Information needs and information seeking in a biomedical research setting: a study of scientists and science administrators

Suzanne F. Grefsheim, MEd, MSLS; Jocelyn A. Rankin, PhD, MLn, AHIP, FMLA

See end of article for authors' affiliations.

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Objective: An information needs study of clinical specialists and biomedical researchers was conducted at the US National Institutes of Health (NIH) to inform library services and contribute to a broader understanding of information use in academic and research settings.

Methods: A random stratified sample by job category of 500 NIH scientists was surveyed by telephone by an independent consultant using a standardized information industry instrument, augmented with locally developed questions. Results were analyzed for statistical significance using *t*-tests and chi square. Findings were compared with published studies and an aggregated dataset of information users in business, government, and health care from Outsell.

Results: The study results highlighted similarities and differences with other studies and the industry standard, providing insights into user preferences, including new technologies. NIH scientists overwhelmingly used the NIH Library (424/500), began their searches at the library's Website rather than Google ($P = < 0.001$), were likely to seek information themselves (474/500), and valued desktop resources and services.

Conclusion: While NIH staff work in a unique setting, they share some information characteristics with other researchers. The findings underscored the need to continue assessing specialized needs and seek innovative solutions. The study led to improvements or expansion of services such as developing a Website search engine, organizing gene sequence data, and assisting with manuscript preparation.

INTRODUCTION

In the last twenty-five years, research has contributed to a better understanding of information needs and information-seeking behaviors among health practitioners in primary care settings. Studies of primary care physicians showed that their questions were frequently related to diagnosis, treatment, and drug therapy of conditions presenting during office visits. However, fewer than half the questions were pursued. When answers were sought, physicians first turned to colleagues, then to print resources such as textbooks and journals in their offices. Online databases and libraries, even when available, were infrequently consulted due to lack of time or search skills [1–7]. Cogdill and others extended these findings to nurse practitioners, physician assistants, and personnel in other clinical settings [8–11]. Cogdill also confirmed Gorman and Helfand's finding that ''the generalizability of the need, or the extent to which it could be applied to the care of other patients . . . is a negative predictor of information seeking'' [8]. More recently, Coumou et al. reviewed studies of primary care physicians published between 1992 and 2005, a period when information technology and medical databases became widely available to health practitioners. They found no change in information-seeking behaviors, with lack of time and limited searching ability again the primary obstacles [12].

Only a few information needs studies have been conducted with clinical or basic science researchers and none among administrators in research settings, the types of scientists seen frequently in many academic health sciences centers and in research institutes such as the National Institutes of Health (NIH). The few studies of these groups in an academic or research setting showed that, unlike busy health practitioners, access to and use of the research literature are considered essential for their work. Developing protocols, keeping up-to-date in a specialty, conducting research related to academic writing, and supporting teaching responsibilities led the list of reported needs for information [13–15]. In another study, molecular biologists and biotechnologists indicated that their primary information needs were met by nonbibliographic databases, followed by personal communication with colleagues [16]. Further, they expressed greater trust in their own bibliographic searching than that of librarians and questioned indexing practices of major databases when they did not find expected information. Two recent studies reported that molecular biologists also needed tools for mining the medical literature and large genetic datasets to discover relationships and generate new hypotheses [17, 18].

BACKGROUND

NIH is the largest supporter of US biomedical research, with approximately 80% of its budget ($22.4 billion in fiscal year 2005) earmarked for grants, contracts, and cooperative agreements with universities, hospitals, and other research institutions [19]. Administration and management of this external funding is done by extramural program staff in the 27 NIH in-

stitutes and centers. These science administrators identify emerging research areas, set research funding priorities, and monitor and administer grants and contracts. They typically are former research scientists and domain experts with medical and/or doctoral degrees.

Ten percent of the NIH budget supports the translational clinical research conducted intramurally (internally) by NIH employees located at NIH facilities principally in Maryland, North Carolina, and Montana [19]. While NIH researchers do not compete for grants to support their research, they do compete for tenure and their science is reviewed by boards of scientific counselors made up of respected academic scientists. Most intramural research programs include a training component with post-doctoral fellows from around the world spending two to five years learning to conduct translational research.

The NIH Library, with collections and services analogous to a large academic biomedical library, serves the information needs of both intramural researchers and fellows in labs and clinics and the science administrators working in the various extramural program offices. It does not support the information needs of NIH grantees or contract recipients.

STUDY OBJECTIVES

To learn about the information needs and information-seeking behavior of researchers and science administrators, a user needs assessment was conducted among a representative sample of NIH staff. While the overarching purpose was to inform library services, the study also attempted to build on earlier information use studies and to contribute to what is known about the information-related behavior of scientists engaged in translational (bench-to-bedside) biomedical research.

The study had two major objectives. The first was to identify similarities and differences in information needs and information-seeking behaviors among researchers engaged in medicine and public health, the biological sciences, other sciences (physical, social and behavioral, veterinary, and mathematics and statistics), and science administration. Also of interest was whether and/or how the role a scientist plays in the research enterprise—administering science programs versus conducting research—affects this behavior. Where appropriate, findings were compared to aggregated data compiled by Outsell on the information-related behavior of scientific and medical personnel in corporate, government, and health care settings to determine whether NIH staff information needs are unique.

Second, the study hoped to identify NIH staff who did not use the NIH Library to better understand their unmet needs. Anticipating that extramural staff, primarily science administrators, would account for most nonusers, a study focus was to compare their responses to intramural researchers. Although the NIH Library's mission indicates that it supports all staff, in reality collection policies and services have emphasized clinical and basic science research. However, as the virtual library grew to include more than 6,000 online journals, several hundred online books, and numerous databases, demand for information resources and services from extramural staff, who generally are in off-campus facilities, has increased. A better understanding was required of their information needs and the kind of resources and services that could make their work more efficient and effective. Were the library's journals, databases, and books meeting their needs, or did they need something very different?

Highlights

- Journals were the single most important information resource for biomedical researchers in this study, and online journals were overwhelmingly preferred by all types of scientists and all age groups.
- Biomedical research scientists were self-sufficient information seekers by preference.
- Researchers who started a search for information from the library's virtual or physical library reported spending less time searching for information and more time analyzing it than researchers who reported starting their search from an Internet search engine such as Google or Yahoo.
- New information services that some researchers would welcome are help with organizing gene sequence data, mining of large data sets, and preparing manuscripts.
- Nonusers valued the same library services users do, but they knew less about what is available and had lower expectations of the library.

Implications

- Given researchers' preference for self-sufficiency, dynamic communication and instruction programs are essential.
- A library Website that makes finding and accessing needed information easy can positively affect researcher productivity.
- Librarians who have successfully enabled self-sufficient users should be prepared to use their knowledge, skills, and abilities to offer new services in new settings.

METHODS

Although NIH employs over 18,000 federal employees, this study targeted only the library's primary user groups in the scientific or clinical professions. The 9,829 NIH employees in the scientific or clinical professions job series being studied were identified through the NIH Office of Personnel Management Fedscope database [20]. Based on this population, a sample size of 500 was determined sufficient to identify trends and detect differences in information needs

Table 1
Survey sample

Job category	OPM database	Sample	Margin of error 95% confidence
Medical and public health	3,344	170	± 7
Biological sciences	3,151	184	± 7
Physical sciences	861	14	± 15
Mathematics and statistics	303	12	± 15
Social and behavioral sciences	271	13	± 15
Veterinary sciences	65	5	± 15
Science administration	1,834	102	± 9
Total	9,829	500	± 4

Total employees in each job category according to the National Institutes of Health Office of Personnel Management (OPM) database, number in the sample, and resulting margin of error.

and behaviors between and among the scientific and clinical professions studied at the 95% confidence level.

The sample of 500 was stratified by job category so that the number surveyed in each job category reflected the percentage in that job series in the total population of 9,829 (Table 1). For example, NIH employees in the medical and public health job series (3,344) made up 34% of the total NIH employees in the study population. Therefore, 170 NIH employees in the medical and public health series were surveyed (34%, n = 500). To generate random call lists, Excel spreadsheets with data for individuals in each job category were developed using the NIH global directory. The directory includes job category information for the majority of NIH employees. Excel's randomization function was used to create the call lists. Recruitment ceased for a job category when the appropriate number of responses was received. Because of relatively small numbers in the total population, responses from the physical, social and behavioral, and mathematics and statistics categories were grouped together to form an ''Other'' category for analysis.

Outsell's User Needs Assessment Toolkit was used for the survey instrument. Outsell, a market research firm focused on the information industry, regularly surveys thousands of information users working in corporate, academic, and government sectors. Its subscription-based database contains over 40,000 completed surveys from a broad spectrum of information users. The comparison data for this study were derived from the surveys in the Outsell database from 269 respondents who were categorized in the research and development scientist or medical job categories working in the biotechnology/pharmaceutical or chemical industries, universities, or practice, clinic, or lab settings [21].

The NIH survey contained forty-five questions derived from the Outsell toolkit. Thirty-two questions asked about the frequency of use and importance of types of information sources ranging from books and journals to various legal and market research sources. Thirteen questions asked about general information-seeking behaviors, such as time spent gathering and analyzing information, major challenges in obtaining information, and criteria for evaluating information sources. Additional questions developed by library staff gathered demographic data, information about NIH Library use, and perceived value of current and potential library services. The survey concluded with an open-ended question about information services or resources that would make respondents' work easier. Most questions presented respondents with a set of choices for the most appropriate response.

The survey was administered by an independent consultant, Lazarus Strategic Services (LSS), from September 9 to 30, 2005, by telephone to the randomly selected NIH employees in the selected job categories. NIH does not require institutional review board (IRB) approval for surveys conducted among its staff by central service organizations such as the NIH Library. The margin of error for a sample of this size is ±4% at the 95% confidence level. Subgroup margins of error are larger (Table 1). LSS provided statistical analysis. Data were analyzed using *t*-tests to calculate significance at both 90% and 95% levels between and among the following: users and nonusers, age groups, intramural and extramural programs staff, and job categories. A chi square analysis was used to measure significance among respondent choices for strategies used when beginning an information search.

RESULTS

Demographics

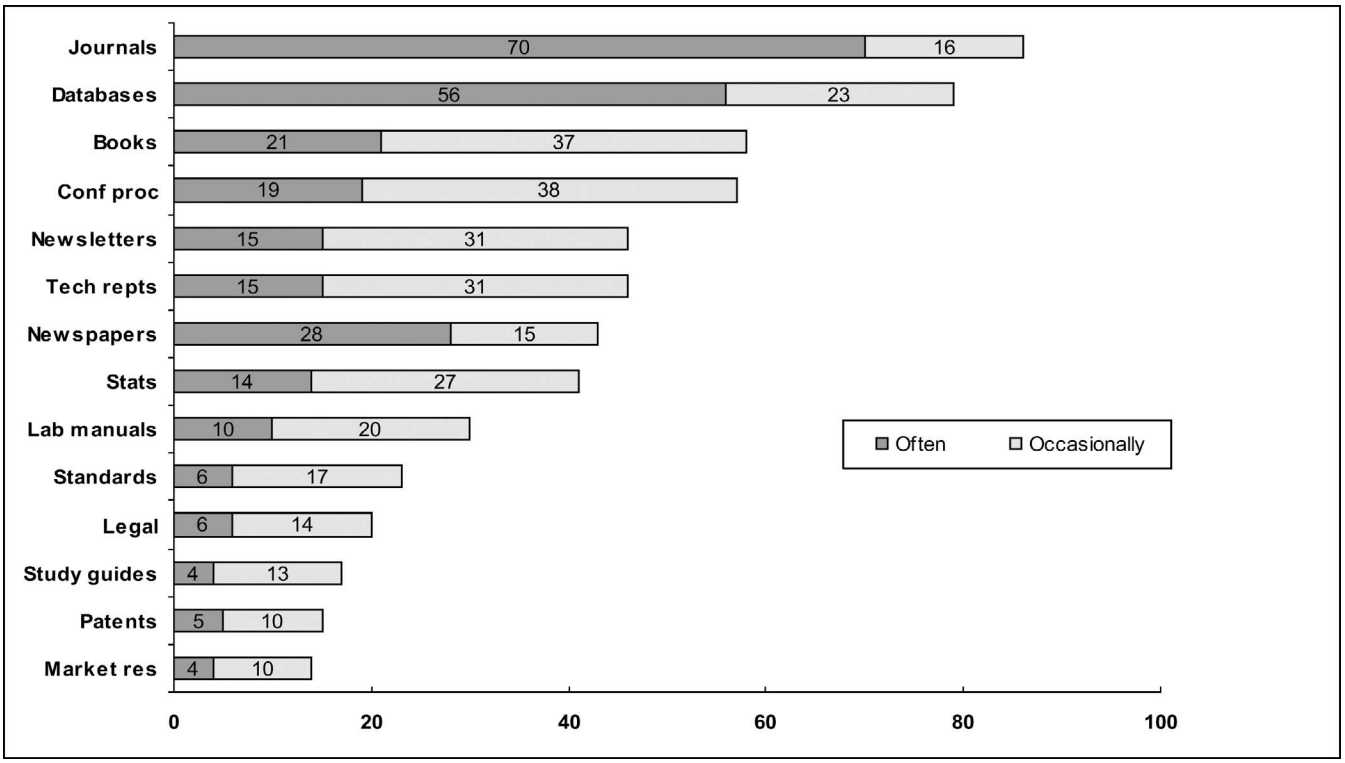
Of the 500 survey respondents, 54% (n = 269) indicated they were intramural program staff, 45% (n = 225) were extramural, and 1% (n = 6) did not respond to this question (Table 2). As predicted, extramural re-

Table 2
Survey respondent demographics

Job category	Survey respondents	Intramural	Extramural	Age distribution < 35	35–44	45–54	> 55	Library users n (%)	Library nonusers n (%)
Medical and public health	170	93	77	26	49	49	45	151 (89%)	19 (11%)
Biological sciences	189	141	45	42	55	49	40	176 (93%)	13 (7%)
Other*	39	17	22	6	10	16	7	36 (92%)	3 (8%)
Science administration	102	18	81	16	26	33	25	61 (60%)	41 (40%)
Total	500	269 (54%)	225 (45%)	90 (18%)	140 (28%)	147 (29%)	117 (23%)	424 (85%)	76 (15%)
Nonrespondents		6			6			N/A	

* The Other category combines the smaller subgroups of physical, social and behavioral scientists, and mathematicians and statisticians. Number of nonrespondents varies by survey question.

Figure 1
Preference in use of information resources



Resource types abbreviated in the above list: conference proceedings, technical reports, statistics, laboratory manuals, and market research.

spondents were more likely to be science administrators and library nonusers than were intramural scientists.

In general, study participants were middle-aged with the majority (57%, 287/500) falling in the combined age group of 35–54. The next largest group (23%, 117/500) was 55 or older. Only 90 of the 500 respondents (18%) were under 35, and 6 (1%) did not answer this question. The biological sciences category contained the largest number of staff age 35 or younger (Table 2). Extramural respondents tended to be older with 70% (154/221) 45 years or older, compared with 40% (108/267) of intramural staff in these age brackets. Forty-one percent of study participants (206/500) had worked at NIH from 3–8 years, and 30% (152/500) had been at NIH more than 14 years.

Survey respondents overwhelmingly reported regular use of the NIH Library Website or physical library. Only 15% (76/500) of the total sample were library nonusers (e.g., had not used the library in the past year or had never used the library). An analysis by job category showed that 93% of the biological scientists (176/189), 89% of medical and public health respondents (151/170), and 92% of the other scientists (36/39) were library users. Fewer science administrators (60%, 61/102) used the library regularly (Table 2).

Resources used

On a frequency-of-use scale of ''often/routinely,'' ''occasionally,'' and ''infrequently or not at all,'' journals were used ''often/routinely'' at NIH by 70% of the respondents (348/500) (Figure 1). Databases (bibliographic and nonbibliographic) were the next most popular resource, with 56% (281/500) using these ''often/routinely.'' Respondents in the science administrator category were significantly less likely to use journals often ($P = 0.05$) but slightly more likely to use databases more frequently (63%, 64/102) than others, including those in the medical and public health category (49%, 84/170). Given a selection of 27 information resource types including ''other,'' all other resource types were used ''occasionally'' or ''not at all'' by a large majority. When asked about preference for print or online journals, of 427 who responded, 84% (n = 358) preferred online journals and only 5% (n = 21) preferred print; 11% (n = 47) wanted both. A strong preference for online access was found among all age groups; however, of those expressing a preference for both print and online access, the 45 and older staff constituted the majority (70%, 32/46).

From the same list of information resource types, 62% of respondents (290/471) selected journals as the most important information source for their work; 21% (99/471) indicated databases. Of the 290 respondents who rated journals most important, 69% (n = 179) were intramural staff while just 53% (n = 110) were extramural staff, a significant difference ($P = 0.05$). Databases were significantly more important to science administrators ($P = 0.05$) than to medical and

biological scientists (37%, 33/90, compared to 16%, 26/162, and 19%, 34/181, respectively). The next most important information resource was policy documents, selected by 2.5% (12/471, of which 7 were science administrators), followed by books, chosen by 2% (11/471). All other resources were important to 1% (n = 6) or fewer respondents. Resources such as newsletters and regulations, each rated most important by 6 respondents, were more likely to be so rated by science administrators than by any other job category (3/6 and 5/6, respectively).

Information-seeking behavior

Self-sufficient information users. When asked how they usually obtained information, a large majority (95%, 474/500) responded that the most common way they obtained information for work was to seek it themselves. This was true across all age groups and job categories and among users and nonusers and extramural and intramural staff. When asked how they *preferred* to obtain needed information, 91% of respondents (454/500) preferred to seek it themselves as well.

Finding information. The NIH Library (online and physical) was the primary source for finding information for 50% of all respondents (248/500) and for 57% (240/424) of library users. A statistically significant and enlightening finding was that the library Website was reported as the place to begin an information search by a large plurality of all respondents (227/500) ($P < 0.001$). Search engines such as Google or Yahoo were cited as the primary information finding source by 32% (158/500), while only 29% (121/424) of library users chose this method first. Library nonusers (49%, 37/76) were significantly more likely to use Google than library users (29%, 121/424) ($P = 0.05$). Science administrators also often reported using an Internet search engine first (40%, 41/102).

Only 10 NIH scientists (2%) reported usually going to colleagues or experts in the field as primary sources for information. This was true across all job categories. However, 30% of all respondents (150/500) reported they were likely to learn about new information sources from colleagues or coworkers or an outside expert and 15% (76/500) reported that they were likely to learn about new articles in their field this way. Almost half (242/500) of the respondents conducted their own periodic database searches to identify journal articles of interest to them; 19% (96/500) relied on an alerting service; and 5% (23/500) used personal journal collections. Of the newer alerting services, only 2 people mentioned really simple syndication (RSS) feeds and 4 noted blogs.

Time spent on information tasks. In response to an open-ended question, respondents reported an average of 3.5 hours gathering published information and 5.8 hours reviewing and analyzing it each week.

Evaluating information. Given a list of seven criteria—including price, comprehensiveness, and accuracy—survey participants were asked to identify the top-three criteria they used when evaluating various information types. On a scale of 1–3, with 3 as most important, ''Accuracy of information'' (mean score 2.4) and ''Ease of access and use'' (mean score 2.23) were clearly the most important criteria among NIH scientists for evaluating information sources. They received both the greatest number of responses and the highest scores (Table 3).

Table 3
Information criteria

Criteria for evaluating information	Number of respondents*	Rank order
Accuracy of information	375	2.40
Ease of use and access	324	2.23
Timeliness	250	1.70
Relevance	237	1.91
Comprehensiveness	146	1.64
Reputation of source	125	1.51
Price	34	1.38

Survey respondents were asked to select their top 3 criteria when evaluating information.
* Indicates number of respondents selecting this choice.

Barriers and challenges. When seeking information, the most frequently mentioned problems for respondents were ''Not having enough time to search for and gather information'' (27%, 136/500), followed by ''Not knowing what is available'' (18%, 92/500) and ''Information is too hard to find'' (15%, 73/500).

To identify opportunities for library interventions, respondents were asked about information-related challenges. Examples included preparing manuscripts, organizing and managing bibliographic information, analyzing and organizing gene sequence data, tracking grantee publications, and interpreting the validity of published information. On a scale of 1–3 with 3 a major challenge, NIH respondents as a whole did not report any major information-related challenges (Table 4). However, 51% (96/189) of biological scientists found managing gene sequence data challenging and 60% (162/269) of intramural scientists had problems with manuscript preparation.

Use of the National Institutes of Health (NIH) Library

The majority of survey respondents were NIH Library users. Most (38%, 189/500), reported using the library to find information within the last 24 hours, while another 27% (135/500) said they had used the library within the last week, 11% (53/500) within the last month, and 9% (47/500) within the last year. Only 7% (37/500) had never used the library. Of the 76 people who had not used the library in more than a year or had never used it, 64% (n = 49) were extramural staff and most of them (n = 41) were science administrators.

When asked why they had not used the NIH Library, 3 of the 76 nonusers noted that they had never heard of it. A third of nonusers (25/76) got informa-

Table 4
Information challenges

Information challenges	Number of respondents*	Rank order
Manuscript preparation	440	1.77
Conducting comprehensive searches	471	1.77
Managing bibliographic information	488	1.75
Managing gene sequence data	337	1.72
Preparing papers for presentation	467	1.67
Tracking grantee publications	390	1.58
Technology	484	1.59
Interpreting validity of articles read	479	1.59
Verifying citations	448	1.50
Cited reference searching	467	1.44

Survey respondents were asked to rate challenges to their information seeking as major, minor, or minimal.
* Indicates number of respondents selecting this choice.

tion elsewhere, and 26% (20/76) said that their job did not require them to use library services. Another 25% (n = 19) of nonusers indicated lack of awareness of library offerings, and 10 people (9 of whom were located off-campus) responded that the library's location was inconvenient. (Multiple responses were possible.)

Benefits of library use. Across all job categories and groups (user/nonuser, extramural/intramural), the main benefit of the NIH Library (virtual or physical) was that it was ''Convenient to use'' (39%, 93/500). The next most-frequent response (chosen by 26%, 129/500), ''It saved time in finding information,'' was more of a benefit to library users than nonusers (125/424, 29%, compared to 4/76, 5%) and intramural rather than extramural staff (81/269, 30%, compared to 47/225, 21%). The third most frequent response, ''It provided me with information I would not have found otherwise'' (chosen by 16%, 79/500), showed no discernible difference between categories.

Communicating with the library. The overwhelming communication preference (68%, 341/500) was to ask questions by email or telephone, with no interest in completing Web forms. Only 16% (79/500) of respondents preferred to ask questions ''Using an interactive Web-based reference service,'' and 22% (111/500) wanted to use it to request searches.

Valued library services. Looking to the future, respondents were asked to rank various current and potential services on a scale of 1 to 10, with 10 being of greatest value (Table 5). Online resources and services were clearly preferred, with ''Making a wide range of journals and databases available at the desktop'' receiving the highest rating (8.71), followed closely by ''Requesting needed journal articles at your computer and receiving the articles by e-mail'' (8.58) and ''Bringing together all the information sources that you need in one Website'' (8.0). Overall, extramural staff and nonuser ratings for information and library services were lower than intramural staff and users.

Given that almost half the respondents were in the extramural (off-campus) category, ''Space for collaboration'' (4.08) and ''Quiet study space'' (4.75) were among the lowest rated services listed. Intramural staff, who are more likely to be on-campus, gave a value rating of 5.58 to ''Quiet study space,'' and younger respondents (< 35) rated this at 6.19. Overall, the least valuable service was ''Developing taxonomies'' (3.24).

Almost 41% (204/500) of respondents reported having a wireless handheld device or personal digital assistant (PDA). Some (85/204) currently used it—or expressed interest in using it—to access library databases. Nonusers were as likely to have a PDA as library users, were somewhat less likely to be interested in searching PubMed than users (16% of nonusers, 6/36,

Table 5
Valued library services

Value of library services	Total number of respondents	Rank order	Extramural respondents rank	Intramural respondents rank	Library users rank	Library nonusers rank
Making a wide range of journals and databases available on the desktop	497	8.71	8.45	8.94	9.03	6.88
Requesting and receiving needed journal articles at your computer	498	8.58	8.02	9.10	8.92	6.69
Bringing together all needed information sources to one online location	496	8.00	7.64	8.30	8.21	6.77
Providing an alerting service on selected topics	496	7.08	6.77	7.32	7.32	5.74
Help locating unpublished information and experts in topics of interest	491	6.64	6.20	6.96	6.83	5.53
Advice on using an information source	495	6.44	6.10	6.76	6.59	5.61
Training to improve your searches	497	6.18	5.88	6.40	6.44	4.64
Conducting background research on your behalf	494	5.84	5.50	6.12	6.03	4.69
Providing a librarian to work on your projects	485	5.61	5.12	5.98	5.82	4.45
Analyzing the results of a search and selecting most relevant articles	493	5.58	4.80	6.20	5.76	4.58
Developing custom databases	489	5.55	4.94	6.03	5.71	4.65
Embedding access to information in your personal or departmental Website	480	5.36	5.05	5.58	5.46	4.81
Consultation on organizing your information, data, references files	489	5.31	4.80	5.71	5.46	4.43
Managing a physical library	488	5.02	4.18	5.73	5.38	2.90
Developing bibliographies	485	4.80	4.47	5.13	5.11	2.99
Providing a quiet space for reading, writing, research, and contemplation	495	4.75	3.66	5.58	5.00	3.39
Providing space for collaboration	474	4.08	3.35	4.68	4.26	3.10
Developing taxonomies	442	3.24	2.72	3.74	3.49	1.83

Survey respondents rated a list of current and potential library services on a scale of 1 to 10 with 10 being most valued. Rankings overall are provided along with extramural or intramural staff and library users or nonusers.

versus 36% of users, 61/168), but were somewhat more likely to want to search ''other'' databases on their PDA (64% of nonusers, 23/36, versus 46% of users, 77/168).

Suggestions for improved service

Finally, 145 respondents contributed suggestions for ways to make the library a better or more useful place to do their work. Forty percent (57/145) requested more online journals, some in subject areas not currently received, and 18 wanted more online backfiles. A smaller number (14/145) suggested book collection improvements in specific subject areas. There was no overlap in the subject areas mentioned for either journals or books.

Another 63 comments related to library communication. More training was requested 44 times, and more publicity about library services and resources was suggested 19 times. Only 7 suggestions concerned the physical library, recommending more quiet study space and a coffee bar. While it was not possible to attribute comments to individual respondents, 32% of extramural staff (73/225) offered suggestions, with 29 of these suggestions from science administrators, while 26% (71/269) of intramural staff made suggestions for improvements.

DISCUSSION

The survey enabled characterization of respondents by major demographic attributes and provided a profile of preferred information resources, user information-seeking behaviors, and patterns of library use. The large majority of NIH staff surveyed were library users who relied on journals as their most important information source. Online journals were preferred by all age groups over print. Respondents also appeared to be avid, self-sufficient information seekers more likely to start their information search from the library's Website than other methods including Google or Yahoo.

Similarities and difference between NIH staff and other scientists

In a recent TrendAlert publication, Outsell reported that scientists in corporate, government, and academic sectors who had completed their survey strongly preferred Internet search engines (55%) for finding information. Respondents' organizational intranets or portals was the second most often reported choice (21%). Assuming these intranets or portals included an online library, when combined with the 4% who reported the organization's physical library as a primary source, at most, only 25% of this sample go to library resources first to seek information. Outsell scientists also reported spending 5.8 hours a week looking for information and only 4.7 hours analyzing and applying it [22]. By comparison, NIH researchers, who were twice as likely to use library-provided resources and services as the Outsell group, spent on average less time on information-related tasks. Also less of this time went to gathering information, with more time in analysis and use of what they found.

In the area of information self-sufficiency, NIH researchers were in the mainstream. The strong preference across all demographic categories to find their own information supported a 1989 study of biotechnologists who were more likely to trust their own information searches than an intermediary's [16]. Outsell's findings were similar, if not as dramatic, with their scientists reporting seeking information themselves 77% of the time and 69% preferring this approach [22], compared to the 95% of NIH scientists who sought information themselves and 91% who preferred this approach. Four Danish universities also found a strong propensity among students and researchers for information-seeking self-sufficiency, which they thought the libraries themselves had nurtured [23].

Colleagues as sources of information played a larger role for other scientists than for NIH researchers and administrators. While 16% of the Outsell scientists cited colleagues inside and outside their organizations as sources of information [22], only 2% of NIH respondents considered them primary sources of information. In this regard, they were also unlike the molecular biologists from the 1989 study who cited colleagues second only to nonbibliographic databases as their primary sources of information [16]. The type of research conducted at NIH might be a factor in this difference. For example, all patients seen at NIH are research subjects participating in protocols that are outgrowths of the laboratory research conducted on campus.

While problems experienced by NIH and Outsell scientists overlap, each group's most frequently cited problem does not appear on the other's list. ''Not enough budget to pay for information,'' Outsell's top problem, did not make the NIH list, and Outsell respondents do not appear to have a problem with time, an issue at NIH.

A similarity with academics is that over 50% of NIH biological scientists considered ''Analyzing and/or organizing gene sequence data'' a challenge, confirming earlier studies showing this is a growing information need among molecular biologists [17, 18].

Differences between NIH researchers and science administrators

While most NIH staff knew about and used the NIH Library, extramural staff, science administrators in particular, are more likely to be library nonusers than intramural staff. They also are more likely to make suggestions for improvements in library services and resources. Notable differences are also apparent in their resource use, with preferences for nontraditional formats. The current collection development policy rejects these information types as out of scope, but this policy is now under review.

Intramural and extramural staff also differ in their perceptions of information challenges that could influence new or existing services. Because intramural re-

spondents indicate a greater interest in assistance with manuscripts, a new service is being considered to support this need, possibly in the form of workshops or Websites. Working with gene sequence data is also a greater need among intramural respondents. Expansion of library service related to organizing genetic data will be pursued, building on the current collaboration with NIH's Center for Information Technology, where one librarian with expertise in organizing and data mining large genetic datasets is a member of a computational biology laboratory team.

While extramural staff consistently rated both their information challenges and the value of current or potential services lower than intramural staff did, the rank order of the top-rated library services by the two groups was identical and they had only slight differences among the lower ranked services. Hopefully, this consistency will make setting priorities easier as the library moves forward.

Study findings that impact future directions include the following.

Targeted communications with NIH staff are needed. Results indicate that support for online access and use of library resources and services across all categories of users and nonusers is broad and deep. It also is evident that library programs and communications with science administrators could be more effective. Although extramural staff and nonusers appear to value the same services that users do, they know less about what is available and have lower expectations of the library. Understanding how to reach extramural staff and science administrators to better integrate library resources and services into their workflow is a major challenge in the year ahead. Recent follow-up focus groups suggest that discussions with targeted user groups should become routine as issues arise or as services are considered and/or introduced.

Library resources and services contribute to researcher efficiency. For years, NIH researchers have reported that the library's electronic resources and services save them time and allow them to be more productive. This study supports these comments by showing that NIH staff, who primarily use the library's Website or physical collections to find information, spend less time gathering information and more time reading and analyzing it than do a similar group of researchers in industry and academia, who overwhelmingly report using a search engine such as Google or Yahoo to find information.

The study also indicates that investing in a dynamic, responsive, online library can achieve major gains in efficiency in a research setting, as this has made information gathering easier and more straightforward. However, for the library's Website to remain the first place for information searching, its usability must continually be assessed. Because having time to search for information is a problem for NIH staff, providing a robust search engine on the Website is essential. The NIH Library is collaborating with the National Library of Medicine's Division of Specialized Information Services to develop a simplified search of multiple databases and Internet resources. Further, given that the vast majority of NIH staff prefer searching for information themselves, a dynamic instruction program must be maintained to provide them with search skills for effective use of both library and Internet resources.

Library services must be responsive. While some new services will be introduced in response to findings of the study, others can be dropped. An example of a library service revisited because of this study is chat reference. The NIH Library introduced its AskUsLive service in 2002 as part of its ongoing effort to bring library services to the desktop. The service was staffed by librarians during regular reference hours, 8:30 a.m. to 5:00 p.m., or 42.5 hours a week. Despite major promotional campaigns, the service never built a strong following. This study indicated that most NIH researchers *prefer* email or telephone calls over interactive reference sessions. A recent study of Danish research libraries reported similar findings among their user groups when they considered and ultimately rejected an online chat service [23]. These findings may be unique in research settings or for research scientists. In any case, the chat reference service was discontinued, freeing librarians to develop new services that may be more responsive to user preferences.

Study limitations. By its nature, this study paints a broad picture of information needs and information-seeking behavior among NIH biomedical researchers and science administrators. The results are limited by the inherent constraints of a survey, with its reliance on self-reported data and volunteer respondents with their potential participant bias. Comparisons with the Outsell findings are of course subject to the limitations of that resource, which is developed through subscription membership participation. Additionally, the unique work environment at NIH may limit generalizability of results. Follow-up with specific user groups is needed to guide programmatic responses.

CONCLUSION

The study reinforces the need to continually strive for integration of information resources and services into users' workflow. The strategies are particular to each institution and perhaps to each user group in an institution. This study indicates both similarities and differences between the NIH staff and a national database of corporate, academic, and government information users, a finding that underscores the importance of each library identifying its own customer needs and environmental influences on information seeking.

Areas for further investigation by others are apparent. While few other health sciences libraries support the number of science administrators that the NIH Library does, most academic and clinical settings do have similar administrative positions in key institutional roles. These administrators may share some of the information needs and information-seeking behaviors of those at NIH. It is this user group that will be

the focus of the next steps for the NIH Library. Follow-up qualitative studies with NIH science administrators as well as other user groups are underway.

For the NIH Library, possible new or expanded services were identified or their need confirmed through this study. These services will be explored and piloted in the coming year. Enhancing library staff research capabilities, which is necessary to continue market research and develop the evidence to advance information practice, is also being emphasized.

The study also has contributed to a broader understanding of the information needs and behaviors of biomedical researchers and specialists in academic or research settings. Biomedical researchers are intensive, self-sufficient users of information; they prize access to the journal literature above all else; and, no matter their age, they want the journals they read available at their desktops, not in the library facility. If librarians, not just library resources, are to have a place in their workflow, it must be in the users' context. The services that match these user preferences are not always the ones that librarians have traditionally offered. There are opportunities for exciting new initiatives, but some of these must be discovered in unfamiliar places.

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AUTHORS' AFFILIATIONS

Suzanne F. Grefsheim, MEd, MSLS, grefshes@nih.gov, Director, Division of Library Services, National Institutes of Health, 10 Center Drive, MSC-1150, Bethesda, MD 20892; **Jocelyn A. Rankin, PhD, MLn, AHIP, FMLA,** jrankin@cdc.gov, Chief, CDC Information Center, Centers for Disease Control and Prevention, 1600 Clifton Road, Mailstop C04, Atlanta, GA 30333

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