacetylated salicylates really safer—and how much safer—in patients with NSAID GI intolerance (who benefit from anti-inflammatory effect)?
- For diagnosis of deep-vein thrombosis, how good is ultrasound; does it obviate the need for venogram (can it exclude the diagnosis)?
- Is amoxicillin safe for use in a lactating woman?
- What is [*sic*] the sensitivity and specificity of arterial ultrasound exam of the lower extremities?
- Is hypothyroidism associated with high cholesterol or low?
- What is the dose of Imferon?
- At what point is endoscopy indicated in patients with esophagitis who remain symptomatic on medication?
- Where can I send this patient for education about his alcoholism: more education than Alcoholics Anonymous provides, less expense than inpatient treatment?

Online searches

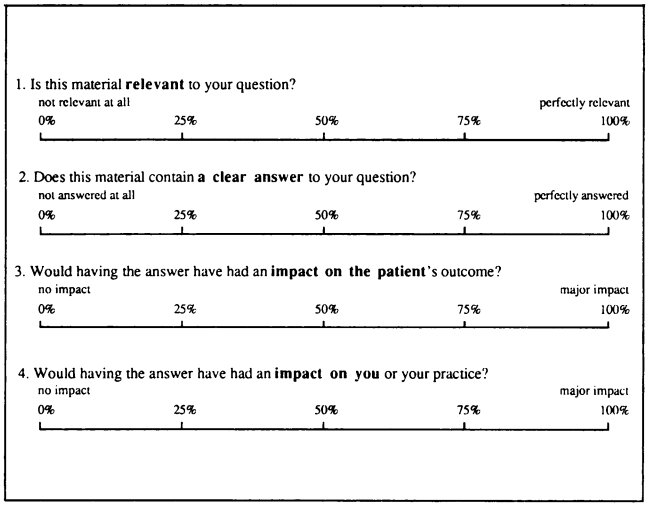
Based on a sample size calculation, 60 of 295 questions from the forty-nine half-day interviews were randomly selected for online searches. To simulate the best available conditions for access to the literature (assuming barriers to access were removed), experienced medical librarians were asked to search the medical literature and select references that would answer the clinicians' questions. Librarians were asked to serve, in effect, as the "gold standard" for information services. Time, effort, and cost of searching were not limited.

Searches were performed by seven medical librarians familiar with bibliographic retrieval using MEDLARS and other systems, with an average of 13.6 (range five to twenty) years' experience. Searchers were instructed to "treat each question as if it had been submitted by a primary care physician at a remote location looking for an immediate, practical, up-to-date answer to a specific question about patient care." Searches were limited to bibliographic databases accessible by remote electronic searching. They were not to include texts that, though available in electronic form, are mainly used in print form and could be used by a physician without the hardware, software, and expertise needed to do online searches. Searchers could choose any database they deemed appropriate, but nearly all searches were performed on MEDLINE. The primary care physicians who originally asked the questions were not available for the

librarians to interview, but further information about the questions was available from the general internist who performed the interviews and was familiar with the clinical problems.

After the searches were completed, the librarians were asked to select a small number of articles to be photocopied and forwarded to the originating primary care physicians. There is evidence that librarians can effectively perform this "quality filtering" function in the clinical setting [20]. In this selection process, preference was to be given to "high quality evidence" such as meta-analyses and randomized trials, whenever these were available and relevant to the clinical question. For each question searched, the authors recorded the time spent preparing and performing the search, the time selecting articles for photocopying, the online and total cost of the search, and the librarian's judgment of whether this material was relevant and provided a clear answer to the question. Calculation of total cost included not only the online cost of the search (all searches were performed after the MEDLINE price reduction of January 1, 1993) but also the cost of the librarian's time and of copying and transmitting articles to the clinicians.

Figure 1
Visual analog scales used for clinician responses*



* Responses greater than or equal to 75% were coded positive.

Clinician feedback

Articles selected by the librarians were forwarded to the requesting primary care physicians six to twelve months after the original interview had taken place. Clinicians were asked to record their judgment of whether this material was relevant, provided a clear answer to the question, would have had an impact on their patient, and would have had an impact on them or their practice. One and three weeks after the initial mailing, reminders were mailed to physicians who had not responded. After one month, nonrespondents were again reminded, if possible, by telephone.

Data analysis

All data were entered into a microcomputer database (FileMaker Pro, version 2.0, Claris Corporation, Santa Clara, California) and their accuracy verified by one of the authors. Statistical analyses were performed using JMP statistical software (version 2.0, SAS Institute, Cary, North Carolina). To allow for the expected gradations in responses regarding the relevance and usefulness of the material, these variables were recorded using a visual analog scale. Figure 1 shows an example of the scales used. For purposes of analysis, responses greater than or equal to 75% (corresponding to 4 or 5 on a five-point Likert scale) were coded as positive, and responses less than 75% were coded as negative.

Pearson's χ^2 test at a significance level of $P = 0.05$ was used to compare the proportion of questions answered in this study, using electronic bibliographic databases to the proportion of questions found previously to be answered using any information source (30%) or a computerized source (less than 1%) [21].

RESULTS

The search and selection process was completed for sixty questions. Four physicians had relocated and could not be contacted for review of their articles. Of the remaining fifty-six questions, response forms were returned for forty-eight, for an adjusted response rate of 86%.

Table 1 shows the librarians' judgments of the best initial source to find the answers to the questions, compared to the sources actually used by primary care physicians [22]. As indicated, only 30% of questions were ever pursued by the physicians, and a computer search had been performed for fewer than 1% of questions, while the librarians expected that a MEDLINE (or equivalent) search would be the best source to answer 43% of the questions. When asked whether each question was appropriate for a MEDLINE search, even if it would not be their first choice, fifty-three of sixty questions (88%) were judged by the librarians to be appropriate for MEDLINE.

The effort, costs, and results of the searches are shown in Table 2. On average, the total time required to complete these searches, including preparing and performing the searches and selecting the most relevant and useful articles for clinicians, was nearly

Table 1
Librarians' preferred source to answer clinical questions, compared to sources used by primary care physicians to answer 295 questions

Information source	First choice of librarians (%)*	Sources used by physicians (%)†
MEDLINE search	24 (43)	2 (1)
Specialty textbook	14 (25)	17 (6)
Subspecialist physician	9 (16)	17 (6)
Drug textbook	6 (11)	14 (5)
Nonphysician (e.g., pharmacist)	3 (5)	9 (3)
Colleague		8 (3)
Other		4 (1)
Clinical manual		5 (2)
Reprint file		4 (1)
Pursued but not answered		8 (3)
Not pursued		207 (70)
Total	56	295

* Response to "In your judgment, what would be the *best* source to answer this question?"
† Data from Gorman et al., 1993.

Table 2
Effort, cost, and results of search and selection process

	Mean	Tenth percentile	Ninetieth percentile
Preparing the search (minutes)	8.7	3.0	19.5
Performing the search (minutes)	11.3	3.2	22.9
Selecting articles to copy (minutes)	23.6	6	40
Total search and selection time (minutes)	43.2	16.0	74.7
Online cost ($)	4.16	1.42	7.69
Total cost* ($)	27.37	14.90	41.79
Total articles selected	2.75	1	5
Total pages copied	19.6	3	36

* Total cost based on actual online costs and current charges for services at our institution: total cost = online cost + $3.00 per article to copy + $2.00 per order to mail + librarian @ $18.00/hour.

three quarters of an hour. More than half of this time was needed to select the appropriate articles for the clinicians. The distribution of selection time was bimodal, however, with about half the questions requiring ten to fifteen minutes to select appropriate articles and about half requiring more than thirty minutes. On average, preparing the search took nine minutes, and performing the search online took eleven minutes. For most questions, two to four articles were selected to be forwarded to the clinicians. For four questions no article was selected, though in some instances this result was considered by the clinician to be an answer. Thus, on average, to answer these questions, librarians spent forty-three minutes finding and selecting about three articles totaling approximately twenty pages at an average cost of $27.37, including the librarian's time and the charges for copying and forwarding articles to the clinicians.

The clinicians' evaluation of the material retrieved for them is shown in Table 3. They judged the material to be relevant for twenty-eight of forty-eight questions (56%) and reported that "a clear answer" had been provided to twenty-two of forty-eight questions (46%). These results are significantly higher than the 30% of questions now being answered by physicians using any source ($\chi^2 = 9.27$, $P = 0.002$) and the less than 1% of questions being answered by physicians using bibliographic retrieval ($\chi^2 = 126.5$, $P < 0.0001$). In eight cases, the clinicians responded that the material was relevant, but the question had not been answered. In two cases, the clinician responded that "a clear answer" had been provided even though material retrieved was not highly relevant. In one case, a question about whether a drug interaction had been reported, no articles were retrieved, but the clinician responded that this was "a clear answer." Clinicians estimated that the information would have had an impact on the patient for 19 questions (40%), and an impact on themselves or their practice for 24 questions (51%). Comments added by clinicians for twenty-nine questions ranged from a simple "thank you" to a paragraph or more about the question and the information they had received.

DISCUSSION

In this study, searchers with the necessary expertise, hardware and software, and adequate time and resources to search the journal literature found answers to twenty-eight of forty-eight complex, highly patient-specific, "native" questions asked by primary care physicians in the course of routine office practice. On the average, the search and selection process took forty-three minutes and cost $27.00. Previous work had shown that only 30% of such questions are being answered at all by physicians using any knowledge sources, and that no more than 1 to 2% of such questions are answered by physicians using a bibliographic retrieval system such as MEDLINE. The main finding of the present study—that the clinicians themselves said "a clear answer" was found for 46% of their clinical questions by searching the journal literature—should be encouraging to those working to better meet the information needs of physicians by making bibliographic retrieval more accessible.

Several limitations and constraints of this study should be noted. First, the librarians performing the searches had no opportunity to interview their clients as they normally would. Although this saved the clinicians time, it may have increased the time and effort the librarians devoted to performing the searches and it also may have diminished their effectiveness at locating relevant and useful material. Second, the librarians performing the searches were limited to on-

line bibliographic retrieval only, because these systems were the focus of the study. Searchers said this limited their effectiveness and possibly also their efficiency. Both of these limitations would tend to increase the costs and reduce the benefits of searching; thus, greater benefit and lower cost may be expected under more usual conditions. A third limitation is that the clinicians' recall of the questions may have been limited by the long delay between their interviews and receipt of the retrieved articles, leading perhaps to less accurate estimates of relevance and usefulness than might be possible. Clinicians acknowledged this phenomenon in two instances, although the comments they added indicated that in general they were able to recall the patient and the question.

Sampling bias is another potential limitation. Participating physicians were volunteers, representing only a fraction of the primary care physician population. The authors know of no data to indicate whether the questions of nonvolunteers would be more or less answerable than those in this study. Also, the study sample overrepresented rural physicians by design, to ensure that results would apply to this important group. Although rural physicians may have less access to information sources, the authors know of no data to indicate that their questions are more or less answerable than those of nonrural physicians.

This was not a study of search efficiency, in the sense of assessing the ability to retrieve relevant articles, measured in terms of recall and precision. This topic has been examined elsewhere [23]. *Relevance,* defined in Webster as "having significant and demonstrable bearing on the matter at hand," is a necessary but not sufficient condition for providing an *answer,* which, according to Webster, "implies the satisfaction of a question, demand, call, or need" [24]. The data presented in this paper reflect this distinction, because, for eight questions, although clinicians judged the material retrieved for them to be relevant, it did not provide them with an answer.

This study differs from many previous studies of clinical librarian services in several important ways. First, the questions evaluated were not questions intended to be submitted for MEDLINE searches nor were they directed to any other potential source of an answer. This is a common approach in studies of information services such as clinical librarian or pharmacy information services, in which a librarian or pharmacist attends "rounds" with a group of physicians to identify questions that might be appropriate for a search. These were, rather, "native" clinical questions, as they occurred to practicing physicians in the context of a specific patient problem, without regard for whether or how they might be pursued. Second, the participants were office-based primary care physicians, whose information needs may differ from those of hospital-based academic and specialist physicians. Third, this study included in the calculations not only the online time and cost of literature searching, but also the offline costs, including the cost of the librarians' time. These figures are more representative of the total cost of providing such a service than are online costs alone, and they thus may be more relevant from a policy perspective.

Table 3
Clinicians' evaluation of information retrieved*

	Clinicians (%)
Relevant to the question	28 (58)
Contains "a clear answer" to the question	22 (46)
Expected impact on the patient	19 (40)
Expected impact on the physician	24 (51)

* Responses received from 48 of the 56 physicians contacted.

The authors are encouraged by the results of this study. In spite of limits on the recall and precision of searches by even trained searchers [25], the results show that answers to a substantial proportion of the questions that arise in routine primary care practice *can* be found by bibliographic retrieval. More questions can be answered using the journal literature than are currently being answered by physicians using bibliographic retrieval (approximately 1%) or using any information source (approximately 30%). In previous work, the authors found that one of the strongest determinants of whether a physician would pursue the answer to a question is her or his expectation that an answer can be found [26]. It seems reasonable to expect, then, that if the substantial time, effort, and cost of doing searches can be reduced, the benefit of searching will increasingly be seen to outweigh the cost. The result, the authors hope, will be increasingly frequent use of the journal literature to answer clinical questions in primary care to the benefit of practitioners and their patients.

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