
Physicians' preferences for information sources: a meta-analytic study

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Identification of the resources physicians use to acquire information for clinical practice and medical research is an important area of research for health sciences librarianship and medical practice. During the past twenty years several studies have addressed questions about physicians' preferences for information sources, but generalization from the results of these studies has been hampered by limited sampling, diverse methods, and varied reportorial formats. Meta-analysis provides a method for reducing these limits. Using a meta-analytic procedure, this study reviews twelve studies published between 1978 and 1992, categorizes and ranks the physicians' preferred information sources reported in each study, then aggregates and counts the frequencies of the top six preferences, as well as the associated first and second preferences, for all the study populations or their strata. The results indicate that physicians prefer to obtain information from journals and books, but also that they often consult colleagues to get answers to clinical and research questions. The implications of these findings for health sciences librarianship are briefly discussed.

INTRODUCTION

During the past several years a number of medical researchers have expressed apprehension about gaps in physicians' knowledge of current research in clinical medicine. The focus of concern has been physicians' timely access to credible sources of information [1, 2]. How do physicians fill gaps in their medical knowledge? What sources of information do physicians employ to answer questions generated by the problematic situations they encounter in clinical practice? Do practicing physicians usually get answers from medical literature, from colleagues, or from yet other sources? While often asked and researched, these questions remain a matter of paramount importance. It is a matter that concerns the health of patients and the public, the professional credibility and status of physicians, and the organization of institutions and services for training and providing information to physicians. Prominent among the institutions and professions concerned with physicians' information seeking are medical libraries and medical librarianship. The ways physicians seek clinically related information, and the resources they use for finding that information, inevitably affect the roles of medical librarians.

Finding answers to these questions about physi-

cians' information-seeking behavior is by no means straightforward. From the perspective of cognitive psychology, seeking information needed for solving a problem is the midpoint in a multifaceted, dynamic process that begins with problem recognition and ends with problem resolution. Physicians' recognition of deficiencies in their knowledge, as well as the vigor with which they attempt to eliminate the deficiencies, undoubtedly has a dialectical relationship with the socioeconomic contexts in which they work and with the information-seeking strategies and information sources they employ. Rigorous, systematic analysis of this relationship poses a challenge to research. Such an analysis would require a detailed treatment of the whole process of perceiving problems, forming questions and hypotheses, seeking information to answer those questions, then using the information found to solve problems. All this lies beyond the scope of the published investigations of physicians' information-seeking behavior.

This study focuses on a part of the problem. Its primary purpose is to find out what empirical generalizations one can make from the findings of recent studies of U.S. and Canadian physicians' preferences for sources of professional information. Since the publication of Sherington's annotated bibliography [3],

several studies of physicians' information-seeking practices have appeared in medical and library journals. Elayyan's [4] review covered most of the studies of U.S., British, and Canadian physicians done between 1965 and 1984. Verhoeven et al. [5] recently surveyed eleven studies of North American and European family physicians published during the years 1978 through 1990. The present study analyzes twelve published investigations of physicians in the United States and Canada that were reported from 1978 to 1992: Strasser [6], Stinson and Mueller [7], Cohen et al. [8], Northup et al. [9], Covell et al. [10], Lockyer et al. [11], Ferguson and Caplan [12], Gruppen et al. [13], Williamson et al. [14], Woolf and Benson [15], Connelly et al. [16], and Ely et al. [17]. It compares, quantitatively aggregates, and synthesizes selected, relevant data from these investigations, then secondarily considers the importance of the synthesis of these findings for medical librarianship.

METHODS

Literature search and sample selection

The literature search for the study was limited to investigations published in journals from 1978 to 1992. The location of pertinent, qualified studies involved two procedures. Initially, the MEDLINE database was searched by means of three related low-precision strategies, one employing a Boolean combination of the MeSH descriptor "information services" and the MeSH descriptor "physicians," or the keyword "physicians"; the second the MeSH descriptors "information services" and "questionnaires"; and the third the MeSH descriptor "questionnaires" and the keyword "physicians." Abstracts and titles in the records thereby retrieved were then visually perused to determine whether an associated article would meet the study's eligibility criteria. The application of eligibility criteria to the resulting sets identified nine (75%) of the twelve journal articles used in this study. The second procedure, tracking the bibliographic citations of the nine articles, located the remaining three articles, which were published in a journal not indexed in MEDLINE (*Möbius*). Final decisions to include the items in the study sample were based on reading of the articles.

Besides restriction of the studies to those published in journals from 1978 to 1992, the eligibility criteria were as follows: the articles must have been written in English; the articles must have reported original behavioral studies of information-seeking by physicians; the studies must have included quantitative observational or survey data in the form of frequencies, proportions, or ranks of information sources used by physicians; and the studies' source populations had to be from either the United States or Canada.

Analytical methods

Comparative analysis of the twelve selected studies was limited by their dissimilar research questions, research instruments, and reportorial formats. All of the studies were cross-sectional surveys or observations; none had a prospective or follow-up design. All were descriptive; none was designed to explore cause-and-effect relations among variables or to test directional hypotheses. Moreover, although six of the investigations reported using random sampling to select physicians for questioning or observation, in several cases sample sizes were small, and sampling frames geographically or occupationally restricted. As a result, generalization from the findings of any one of the studies would be tenuous, if not unwarranted.

All the same, the findings of these investigations possess two features that appear valuable for research. First, the findings should stimulate further pertinent research. Second, the data lend themselves, with some effort, to quantitative synthesis or meta-analysis, the analysis of analyses. Meta-analytic procedures for combining the data of separate investigations might reveal more about information-seeking behavior among physicians than those shown by the numerically and spatially limited single studies. Meta-analytic procedures have been fruitfully used in epidemiology [18, 19] and the social sciences [20, 21]. Meta-analysis offers two major advantages for research. By effectively expanding the size and scope of the study sample, it reduces the limits on generalization imposed by the small samples usually examined in separate studies. It also provides an objective procedure for interpreting and synthesizing the findings of several studies. One difficulty is its inability to erase any biases inherent in the studies that it incorporates; another is that studies often gather, analyze, and report data in disparate, sometimes incommensurable ways. Unfortunately, the published findings of the research described in this paper do not permit rigorous statistical meta-analysis. Conventional meta-analysis marshals evidence for or against relations among variables common to several studies by combining results of significance tests or statistics which measure strength of relationship. The twelve investigations analyzed in this study neither share a common hypothesis nor test for relations among a common set of variables. Further, half of the investigations report preferences for information sources on incommensurable scales. Although six of the studies report percentages of preferred information source, three of the six present percentages of subjects while the other three give percentages of responses, thus making aggregation of percentages inappropriate. Despite these limitations, the data can be placed in comparable categories without bias, ranked, counted, and aggregated. This meta-analytic

procedure reveals consistent patterns of information seeking.

The investigations analyzed in this study examined various dimensions of physicians' information seeking. Of the many variables the investigators measured and reported, one especially pertains to medical librarians: preference for specific sources of information. However, the several researchers utilized neither standard quantitative measures of information preference nor a uniform classification of information sources. Preferences were variously reported as frequencies of individual physicians, frequencies of responses, or ordinal scores. Numbers of categories of information sources reported ranged from three to nineteen. To overcome these inconsistencies, the present study employed three conjoined methods. Application of the methods resulted in loss of information, but also facilitated comparison, tabulation, and aggregation of the data. To begin with, each study was examined to determine the rank order of its six most frequently preferred information sources. Ranking of the information sources from the most (numbered 1) to the least frequently sought (numbered 6) was based on either relative frequencies or mean scores enumerated by the investigators. Ties for preferred source in any one study were recorded as numbers of equal rank (e.g., two 4s).

Next, a set of nine nominal categories of information sources was constructed and the ranked sources from each study assigned to these categories. The classification included "Books" (monographs, textbooks, handbooks), "Colleagues/Consultations" (consultations with other physicians), "Courses/Workshops," "Drug Company Information" (pamphlets, representatives), "Journals," "Library Reference Services," "Indexes/Abstracts" (both printed and electronic), "Professional Meetings," and "Other." The categories were designed to accommodate and comprehend the principal sources reported in the twelve studies analyzed, but they neither consistently nor precisely correspond to those used in the separate studies, and thus should be regarded as secondary analytical constructs.

Finally, the rankings of information sources for all twelve studies were tabulated, then summarized and synthesized by counting the choices of preferred information sources reported in each study. In order to simplify analysis and reporting, the rankings were aggregated in two ways: by frequency of preference for information source by all six ranks, and then by the studies' associated first and second choices. Five of the studies reported data for the whole study sample, but seven did not. Where aggregated, unstratified data were reported, the units counted were study populations [22]; otherwise, the units counted were strata of the study populations. Treating study populations and strata as equal analytical units provided the advantage of simplifying analysis, but created a risk of assigning disproportionate weight to the findings of studies that

reported stratified data. Taking this risk seemed preferable to omitting these studies altogether. In any event, twenty units, either study populations or strata, entered into the frequency count.

OVERVIEW OF INCLUDED RESEARCH

Between 1978 and 1992, twelve studies measured and reported the sources of medical information preferred by selected groups of physicians in the United States and Canada. The first of these studies, reported in 1978, was Strasser's [23] survey of 258 medical doctors from upstate New York. The study population represented about 45% of 592 physicians drawn by systematic sampling. Strasser reported participants' frequency of use of information sources as mean scores on an ordinal scale. Even though she presented findings for seven different medical specialties, only the ranked preferences for all respondents were used in the present analysis. Strasser found that her respondents preferred the following information sources, listed in order of importance: journal articles; consultations with colleagues; books; seminars, workshops, and conferences; and equally in fourth place, private files (here classified as "Other"). Abstracts were ranked fifth and library reference services sixth.

Stinson and Mueller's [24] random sample of 402 health professionals in Alabama included both physicians and members of other health professions. Because the authors did not stratify their data by professional group, data on physicians could not be partitioned from the aggregate findings. However, since 77% of those interviewed were physicians, the results of their investigation were included in the present study. The authors reported frequency of use as mean ordinal scores. Most of the 398 respondents indicated books and journals to be their coequal first preferences of information sources, and that they most often obtained these items from their personal libraries. By order of frequency, their next choices were professional colleagues, meetings, continuing education courses, and pharmaceutical representatives.

Cohen et al. [25] sought to learn how physicians at different levels of training perceived the degree to which various sources of information influenced their medical decisions. They analyzed cross-sectional data collected through questionnaires they had given to a very small convenience sample of interns, residents, and faculty serving in general internal medicine at the Indiana University School of Medicine. Their analysis, reported on an ordinal scale, revealed that all three groups perceived journals to be their most important source of information. Interns regarded past experience as being next in importance (categorized as "Other" for the present study). In contrast, residents and faculty ranked conferences and subspecialty staff (here classified as "Colleagues/Consultations") second. For

interns, third place was occupied by information from house staff and general internists; for residents and faculty, past experience ranked third.

Questioning of 293 randomly selected physicians and medical students in New Mexico by Northup et al. [26] by means of the critical incident technique revealed a pattern of responses somewhat different from that found by Stinson and Mueller. Comparison of this report with the others is impaired by its use of choice rather than chooser as the countable analytic unit [27]. By inference, however, the participants collectively, as well as the medical students and residents separately, preferred to get information from books, colleagues, journals, and other sources (e.g., laboratory tests and audiovisual materials) in that order. For practicing physicians ($n = 213$, 73% of the sample), the pattern was identical except for the fact that colleagues were ranked above books as sources of medical information. Northup also queried the physicians about the locations they used for finding the medical literature in which they sought information. Slightly more than half of all the respondents reported using personal libraries, nearly a third institutional libraries, and the remainder reprint files and other locations. Analysis found no statistically significant differences among the three groups' preferences for information sources or for locations of printed resources.

Though based on a small random sample (forty-seven) of internists practicing in Los Angeles County, the study conducted by Covell et al. [28] gave provocative results: it found a discrepancy between ideal and real behavior. The investigators first administered to the participants a questionnaire concerning information sources and uses, then followed up the questionnaire with an office interview intended to find out how they had recently sought and located clinical information. Use was reported as percentages of responses, not as percentages of participants. The self-reported ranking of information sources by frequency of use was almost identical with that reported by Northup et al.; that is, books, colleagues or consultants, journals, and other sources. In contrast, observation (i.e., office interviews) revealed that the internists most often chose colleagues or consultants, then other sources, books, and, in fourth place, journals [29]. These findings clearly warn investigators of the possibility of bias in self-reported behaviors, that is, a discrepancy between what people profess and what they do.

Lockyer et al. [30] surveyed Canadian specialist and family physicians with the intention of learning which sources of information the participants used for "making changes in their clinical practices" [31]. There were 160 subjects invited to participate, including 74 family physicians and 86 specialists. Forty-two were selected randomly, 118 by convenience. The investigators indicated that slightly more than 95% responded, but failed to give the numbers of participants. One can

thus merely infer that the study population comprised approximately 152 subjects, of whom nearly 70 were family physicians and 82 specialists, assuming equal response rates for both groups. The areas of practice in which they sought to measure change were drugs, investigations, and technical procedures. Results were reported as numbers of changes, not as numbers of individuals expressing preferences. The authors distinguished between "the initial change agent," the factor that made the physician initially aware of potential change, and "the precipitating change agent," the factor that persuaded the physician to adopt the change [32]. Looking only at the initial agent in adopting a new drug [33], the study found that for specialists the primary source of information was medical journals, followed by continuing medical education (CME) courses and pharmaceutical representatives in second place, then by discussion with colleagues and other sources (hospital rounds, etc.) in the third and fourth ranks. Among family physicians, the top four initial change agents were pharmaceutical representatives, medical journals, CME courses, and other sources. Family physicians cited pharmaceutical representatives significantly more often ($p < .01$) and colleagues significantly less often ($p < .01$) than specialists.

The scope of Ferguson and Caplan's study [34] of physicians enrolled in continuing medical education at the University of Iowa was narrower than the foci of studies previously discussed, namely, to "determine whether self-identified independent learners [physicians] differed significantly from their colleagues regarding preferred learning methods and sources of information" [35]. Yet its findings add to the overall sample of physicians' information-acquiring behaviors. Of 168 independent learners and 161 course participants given questionnaires, 61 (36%) of the former group and 36 (22%) of the latter group responded. Questions about the preferred information sources of the two groups of physicians, both selected by convenience, revealed no differences in rank order of sources. Preferences were reported as mean ordinal scores. Both groups preferred meetings, courses, colleagues, and medical literature (books and journals equally), other sources (videocassettes, audiocassettes, chart audits), and last, drug company representatives [36]. However, course participants indicated a significantly higher preference for drug company representatives than did independent study physicians ($p < .01$). Still, generalizing from these findings is hampered not only by small sample size but also by the potential for selection bias produced by convenience sampling.

The intention of the research done by Gruppen et al. [37] was to find out whether there were differences between the ways internists and family physicians selected information sources utilized to solve clinical problems. In order to answer this question the investigators surveyed 208 physicians who attended four

CME courses given in 1984 at the University of Michigan Medical Center. In effect, participants were chosen by convenience. Eighty-five percent of the physicians completed the questionnaire. After the exclusion of uncompleted forms, 171 remained. For the ninety-eight internists in the sample, the first choice of information source was textbooks, the second was consultations with colleagues or specialists, and the third was journals. On the other hand, for the seventy-three family physicians included, the preferred information sources were consultations, textbooks, and journals. Internists chose textbooks and journals significantly more often ($p = .002$ and $p = .046$, respectively) but informal consultations less often ($p = .004$) than did family practitioners.

The survey of physicians conducted by Williamson et al. was intended to "identify self-perceived problems in managing science information needs of U.S. primary practitioners and their opinion leaders" [38]. Williamson assessed physicians' skill in identifying needs for information, in getting needed information, and in critically evaluating information obtained. The study population comprised sixty-one general practitioners, sixty-five family practitioners, and seventy-six internists who were randomly selected from the American Medical Association's "Masterlist of Physicians." Participants were interviewed by telephone. Of the several questions asked the physicians, only one is considered here. It concerns the identity of the initial source of information about a "marker," i.e., a recent advance in clinical medicine. Participants were queried about knowledge of several different markers. If only the initial source of information about a single marker, digitalis withdrawal, is taken into consideration the preferences were as follows: For general practitioners, the top five sources were colleagues, journals, meetings, training (courses or workshops), and other sources. The preferred sources for family physicians were similar: colleagues, journals, training, and meetings. For internists, however, the sources were journals, colleagues, training, and, in fourth place, meetings and other sources [39].

Woolf and Benson [40] randomly selected 80 of the 615 pediatricians and internists at Johns Hopkins Hospital for their study of information seeking. With a response rate of 84%, the authors interviewed forty-two faculty and twenty-five house staff (physicians in training) at the hospital. One of the questions asked both faculty and house staff was, "From where do you usually obtain reference information?" Responses were reported as median ordinal scores of frequency of use. Comparison of the two groups revealed statistically significant differences between their preferences: house staff more often used textbooks ($p < .01$) and handbooks ($p < .001$) than faculty, but faculty more frequently used Mini-MEDLINE searches than house staff ($p < .01$). Nonetheless, ranking the sources

by reported frequency of use revealed that the patterns of preference closely resembled one another. For both faculty and house staff, books and "Colleagues/Consultations" ranked first and second in frequency. Journals ranked third for faculty but fourth for house staff, while indexes and abstracts (Mini-MEDLINE, BRS Colleague, *Index Medicus*) stood in fourth place for faculty and third place for house staff [41]. Both groups ranked sources categorized as "Other" in distant fifth place. Although the design of Woolf and Benson's study was methodologically sound, drawing general inferences from its findings seems questionable, as the authors note [42]. The academic setting of the study does not represent the settings occupied by most practicing physicians.

Connelley et al. [43] reported a study of family physicians practicing in various locations in Minnesota. Selected by convenience sampling, the study population comprised 126 of the 162 physicians responding to a questionnaire mailed to 311 physicians listed on the clinical faculty roster of the Department of Family Practice and Community Health at the University of Minnesota. The questionnaire employed Likert scales to measure relevance and frequency of usage of several information sources: textbooks, computerized bibliographic retrieval, colleagues, *Index Medicus*, journal articles, *Physicians' Desk Reference (PDR)*, and drug industry representatives. Analysis revealed that the physicians preferred the *PDR*, colleagues, pharmaceutical representatives, and research articles, in that order, and that they seldom used computer-based information systems or *Index Medicus*.

Ely et al. [44] directly observed physicians' information-acquiring responses to case-specific clinical questions. Their study population, most of a convenience sample of thirty-four, consisted of thirty family physicians living near Columbia, Missouri. The focus of the research was the sources of answers to clinical questions, not merely the sources searched for information. The investigators reported that the physicians most often obtained answers from colleagues. However, careful examination of their data reveals that books, including the *PDR* and medical textbooks, were the physicians' primary choice. Colleagues were the next most frequently used source, whereas journal articles were seldom consulted.

RESULTS

Information preferences reported in the twelve studies are summarized and compared in Table 1. The tabulation lists the studies in chronological order, their source populations, their sampling method (random or convenience), the sizes of their study populations and strata (N), their reported strata or analytic groups, and their top six reported information sources. Aggregate, unstratified data are designated "All." When a reported

Table 1
Rankings†† of top six information sources for physicians in each of twelve studies

Study	Source population	Sampling method	Strata	N	Rankings of preferred information sources								
					Bks	Cls	Wks	DrCo	Jrns	LibS	InAbs	Mtgs	Oth
Strasser (45)	M.D.s in NY	R	All	258	3	2	4		1	6	5	4	4
Stinson (46)	Health workers in AL§	R	All	398	1	2	4	5	1	—	—	3	
Cohen (47)	M.D.s in IN	C	Interns	10	—	3	—	—	1	—	—	—	2
			Residents	22	—	2	—	—	1	—	—	—	3
			Faculty	9	—	2	—	—	1	—	—	—	3
Northup (48)	M.D.s/students in NM	R	All	293	1	2	—	—	3	—	—	4	
Covell (49)	Internists in CA	R	All	47									
			Self-reported		1	2	—	—	3	—	—	—	4
			Observed*		3	1	—	—	4	—	—	—	2
Lockyer (50)	Canadian M.D.s	C	Specialists	82†	—	3**	2	2**	1	—	—	—	4
			Fam. physicians	70	—	—	3	1	2	—	—	—	4
Ferguson (51)	M.D.s in CME	C	Indep. study	61	4	3	2	6	4	—	—	1	5
			Course	36	—	3	2	6	4	—	—	1	5
Gruppen (52)	M.D.s in CME	C	Internists	98	1**	2**	—	—	3**	—	—	—	—
			Fam. physicians	73	2	1	—	—	3	—	—	—	—
Williamson (53)‡	M.D.s from AMA list	R	Gen. practitioners	61	—	1	4	—	2	—	—	3	5
			Fam. practitioners	65	—	1	3	—	2	—	—	4	5
			Internists	76	—	2	3	—	1	—	—	4	4
Woolf (54)	University M.D.s	R	Faculty	42	1	2	—	—	3	—	4**	—	5
			Housestaff	25	1**	2	—	—	4	—	3	—	5
Connelly (55)	Fam. physicians in MN	C	All	126	1	2	—	3	4	—	5	—	
Ely (56)	Fam. physicians in MO	C	All	30	1	2	—	—	3	—	—	—	

* Observed only counted in Tables 2 and 3.

† Preferences for drug information only.

‡ Initial source of information about digitalis withdrawal.

§ 77% physicians.

** Strata significantly different ($p < .05$).

†† Ranking of preferred information sources is from 1 (most frequent) to 6 (least frequent). Blank spaces represent sources ranked lower than 6th. Dashes mean item was not reported. Bks = Books, Cls = Colleagues/Consults, Wks = Courses/Workshops, DrCo = Drug Company, Jrns = Journals, LibS = Library Reference Services, Mtgs = Meetings, InAbs = Indexes/Abstracts, Oth = Other. Sampling Method: R = Random, C = Convenience.

information source was ranked seventh or lower in preference, the corresponding block in the table was left blank. By contrast, when investigators did not report one of the information sources listed in the table, the appropriate block was marked with a dash. Asterisks following ranks indicate reported significant differences ($p < .05$) between strata of a study in regard to preference for a designated information source.

Inspection of Table 1 reveals that study populations were of statistically respectable size overall, ranging from 30 to 398, with a median of 139, but that only

half of the studies employed random sampling. Moreover, the numerous dashes in the columns for categories of information sources emphasize the fact that the several studies did not measure the full range of tabulated categories. The table nevertheless contains sufficient data for further informative analysis.

Aggregated counts of choices, compiled from Table 1, appear in Table 2 and Table 3. Table 2 provides summed frequencies of rankings of physicians' preferred

Table 2
Aggregation of frequencies of rankings of physicians' references for information sources

Ranks	Information sources*								
	Bks	Cls	Wks	DrCo	Jrns	LibS	InAbs	Mtgs	Oth
1	7	4	0	1	7	0	0	2	0
2	1	11	3	1	3	0	0	0	2
3	2	4	3	1	5	0	1	2	2
4	1	0	3	0	5	0	1	3	5
5	0	0	0	1	0	0	2	0	6
6	0	0	0	2	0	1	0	0	0

* Counts, compiled in Table 1, represent rankings of preference determined for study populations or strata. Ranks and abbreviations are identical to those in Table 1.

Table 3
Aggregated counts of associated first and second choices of physicians' preferred information services, ordered by frequency

1st information source	2d information source	N studies/strata*
Books	Colleagues/consultations	7
Journals	Colleagues/consultations	5
Colleagues/consultations	Journals	2
Meetings	Workshops/courses	2
Colleagues	Books	1
Colleagues	Other	1
Journals	Other	1
Journals	Drug company	1
Drug company	Journals	1

* Numerals are counts of studies' aggregate samples or strata showing combinations of first and second choices of information sources, compiled from Table 1.

ferences arrayed by category of information source and rank. In other words, the numbers in its cells are counts of analytical units (study populations or strata) for which a designated information source occupied a specified rank. Its scale, from 1 to 6, is identical to that employed in Table 1. Table 3 gives frequencies of study populations or strata whose first preference for one kind of information source was associated with a second preference for another. Its numbers do not represent individuals' sequences of choice. In constructing both tables, only rankings for "All" were counted for Northup's study [57]; similarly, only the rankings for "Observed" in Covell's paper [58] were included. Tied ranks produce a total N of 21 instead of 20 in Table 3.

The enumeration in Table 2 reveals that for most physicians surveyed, the first-ranked source of information was medical literature, including both journals and books, with journals being chosen as often as books. For seven of the twenty counted units (study populations or strata), journals were the first preferred source, whereas for seven units books were the predominant first choice. For four units, consultations or discussions with colleagues were the first preference, so that consultations rank next below books and journals among the first choices. Another way to interpret this listing of first choices would be that consulting books was not usually conjoined with reading journals, and that if coupled with any other information-seeking strategy, the use of books or journals may have been related to or followed by consultations or discussions with a colleague. This idea receives some support from the second line in Table 2, which shows that the most frequent second choice was "Colleagues/Consultations" (eleven of twenty units).

Additional evidence for this relationship appears in Table 3. The table reveals that seven units in which books were the first-ranked information source likewise indicated colleagues and consultations to be the second choice, and similarly, that five units reporting a primary preference for journals ranked colleagues and consultations second. Further, Table 3 indicates that for two units the first preference was colleagues and consultations and the second preference journals, and that for one unit the first choice was "Colleagues/Consultations" whereas the second choice was books. In sum, books or journals were associated with colleagues and consultations in fifteen of the twenty analytical units.

An association between medical literature and consultations is also shown by the findings of Gruppen et al. [59]. Analyses of data collected in their study indicated that for internists whose primary information source was textbooks (forty-nine of ninety-eight), the next most frequent source was consultation. The findings of Gruppen et al. were based upon sequential choices made by individual physicians. None of the other studies included in the meta-analysis measured

sequence of choice. The aggregated, population-based data used in the present study do not permit a rigorous test of this hypothesis.

DISCUSSION

Several conditions impede generalization from the quantitative synthesis of the findings of the twelve studies. Some originate in the designs of the separate investigations, others from the nature of the data and from the design of the meta-analysis. One difficulty of the former kind is that convenience sampling by half of the studies may have inadvertently selected study populations that did not accurately represent their target populations. Another is incommensurability of data reported by the studies, resulting mainly from diverse measurements and classifications of information sources. The most troubling difficulty arises from the potential for bias in the physician's self-reported choices. As revealed by the direct observations of information seeking reported in Covell's study [60], the information sources for which many of the subjects expressed preference may not have been the sources they actually most often employed. If this discrepancy was present but undetected in the behavior of a large proportion of the participants in the other investigations, it would have markedly distorted the validity of the studies' findings. This possible contradiction is one that meta-analysis cannot resolve.

Other conditions hampering generalization relate to the meta-analysis itself. One such condition consists in the small number of investigations published and, equally, in the small number analyzed by the present study. Generalization is also weakened by the fact that the physicians' information-seeking behaviors were sampled by cross-sectional surveys scattered over a period of fifteen years. Since both the technology for accessing information and, perhaps to a lesser degree, the education and training of physicians have changed during that period, one might expect physicians' information preferences in 1978 to differ considerably from their information preferences in 1992. While not providing compelling evidence against this expectation, the observation that Table 1 exhibits no apparent trend in ranking of preferred information sources suggests that technological and educational change did not radically alter physicians' information-seeking behavior during the period under consideration. A third condition is that the data are complex and therefore open to varying interpretations. The studies report multiple sources of variation, including medical specialty [61-64], levels of training [65, 66], recency of training [67], and geographic location (especially proximity to urban settings) [68], as well as institutional association. Any of these variables—alone or combined—may have interacted with and modified physicians' choices of information source. If numerous in-

vestigations had consistently measured and reported these variables, meta-analysis could usefully estimate their effects, but this is not the case. The small number of studies, together with the heterogeneity of study variables and methods, makes control by this approach presently impracticable.

Notwithstanding these difficulties, the foregoing meta-analysis reveals a credible pattern of physicians' information-seeking practices. It is a pattern that largely accords with previous interpretations. Physicians frequently cited (and presumably used) books and journals as their preferred sources of clinical information. Nonetheless, getting information from colleagues or consultants ranked next to medical literature in reported preference, and appears to have often been associated with the use of books and journals. Even the academic physicians questioned by Cohen [69] and Woolf [70] ranked colleagues and consultations second in importance to published sources. The research of Weinberg et al. on informal person-to-person advice-seeking between physicians [71] supports the importance of this informal mode of communication. It is not surprising that physicians appeared to choose the sources of information that were most easily and efficiently accessed and most applicable to practical, clinical problems. In this respect their information-seeking behavior more closely resembles that of engineers and nurses [72] than of the academic scientists (physicists) studied by Chen [73], who rated formal publications far above informal communication. Yet, the importance of informal communication networks—"invisible colleges" [74]—in scientific research and communication has been well established by sociologists of science. Suffice it to say that seeking advice from colleagues is not unique to practicing physicians.

How do these findings relate to medical librarianship? An answer to this question is limited by the scope of the investigations included in the meta-analysis. Nine of the twelve studies did not explicitly measure physicians' use of medical libraries. The three exceptions, Strasser [75], Stinson [76], and Northup [77], found that the physicians they surveyed reported infrequent use of institutional libraries and their services. Physicians in Strasser's sample ranked library reference services sixth among their preferred information sources, while Stinson's subjects indicated that they used their personal libraries far more often than they used hospital, medical school, or medical society libraries. Only one-third of the physicians queried by Northup reported that they found answers in institutional libraries. More ambiguous are the ratings of indexes and abstracts, which in Strasser's and Connelley's [78] surveys ranked fifth, and in Woolf's study [79] ranked third for housestaff and fourth for faculty. Whether the indexes and abstracts were housed in institutional libraries is unclear. Still more difficult to

identify are the sources and use sites of the books and journals strongly preferred by most of the physicians, since the studies generally failed to reveal whether these items were personal or clinic copies, or were instead acquired from institutional libraries. One can reasonably surmise that a physician did not normally visit an institutional library to consult a nearly ubiquitous handbook such as the *PDR*, or perhaps even to consult medical textbooks, but the source and ownership of other categories of books can be neither identified from the published data nor presumptively inferred from general knowledge of physicians' practices.

Yet the fact that physicians most often seek answers to clinical questions in medical literature and from colleagues reflects a pattern of information seeking that surely affects medical librarianship. Assuming that physicians base their choice of information source primarily on the criteria of efficiency of access and applicability to practical problems, one should expect that they would first turn to easily reached medical literature and colleagues for answers. A consequence of this practice is that medical librarians and libraries are often left out of the network for communicating medical information. The acquisition of clinical information from colleagues must seldom directly involve librarians and libraries. However, a portion of the information communicated in this fashion may be indirectly transmitted from library sources and services in that the physicians consulted may have obtained it from library resources. Physicians who actively engage in research may often function as go-betweens who disseminate current information to their colleagues. Gruppen [80] notes that certain physicians, especially those in academic settings, seem to serve as nodes in information networks; these are the "opinion leaders" or "educationally influential" physicians. For librarians to identify such persons, then apprise them of new information sources, would, in Gruppen's thinking, enhance the position of health sciences libraries in the network of information sources utilized by physicians.

CONCLUSIONS

The principal question that this study addresses is this: What sources of information do physicians use to answer questions arising in their clinical practices? To answer this question, the investigation applied a meta-analytic procedure to a sample of twelve studies of U.S. and Canadian physicians that were published between 1978 and 1992. The procedure consisted in constructing a classification of information sources and an ordinal scale for standardizing the individual studies' ranking of sources, then in counting and aggregating the resulting assigned rankings. The meta-analysis indicated that, in general, physicians most frequently find information related to medicine in journals and

books, and then, nearly as often, through consultations with colleagues. Even for physicians whose first choice of information sources was medical literature—either books or journals—the most frequent second choice was consultations. No doubt informal consultation with colleagues plays a vital role in medical communication, and, at the very least, rivals books and journals for first place among preferred information sources. In the main, these results accord with those of previous reviews, as well as with the subjective impression one forms from reading the individual studies. This pattern of information-seeking behavior will undoubtedly continue to influence the conduct and resources of medical librarianship.

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