A STUDY OF THE CHARACTERISTICS OF LIBRARIES PARTICIPATING IN A MULTI-STATE RECIPROCAL INTERLIBRARY LOAN CONSORTIA USING DOCLINE ROUTING TABLES

by
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Approved by:

Advisor

This study compares the characteristics of 49 health science libraries participating in a multi-state reciprocal interlibrary loan consortia using DOCLINE routing tables with a random sample of 249 health science libraries in the same five-state area. The following hypothesis is tested: libraries will be more likely to join the consortia when staffing levels are greater than one, when SERHOLD holdings information is reported at Level 3, and when the library charges for interlibrary loans.

Results of the statistical analysis reveal that there is no meaningful difference between the consortia group and the sample population on the hypothesis variables. Significant differences do exist in the representation of library types for libraries participating in the consortia and those in the sample. Differences are also noted between the consortia group and the sample group for the percentages of libraries submitting information to professional directories and to the DOCUSER database.

Headings:

Medical libraries and collections – Interlibrary loans

Cooperation – Medical libraries and collections

Interlibrary loans -- Automation
Introduction

Interlibrary loan is a key service for health science libraries. No library can expect collections, however well chosen, to meet all the information needs of their patrons. This is especially true in smaller libraries providing direct service to health care providers. Several developments over the past thirty-five years have served to improve the access of all health care professionals to the biomedical literature. The programs of the National Library of Medicine (NLM), National Network of Libraries of Medicine (NN/LM) and the National Area Health Education Centers have worked to ensure this continuing progression of information delivery (Stoddart & McCloskey, 1994). One important factor in this increasing level of access is the support the NN/LM gives to the development of resource-sharing cooperatives between libraries. This research examines the characteristics of libraries that have recently joined one such resource-sharing consortia focused on reciprocal interlibrary loan agreements using DOCLINE routing tables. This study was undertaken in an effort to determine if participation in such a multi-state network can be predicted.
Literature Review

*History of NN/LM, NLM, and DOCLINE*

The most important development in the strengthening of health science libraries and the movement toward the formation of health sciences library consortium was the passage of the Medical Library Assistance Act of 1965 (Colaianna, 1998, Hendricks, 1975, and Stoddart & McCloskey, 1994). This legislation created the Regional Medical Library Program (known since 1991 as the National Network of Libraries of Medicine), provided for training in medical library sciences, and expanded the basic resources of health science libraries. Hendricks (1975) provides a good overview of the first decade of the Regional Medical Library Program. This network is a tiered system with the NLM as the library of last resort, followed by the regional libraries (geographically dispersed libraries funded by federal contracts), then resource libraries, and finally basic health science libraries. Resource libraries are generally large academic health science libraries associated with schools of medicine. The basic health science library is any library that directly serves health care professionals, usually hospital libraries, and these libraries act as gateways to the rest of the network. Needs that can not be met at the lower levels get passed on to the higher levels.

The development of local consortia grew out of the need to distribute requests for materials horizontally throughout the system, rather than leap-frogging all requests for materials and photocopies straight up to the NLM. As Hendricks notes, “interlibrary loan” is something of a misnomer for the activities most medical libraries engage in, since the majority of transactions involve making photocopies of journal articles which become
the property of the requestor (1975, also Arnold & Fishel, 1995). Another factor influencing early consortia formation is the fact that many interlibrary loan transactions in health science libraries that ended up in resource libraries or the NLM were federally subsidized due to the Medical Library Assistance Act. As federal funding was reduced into the 1970’s, lists of “most available” journal titles were compiled for which federal subsidies would be refused. Libraries were expected to seek sources for loans from these titles within their region and tier. Local and state groups were formed to produce union lists of serials which could be used as locator tools for such loan transactions.

Stoddart and McCloskey (1994) offer an overview of the development of library cooperation, networking, and consortia formation as a subset of library outreach activities. Besides covering the history of the NLM and the NN/LM, one focus is on the Area Health Education Center programs operating in 37 states. These programs are responsible for the organization of many local consortia dedicated to various resource-sharing activities such as interlibrary loan groups, cooperative collection development policies, and training for both health science library staffs and patrons. The goal of all of these activities is to ensure that health professionals have access to the most relevant and recent medical information, regardless of their distance from a graduate medical facility.

Many aspects of current interlibrary loan processes are covered by Arnold and Fishel (1995). They observe that health sciences library consortia take many forms, from large-scale networks to local interlibrary loan groups. Among the factors affecting current interlibrary loan demand, they cite the increasing specialization of the medical field with its concurrent specialization of biomedical literature, and the impact of easier access to the indexing and abstracting databases as a result of end-user searching. As more health
science professionals learn how to search MEDLINE, or any of the other health-related databases, without an intermediary, the more access they will want to the material itself, not just the citations and abstracts. Key developments in this field include the introduction in 1986 of Grateful Med, and Loansome Doc in 1991. Grateful Med is a front-end interface which allows end-user searching of the complete suite of NLM databases, such as MEDLINE and TOXLINE. Loansome Doc provides for transfer of the search result citations to a pre-selected library for photocopying or processing as interlibrary loan requests.

The most important development in health sciences libraries’ interlibrary loan activity was the introduction of DOCLINE in 1987. This automated interlibrary loan system was created by the NLM, and a key feature is its ease of use. DOCLINE provides a seamless interface between several NLM databases to complete an interlibrary loan request with a minimum of key strokes and to systematically route the request to the most appropriate library, given the journal article requested. A necessary first step to the design of DOCLINE, however, was the building of a national serial holdings database (Willmering, Fishel, & McCutcheon, 1988). This database, known as SERHOLD, allows the DOCLINE system to check which library owns the requested material, based on the volume number and year of publication, and send requests to holding libraries. SERHOLD was originally created in 1981 from the union lists from several large health sciences consortia and the individual holdings of a number of academic health science libraries. Willmering, Fishel, and McCutcheon (1988) detail the considerable work involved in deciding upon the standards and formats that the new database would use. Programs had to be devised that would allow groups to contribute their holdings in a
variety of formats and then translate the different records into ANSI serials holdings at the summary level (Z39.42-1980) format. Translated records could still reflect several levels of holdings detail, and less than 20 percent were captured at the most complete level, designated Level 3. Bibliographic control for the holdings list came from comparing titles in SERHOLD to the NLM SERLINE database. Another obstacle to the completion of SERHOLD was overcome when NLM allowed titles they did not own to be added to the SERLINE database. This concession allowed for complete linkage between the SERLINE and SERHOLD databases. Mechanisms for regular updates to the databases also had to be put in place. The libraries and consortia that contributed to the initial loading of SERHOLD played an important role in the development of DOCLINE. Besides making DOCLINE possible, an early benefit of participation in the SERHOLD database was the ability of NLM to generate specialized union lists in print, on microfiche, and on magnetic tape.

With a national serials union list in place, the stage was set for the development of DOCLINE. Dutcher (1989) provides a detailed summary of the databases and processes involved in the operation of DOCLINE (see also U.S. National Library of Medicine, 1999). DOCLINE came online in March 1985, with various regions of the country joining a few at a time. DOCLINE was widely available by 1987, and by 1988 1,688 libraries were active users. The goals incorporated into designing DOCLINE included the need to accommodate a variety of technologies and levels of sophistication among participating libraries, and the desire to minimize the amount of training required by users to go online with the system. DOCLINE is a menu-driven system that operates as a subsystem of MEDLARS, the interface many libraries used to perform MEDLINE searching. Unlike
MEDLINE, or other interlibrary loan systems such as OCLC, the costs of using
DOCLINE are subsidized by NLM. Libraries can generate loan requests, receive
incoming borrowing requests, update borrowing requests, check the status of outstanding
loan requests, and receive quarterly and annual statistics on interlibrary loan use.

A typical transaction makes use of several NLM databases to complete and route a
request. The requesting library’s information is automatically input to the request form
when the library logs on to the system by searching the library’s library identification code,
or libid, in the DOCUSER database and pulling in the name, address and other information
stored there. The complete bibliographic citation can be pulled from any NLM health-
related database by entering the article’s UI or unique identifier. Dutcher notes that this
feature saves key strokes, reduces entry errors, and serves as verification of citation
information. DOCLINE then analyzes the citation and pulls in a Title Control Number for
the journal title from the SERLINE database (Willmering, Fishel, & McCutcheon, 1988).
This Title Control Number is then used to check the SERHOLD database for libraries in
the routing table of the requesting library to see who owns the title, the correct volume
number or correct year. Each library participating in DOCLINE sets up their own routing
table, a ranked list of libraries with which the library has interlibrary loan agreements.
Originally, libraries could designate 80 libraries in their routing tables. That number was
later increased to 120. The routing table is organized as a series of cells, with room for up
to 20 libraries in each cell. DOCLINE randomizes the libraries in cell one and compares
the requested article against the SERHOLD record for each library in turn. If the holdings
in cell one are exhausted without a match, the libraries in cell two are randomized and the
process continues until a library is found in the routing table that holds the correct title and correct year or volume.

Dutcher observes that libraries are encouraged to place libraries of their own hierarchical tier in the lower cells, followed by area resource libraries, then their regional library and finally the NLM in cell 10. While libraries are free to place any library that is a DOCLINE participant in any cell of their routing table, DOCLINE etiquette suggests that libraries be asked for permission before being added to a routing table (National Network of Libraries of Medicine, 1999). A library in a lower routing table cell has an increased chance that requests will be forwarded to that library.

A study of the impact of the DOCLINE system on interlibrary loan fulfillment at NLM was published by Lacroix and Dutcher in 1989. The researchers found that interlibrary loan rates increased dramatically, to over 35 percent more than in the previous year. An examination of the types of requests revealed that of the most heavily requested journal titles, very few were held by other libraries. Nineteen of the titles were not held by a single library in several regions, meaning that the system of using the NLM as the library of last resort was working as planned. Lacroix and Dutcher note that the increase in interlibrary loans coming from hospital libraries, 46 percent in 1987 compared to 35 percent in 1984, was likely due to the adoption of DOCLINE by these libraries. While the rates for interlibrary loan requests went up, so did the percentage of requests that NLM was unable to fill. The main reason for failure to fill a request was the unwillingness of the requesting library to pay the NLM lending fee. The authors point to the increase in loan rates as evidence of improved access to the biomedical literature and of the ease of using the DOCLINE system.
Other studies published on DOCLINE have looked at the impact on interlibrary loan rates among hospital libraries in Michigan (McGaugh, 1990) and the use of DOCLINE statistics and routing tables to perform cluster analysis on library characteristics and interrelationships (McGaugh, 1994). These large-scale studies are complimented by several smaller studies that look at comparisons of the use of DOCLINE and OCLC for interlibrary loans in an academic health science library for the period of 1986 to 1992 (Prendergast, 1994), an examination of unfilled DOCLINE lending requests at an academic health science library (Slater, 1997), and a report of an attempt to expand the use of DOCLINE to nonmedical libraries (Potter & Zenan, 1993).

One limitation of the DOCLINE system that is not directly addressed in the literature is that the holdings of libraries that are not DOCLINE participants are, for all practical purposes, off limits to other libraries in terms of interlibrary loans. If a non-DOCLINE library participates in a local interlibrary loan group and has contributed holdings information to a local union list, then they are probably willing to accept typed American Library Association (ALA) interlibrary loan forms, but that means bypassing the efficiencies of the DOCLINE system in order for DOCLINE libraries to send them requests. So not only is the non-DOCLINE library unable to take advantage of the DOCLINE system for their own borrowing benefit, but in effect, they withhold their own journal collection from other libraries as well.

*Factors affecting Consortia Formation and Participation*

In Lacroix’s 1994 study of more than four million interlibrary loan requests routed through DOCLINE during a two year period, 1991 and 1992, she found that the number
of unique titles requested each year approached the number of currently published journal
titles. Over 19,000 different journal titles were requested in 1992 alone. To put this in
perspective, MEDLINE indexes only approximately 3,700 journal titles (as of 1994).
Another interesting result was the discovery that 76 percent of the articles requested were
used only once. Ninety-seven percent were used five or fewer times. There were between
12 and 14 journal titles for each year that had more than 100 articles requested, with
considerable overlap between the two lists. While Lacroix admits that many of the most
heavily requested journal titles were due to transitory “hot topics” and limited distribution
of hosting journals, studies such as these can have important uses for collection
development and alternate access or document delivery plans.

Another study which looked at journal usage, Dee, Rankin, and Burns (1998),
focuses more on the development of hospital library journal-use benchmarks. While the
researchers do not address the issue of interlibrary loan, their findings certainly have
interesting implications for interlibrary loan consortia formation. In examining journal use
patterns in thirty-six hospital libraries in the Southern Chapter/Medical Library
Association, they found that 86 percent of the journal titles identified were used in only
one or two libraries. Compared to academic libraries which follow the 80/20 rule for
library collections (80 percent of need is met by 20 percent of the collection), they found
that the hospital libraries in their study used 38 percent of their collections to meet 80
percent of their need. This means that not only are hospital libraries more precisely
tailored to the specific needs of their patrons, but also that each library holds unique titles
not found among the others. Instead of finding 36 nearly identical, overlapping
collections, they found a diversity of journal holdings unanticipated, even among the
smallest hospital libraries. This finding has enormous impact for the development of equitable, reciprocal, interlibrary loan partnerships. Taken together with the findings of Lacroix above (19,000 different journal titles used to fill interlibrary loan requests in a given year), this information suggests the importance of including health science libraries of all sizes and types in a reciprocal interlibrary loan consortia.

An early case study of health sciences library consortia formation is Dynamics of Hospital Library Consortia, edited by Fink, Getchell, Hughes, and Moulton (1975). This work details the development of a multi-function network in the Boston area. Chapters of this book cover a review of library cooperation principles, specific information on network communication, funding, and staffing, and various operational goals of the organization. Rather than limiting consortia activities to interlibrary loan agreements and the production of union serial lists, this network also sought to engage in cooperative cataloging and cooperative purchasing for high-cost equipment and computer access time.

Another good description of a health sciences library consortia is found in Friedman et al (1994). This history of the founding and development of the Basic Health Sciences Network in the Northeast (currently NN/LM Regions 1 and 8) covers membership guidelines, consortia activities and the impact of DOCLINE on operations. This reciprocal interlibrary loan network consisted of 460 health science libraries in a ten-state area as of 1994. Library types include college or university libraries, health-related or medical-industry special libraries, and hospital libraries, with the last category making up the vast majority of members. Built upon a melding of smaller local consortia using a common union list or locator tool (a key component for interlibrary loan group formation) in 1985, this network points out an important objective of all such groups: cost savings.
The authors present a detailed description of how DOCLINE routing tables are used to automatically transmit interlibrary loan requests to consortia members. Problems noted include the tendency of larger libraries to become net lenders within the consortia due to greater collection strengths.

The problem of burdening net lenders is also addressed in Ponnappa, Phillips, and Huggins’ 1995 article on a reciprocal interlibrary loan consortia in academic libraries. While not concerned directly with health science libraries, this article covers some of the important aspects of consortia operations. Like the Basic Health Science Network, this group was formed out of an existing cooperative network in the Southeast, the Association of Southeastern Research Libraries. The founding members suggested that the costs involved in the processing and accounting for multiple small invoice amounts, as is common in interlibrary loan transactions, were greater than the revenues generated. They posited that instituting a system which required no fees or bookkeeping and which also assured priority handling to fellow-member libraries could reduce costs and improve service to patrons. A one-year follow-up survey showed that 79 percent of consortia members were enthusiastic about the effect of the agreement and were seeing cost savings realized. Interlibrary loan rates increased 36 percent among the new reciprocal trading partners: national standards for the same period were in the 1 to 11 percent range.

In addition to these research studies, information impacting the use of DOCLINE appears in the *NLM Technical Bulletin*. Trends include a move to providing current documentation for DOCLINE only on the NLM web site, the ability for libraries to directly update their SERHOLD records through the same site, an Internet version of Grateful Med, enhancements to Loansome Doc, and the introduction of free MEDLINE

Another important move, slated for the summer of 1999, is the introduction of DOCLINE on the web. Once the Internet version of DOCLINE is in place, libraries will lose the ability to dial directly into the DOCLINE system through older telecommunication software packages (1998f).

In preparation for this change in service delivery, the NN/LM followed-up an earlier 1993 study of health science libraries’ Internet connectivity in the summer of 1997. The results of the survey are available on the NLM web site (National Network of Libraries of Medicine National Network Office et al, 1998). With 3,491 libraries responding out of 4,545 network members, 73 percent of hospital libraries reported some level of connection to the Internet, with the most common being access to the web (96 percent). Possible interactions included email, telnet, ftp, and the web through a variety of connections: LANs (34 percent), 28.8 plus modems (38 percent), or 14.4 modems or less (19 percent). Nine percent didn’t know how they were connected. More interestingly, of the libraries that were not connected to the Internet, 10 percent planned to never connect and 34 percent didn’t know when they might get an Internet connection. The most serious barriers to Internet connections were reported as computer cost (20 percent), management support (18 percent), and the lack of in-house expertise (17 percent) – these last three percentages are estimates based on bar chart data. While the NLM and NN/LM continue to offer outreach, support, and training to health sciences library staff in making use of new and existing technologies, these numbers (as well as the 1,000 non-respondents) point to a population that can’t seem to get on the Internet train.
These libraries, however, may have a greater incentive to make the technological leap with the changes in accreditation standards for hospitals. Both the 1994 and 1996 revisions of the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) have had major implications for the operation of hospital and primary health care libraries, the effect of which may strengthen management support for library services. The actual JCAHO standards are outlined by Dalrymple and Scherrer (1998). Most of the changes concern the structure of information management systems in the health care setting. Dalrymple and Scherrer point out that the newest 1996 revisions explicitly do not require the presence of an actual physical library, but meeting many of the requirements would be difficult without such an organization in the hospital. Key to the measurement of compliance is the idea of needs assessments and the provision of services given the mission and particular circumstances of the hospital. The role of the hospital librarian and library services fall under several sections of the Management of Information standards (IM). The most relevant section is IM9. This standard requires that “the hospital provides systems, resources, and services to meet its needs for knowledge-based information in patient care, education, research, and management” (Dalrymple & Scherrer, p. 14). Knowledge-based information includes, but is not limited to, the biomedical literature. Subsection IM9.1 requires that “the hospital’s knowledge-based information resources are available, authoritative, and up to date” (p. 14). Requirements such as these point to the need for a well-supported library, or at least library service, integrated into the total information management structure of the hospital.

One study examining the characteristics of hospital libraries in light of the 1994 JCAHO revisions is that of Glitz, Flack, Lovas, and Newell (1998). This survey of
hospital libraries in the NN/LM Pacific Southwest Region measured self-perceived compliance with the 1994 JCAHO standards and actual compliance with the 1994 revision of Medical Library Association (MLA) standards for hospital libraries. The new MLA standards were codified into 19 essential services by the researchers. These essential services include the use of interlibrary loan or document delivery using electronic networks and participation in cooperative networks, as well as access to online bibliographic databases and access to the Internet. With a response rate of 51 percent, the researchers found 77 percent of the hospitals lacked at least three of the essential services. Among the most common services lacking were microcomputer workstations (61 percent) and access to the Internet (55 percent). The survey did find, however, that 74 percent of the libraries responding used DOCLINE for interlibrary loan. That is equal to the number of hospitals reporting a staffed library collection. The remaining hospitals reported either an unstaffed central library collection (23 percent) or no centralized library collection (3 percent).

Background and Research Question

A reciprocal interlibrary loan consortia for health science libraries based on DOCLINE routing tables was formed in 1997 in a five-state area making up a MLA chapter area.\(^1\) As outlined in Friedman et al (1994) and Ponnappa, Phillips and Huggins (1995) above, one objective of the group is to reduce costs by minimizing paperwork, above and beyond any savings accrued from free borrowing. Other objectives include

\(^1\)All information in this paper about the consortia comes from written correspondence to consortia members, from the coordinator, and from articles in the newsletters for the MLA chapter area and the NN/LM.
reduced turn-about time by ensuring priority handling and maximizing the potential for “equitable” borrowing practices by searching the holdings of smaller libraries first. After a one-year pilot project, membership was opened to all interested libraries in April 1998.

The impetus for the consortia formation was a successful existing group in the adjacent states. While the existing group and the newly formed group are both in the same NN/LM region, the existing group was based on its MLA chapter area. The newly formed group followed suit. Unlike the large, multi-function consortia with professional staffs which require considerable investment from member libraries, this is a small volunteer effort, limited in scope. With administrative support from the NN/LM regional library office, this consortia seeks to increase the number of reciprocal trading partners for health science libraries in the five-state area. While local consortia, usually centered on a large urban area or a county, have long served to produce reciprocal agreements for interlibrary loans, the new consortia builds upon this basic level of library cooperation by reserving the first two cells of the DOCLINE routing table for existing relationships. Consortia members are categorized by the size of their health-science related journal holdings. Based on these rankings, libraries are ordered into routing table cells 3 through 5 (smallest to largest). Consortia members can fill the remainder of cells 6 through 9 with resource libraries of their choice. As always, cell ten is reserved for the NLM. It was noted before that each cell of a DOCLINE routing table can hold up to twenty libraries. With this DOCLINE set-up, an interlibrary loan request would have to exhaust the holdings of 100 libraries before being routed to a library that may charge to fill the request. Obviously, the more diverse the collections of the consortia members, the less
likely that interlibrary loan requests would have to be filled by a charging institution. Dee, Rankin, and Burns’ (1998) findings on this topic bodes well for this group.

This study looks at the characteristics of the libraries which have joined the consortia and compares those characteristics with a sample of the total population of potential consortia members. Based on the existing literature and by process of deductive reasoning, this researcher hypothesized that three characteristics would be predictive of consortia membership: staff size, SERHOLD reporting levels, and whether or not the library charged for interlibrary loan. It was predicted that libraries would be more likely to join a consortia when staffing levels were greater than one, when SERHOLD holdings were reported at Level 3, and when the library charged for interlibrary loans. Other data, such as library type, journal holding levels, and date of last SERHOLD update were also collected to look for other potentially predictive variables.

Method

Population

Identifying the population for this study was the first priority. There are actually two population segments under investigation. The first population is the actual consortia members, as identified from the membership directory. The second population is described as any library that is legitimately a potential member of the consortia. McGaugh’s use of the NLM’s DOCUSER database (1990 & 1994) pointed me to this resource as a source of a comprehensive list of health-related libraries. A wealth of material available via the NLM and NN/LM’s web sites describes the scope, purpose, and access options for this database (see References for full list). The DOCUSER database is
made up of any library which has come to the attention of the NLM, frequently by initiating an interlibrary loan request. Listings are further augmented by information gathered and reported by the regional library coordinators to the NN/LM Network Membership Database. Fields available in this database include a library identification number or libid, name, address, phone and fax numbers, contact information, library type, general notes, notes on interlibrary loan policies, SERHOLD participation, SERHOLD holdings level, last SERHOLD update date, DOCLINE participation, and participation in the NN/LM.

A search was performed in the DOCUSER database to find all libraries in the five-state consortia area. This search resulted in a list of 949 libraries. Since this consortia is based on the DOCLINE system, DOCLINE participation is central to the ability of libraries to join. However, instead of limiting the population to just DOCLINE users, I was interested in how many libraries existed in the five-state area who could conceivably be useful consortia partners but were fundamentally excluded from participation because they lacked access to the DOCLINE system. For this reason, all libraries in the five-state area who were members of the NN/LM were included. These libraries have self-identified as having collections or patrons concerned with health-related topics, according to the NN/ML Membership Program Fact Sheet (1998).

Searching on NN/ML membership narrowed the list to 478 libraries which were deemed to be the population for this study. Instead of gathering data for all 478 libraries, a random sample of 250 was taken, using Rea and Parker’s guidelines for “Minimum Sample Sizes for Selected Small Populations” (1997, p. 121). In order to keep the actual consortia members separate from the sample population, their records were removed from
consideration before the sample was drawn. One library had to be removed from the sample when directory information indicated the library was no longer active, leaving a sample population of 249.

Once the population and sample population were identified, information on library characteristics was gathered on both the consortia members and sample population using DOCUSER and library directories. Data on interlibrary loan policies, library type, SERHOLD information, and DOCLINE participation were taken from DOCUSER. Data on staffing levels and journal holdings were taken from the *American Library Directory* and *Directory of Special Libraries and Information Centers*.

**Coding Decisions**

Data was coded and entered into a Microsoft Excel spreadsheet for analysis. Several coding decisions merit discussion. DOCUSER lists six possible values for the library Name Type field: Primary Health Care, Academic Health Sciences, Health-related not-for-profit, Health-related for-profit, Non-health-related for-profit, and Other. Coding was standardized for several library types where values were applied inconsistently. Primary Health Care was reserved for hospital and medical center libraries. Academic Health Sciences was applied only to universities with graduate programs in a health-related field and in most cases data was collected for only the health science library on campus. The Other designation was used for academic institutions with associate-level or undergraduate degree programs in health-related fields, therefore this data may represent the largest library unit on campus.
Interlibrary loan charge information was coded Charges, Does not charge, Did not specify, or No data available. Coding was very conservative for the Does not charge category. The policy statements in the DOCUSER database had to explicitly state “library does not charge.” If a library included statements concerning “free to reciprocal only,” the library was coded as Charges, even if amounts were not included in the statement. If no amounts were listed and there was any doubt about charging policies, the library was coded as Did not specify. Libraries that included no information in the available interlibrary loan policy fields were coded as No data available.

Staff levels were recorded as whole numbers and include total staff members listed for each library. Any indication of a part-time library staff position was recorded as one staff member.

Most fields were recorded as dichotomous variables: DOCLINE users yes/no; consortia member yes/no; SERHOLD participant yes/no; SERHOLD Level 3 yes/no. The remaining fields were recorded as interval data: year of last SERHOLD update, total staff members, and number of current periodical subscriptions.

Data Analysis

Several t-tests were performed on two of the variables identified in the hypothesis to see if statistically significant differences existed between the consortia members and the sample population. In one case, interval data were converted to dichotomous variables in order to test for significance. A chi-square test was performed on the third variable as recorded in nominal form, then a t-test was performed on the converted dichotomous values.
A factor analysis was then performed on all variables to look for relationships between the variables. Descriptive statistics were also run on all variables, using consortia membership as the dependent variable, to look for obvious differences between means. T-tests were performed on a number of these variables to test for statistical significance.

As a final step, a multivariate regression was run on variables identified from the factor analysis to see how much they might explain consortia membership.

Results

Hypothesis Variables

Staffing level data was not available for all libraries in either group. Two t-tests were run on the libraries reporting staff numbers. The first t-test used staff level as interval data. The consortia group had a mean of 3.64 and the sample population had a mean of 14.15, with a one-tailed $p$ of 0.01.\footnote{Much of the difference between these two means can be explained by three libraries in the sample population with staffs over 200. These libraries are for colleges without graduate programs in health science related fields and staffing levels reflect the entire library system.} This shows that there is a statistically significant difference in the mean between these two groups at the 95 percent confidence level. Libraries in the consortia group had smaller staffs overall than did libraries in the sample population. However, the stated hypothesis looks for a difference between libraries with a staff of one and libraries with staffs greater than one. When the interval data is converted to these terms (0=staff of one, 1=staff greater than 1), the t-test fails. The mean for the consortia group becomes 0.36 and the sample population becomes 0.38, with a one-tailed $p$ of 0.43. There is no statistically significant difference between the two
groups on this measure. Table 1 shows the actual values and relative percentages for the two groups.

Table 1. Staffing Levels in Consortia and Sample Libraries.

<table>
<thead>
<tr>
<th>Total Staff</th>
<th>Consortia members</th>
<th>Sample population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Relative %</td>
</tr>
<tr>
<td>1</td>
<td>13</td>
<td>36%</td>
</tr>
<tr>
<td>2 to 9</td>
<td>19</td>
<td>53%</td>
</tr>
<tr>
<td>&gt;= 10</td>
<td>4</td>
<td>11%</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>100%</td>
</tr>
<tr>
<td>% of libraries reporting</td>
<td>73%</td>
<td>55%</td>
</tr>
</tbody>
</table>

The next variable mentioned in the hypothesis is the SERHOLD reporting level. All libraries in the consortia group reported their SERHOLD holdings at Level 3. The sample population had 126 libraries report their SERHOLD holdings at Level 3. Only five libraries reported at Level X. The remaining libraries in the sample group have not submitted their holdings to the SERHOLD database. With a mean of 1.0 for the consortia group and a mean of 0.53 for the sample population, there is a statistically significant difference between the two groups: the one-tailed $p$ for the t-test is 9.47E-37. When comparing means for other variables, however, it was discovered that the means for DOCLINE use was the same as the means for SERHOLD reporting level for both groups. The implications of this finding are covered in the following Discussion section.
Since interlibrary loan charging information was recorded in a nominal form, a t-test was inappropriate. A chi-square test, which looks to accept or reject a null hypothesis that the two variables are statistically independent, was used instead. Using consortia membership as the dependent variable and charging status as the independent variable, an actual frequency table was constructed. An expected frequency table was calculated and the test was performed. The result showed that the null hypothesis must be rejected: the two variables were statistically dependent, meaning knowing the value of one variable tells you something about the other. The test reveals nothing else about the nature of the relationship.

Interlibrary loan charging status was then converted to two different dichotomous variable sets. The first examined only the libraries which reported interlibrary loan policy information and was reduced to Charges no/yes (0=no, 1=yes). The number of reporting libraries was 29 for the consortia group and 132 for the sample population. The mean of the consortia group was 0.86 and the mean for the sample was 0.88, with a one-tailed $p$ of 0.40. There is no statistically significant difference between libraries that charge for interlibrary loan and those that do not charge, based on membership in the consortia group or the sample population group. The second test converted the interlibrary loan charge information to Did not report policy/Reported policy (0,1). On this measure, there is a statistically significant difference between the consortia group and the sample group. The mean for the consortia group was 0.98 and the mean for the sample was 0.76. The one-tailed $p$ of 4.42E-10 passes the test at the 99 percent confidence level. Libraries in the sample group are less likely to report interlibrary loan data to DOCUSER than are libraries in the consortia group. Interlibrary loan charging status is summarized in Table 2.
Table 2. Interlibrary Loan Charging Status for Consortia and Sample Libraries.

<table>
<thead>
<tr>
<th>Charging status</th>
<th>Consortia members</th>
<th>Sample population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Relative %</td>
</tr>
<tr>
<td>Does not charge</td>
<td>4</td>
<td>8%</td>
</tr>
<tr>
<td>Charges</td>
<td>25</td>
<td>51%</td>
</tr>
<tr>
<td>Did not specify</td>
<td>19</td>
<td>39%</td>
</tr>
<tr>
<td>No data available</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>49</td>
<td>100%</td>
</tr>
</tbody>
</table>

% of libraries reporting policies

<table>
<thead>
<tr>
<th></th>
<th>Consortia members</th>
<th>Sample population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>98%</td>
<td>76%</td>
</tr>
</tbody>
</table>

Other Relationships

Library type was identified as a potentially predictive variable from the factor analysis. A chi-square test using library type as nominal data failed, but reducing the data to the dichotomous variable non-Primary Health Care/Primary Health Care (0,1) did produce significant results. The mean for the consortia group was 0.76 and the mean for the sample group was 0.55, with a one-tailed $p$ of 0.002. Libraries coded as Primary Health Care, hospital libraries, are represented in statistically significantly greater numbers in the consortia group than they appear in the sample population. Table 3 shows the breakdown of library types for each group.

Table 3. Library Type for Consortia and Sample Libraries.
<table>
<thead>
<tr>
<th>Library type</th>
<th>Consortia members</th>
<th></th>
<th>Sample population</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Relative %</td>
<td>Number</td>
<td>Relative %</td>
</tr>
<tr>
<td>Primary health care</td>
<td>37</td>
<td>76%</td>
<td>137</td>
<td>55%</td>
</tr>
<tr>
<td>Academic health sciences</td>
<td>2</td>
<td>4%</td>
<td>13</td>
<td>5%</td>
</tr>
<tr>
<td>Health, not-for-profit</td>
<td>8</td>
<td>16%</td>
<td>67</td>
<td>27%</td>
</tr>
<tr>
<td>Health, for-profit</td>
<td>0</td>
<td>0%</td>
<td>12</td>
<td>5%</td>
</tr>
<tr>
<td>Non-health, for-profit</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>4%</td>
<td>22</td>
<td>8%</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>100%</td>
<td>249</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Regressions**

Not surprisingly, staffing levels and journal holdings had a high positive correlation (0.90). Since this level of correlation suggests the two variables are measuring the same phenomenon, only one was picked to be included in the regression models. One model was run using staffing levels as the dichotomous variable staff of one/staff greater than one. A second model was run using staffing level as a dichotomous variable measuring libraries which submitted listings to the data source directories and those which did not.

Other variables identified included library type, reduced to the dichotomous variable non-hospital/hospital and DOCLINE participant, no/yes. The last variable identified from the factor analysis was interlibrary loan charging status. Again, this variable was used in two ways to measure two different aspects of relationships. In one model, interlibrary loan charge status was reduced to the dichotomous variable Does not
charge/Charges. In the other model, interlibrary loan charge status was reduced to Did not provide policy in DOCUSER/Provided policy in DOCUSER. Table 4 shows the exact make-up of each model ran and the resulting adjusted R-squares. Since regressions cannot be run against missing data, the number of observations in each regression is a function of how many records exist with valid data in all measured fields.

Table 4. Regression models 1-4.

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td>Independent variables</td>
</tr>
<tr>
<td>Consortia membership 0/1</td>
<td>DOCLINE user 0/1</td>
</tr>
<tr>
<td></td>
<td>Primary health care 0/1</td>
</tr>
<tr>
<td></td>
<td>ILL charge 0/1</td>
</tr>
<tr>
<td></td>
<td>Staff 1/&gt;1</td>
</tr>
<tr>
<td>Adjusted R-square = 0.0959</td>
<td>Adjusted R-square = 0.1241</td>
</tr>
<tr>
<td>N=157</td>
<td>N=238</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td>Independent variables</td>
</tr>
<tr>
<td>Consortia membership 0/1</td>
<td>DOCLINE user 0/1</td>
</tr>
<tr>
<td></td>
<td>Primary health care 0/1</td>
</tr>
<tr>
<td></td>
<td>ILL data 0/1</td>
</tr>
<tr>
<td></td>
<td>Staff data 0/1</td>
</tr>
<tr>
<td>Adjusted R-square = 0.1493</td>
<td>Adjusted R-square = 0.1012</td>
</tr>
<tr>
<td>N=298</td>
<td>N=173</td>
</tr>
</tbody>
</table>

None of the models predicts a significant amount of the variation between the two groups. The best predictor was Model 3, which measures consortia membership as a
function of DOCLINE user status, hospital library status, reporting interlibrary loan data, and reporting staffing levels. The combination of these four variables together explain nearly 15 percent of the variance between libraries which joined the consortia and those which did not.

Interestingly, when the regression was run using just DOCLINE user status and hospital library status, the adjusted R-square only dropped to 0.1481 (see Table 5, Model 5). This means that these two variables explain a larger percentage of consortia membership than do the interlibrary loan reporting variable and the staffing level reporting variable. Adding these two variables only increases the adjusted R-square by a small amount.

The last regression run was to test the relationship between libraries that are active DOCLINE users and those who report information for staffing levels and for interlibrary loan policy. Since DOCLINE participation is a necessary condition for joining the consortia, I was interested to see to what degree reporting data to standard information sources explained DOCLINE user status. DOCLINE user status was used as the dependent variable and interlibrary loan charge reporting and staffing level reporting were used as independent variables. The results are shown as Model 6 in Table 5. This model actually explains a greater amount of variance than do any of the consortia membership models. Nearly 20 percent of the variance between libraries that are DOCLINE users and those that are not can be explained by knowing if the library reports either interlibrary loan policy information to DOCUSER or staffing level information to the two standard directories in the field.
Table 5. Regression models 5- 6.

<table>
<thead>
<tr>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td>Independent variables</td>
</tr>
<tr>
<td>Consortia membership 0/1</td>
<td>DOCLINE user 0/1</td>
</tr>
<tr>
<td></td>
<td>Primary health care 0/1</td>
</tr>
<tr>
<td>Adjusted R-square = 0.1481</td>
<td></td>
</tr>
<tr>
<td>N=298</td>
<td>N=298</td>
</tr>
</tbody>
</table>

While these findings are interesting, they certainly explain only a fraction of the variance between groups. Given this analysis, there are factors other than those measured that explain participation in the reciprocal consortia.

Discussion

Hypothesis

None of the characteristics anticipated as being predictive of consortia membership proved to be meaningful. Two characteristics, staffing levels and charging for interlibrary loans did not occur at rates significantly different from the sample population. The other variable, reporting holdings at SERHOLD Level 3, turned out to be 100 percent correlated with DOCLINE use in both the consortia group and the sample population. Since reporting SERHOLD Level 3 is, in effect, a substitute measure for DOCLINE use, this basic requirement for consortia participation is a non-meaningful variable to study.

Staffing levels were identified as a indicator of consortia membership based more on intuition than hard evidence. Experience and logic pointed to the fact that libraries with more financial resources for collections, telecommunications access, and information
technology would be the ones most likely to participate in the new consortia. Since any of those variables were impossible to measure given publicly available data sources, staffing levels seemed to be the best proxy for financial support. McGaugh (1994) uses a combination of amount spent, professional staffing levels, and journal subscription numbers as a combined measure of what she calls the “have/have-nots groupings” (p. 216). As mentioned in the coding decision section of Methods, staffing levels were coded in whole numbers. When DOCUSER General Notes or directory information indicated only a part-time staff member, it was recorded as one staff member. Another coding decision was to record total staff numbers, since they were more reliably available, rather than trying to separate out clerical and professional staff.

There is no meaningful difference between the percentage of libraries with staffs of one and those with staffs greater than one for the two groups, based on available data. Thirty-six percent of consortia members had staffs of one and the remaining 64 percent had staffs greater than one. For the sample group, 38 percent had staffs of one and 62 percent had staffs greater than one. The greatest difference between the two groups, and perhaps a more telling indicator of consortia membership, is the number of libraries in each group for which staffing information was available, by way of inclusion in any of the two standard library directories used for data collection. Seventy-three percent of consortia members appear in either of the two directories consulted, whereas only 55 percent of the sample population libraries were listed. While one is tempted to suggest that the remainder of the non-reporting libraries had staff levels that would have been coded as “one,” there is no way to test that assumption given the methods of this paper.
This notion of which libraries elect to be included in standard professional directories gets to an idea mentioned in both the DOCLINE literature and the network formation literature: that the personal characteristics of the staff members themselves have more to do with consortia or network membership, than do their numbers (McGaugh, 1990 & Fink, Getchell, Hughes, & Moulton, 1975).

Another of the variables anticipated to be relevant proved to be non-predictive: whether or not a library charges for interlibrary loan tells you nothing about consortia participation, based on available data. Eight percent of consortia members report a policy of not charging for interlibrary loans, while 51 percent report some charging information. For the sample population, the percentages are 6 percent for no charges and 47 percent for charges. The remainder either did not specify charge policies in their interlibrary policy fields, or did not report any interlibrary loan policy information at all. Although libraries that charge do represent the largest portion of the consortia group members, they do not occur at a rate greater than in the sample population. This author’s perception was that libraries that charge for interlibrary loan would have the greatest incentive for joining the group, given that a prime objective of the consortia is cost saving.

On the other hand, libraries that do not charge for interlibrary loan may have an increased incentive for joining in order to reduce the institution’s costs for borrowing. These libraries, such as some federal libraries, have administrative restrictions on charging for interlibrary loans. There is little motivation for any given library to enter into a one-on-one reciprocal agreement with a library whose services are already free. Joining a consortia may be the only way for non-charging libraries to ensure a large number of trading partners willing to provide articles for no charge.
Unfortunately, no definitive conclusions can be drawn from the data as collected for this study. As in the staffing levels variable above, a more telling indicator may be the presence of interlibrary loan policy information included in the DOCUSER database. Consortia group members included interlibrary loan policy information in their DOCUSER listings at the rate of 98 percent, whereas only 76 percent of the sample population included interlibrary loan policy information.

SERHOLD holdings levels were identified as a potentially important variable based on Willmering, Fishel, and McCutcheon’s findings (1988) that less than 20 percent of SERHOLD participants reported at Level 3 as of 1985. Dutcher reports that the rate had increased to nearly 40 percent by October 1988. SERHOLD Level 3 is a designation for holdings information which includes both volume and year data as specified by the 1980 ANSI Standard at the Summary level – Z39.42-1980 (Dutcher, 1989). The DOCLINE Manual chapter on DOCUSER lists two possible values for the field in the DOCUSER database: one value for Level 3 reporting and one value for Level X, or non-conforming to the ANSI standard. Only later was it discovered in the NLM’s SERHOLD Fact Sheet that 97 percent of the data in the SERHOLD database is reported at Level 3 (as of May 1998). That is in keeping with my findings in this study. There is a 100 percent correlation between libraries reporting their holdings at Level 3 and those libraries which are DOCLINE users in both the consortia group and the sample population. Only five out of 131 sample libraries reported at Level X and none of them are active DOCLINE users. The increase in libraries reporting at Level 3 over the course of ten years points to the considerable work done by the Regional Libraries in helping libraries upgrade their reporting levels.
Limitations of the Data

One possible reason there may not be much discernible difference between libraries that have elected to join this consortia and those that have not is the fact that the consortia is still less than two years old. As statistics on lending and borrowing rates, cost savings, and participant satisfaction are collected and disseminated, membership rates may grow. If, in fact, the only real factor determining participation is DOCLINE user status, then any library in the consortia area who uses DOCLINE is just as likely as any other to eventually join this reciprocal group.

One possible concern is whether or not the results and analysis of this study are generalizable to other regions. Because the study area includes several governmental centers and research park concentrations, there are a large number of non-typical libraries included in the population. The large number of government agencies and not-for-profit associations may not be found in other regions, although each region may have its own anomalous populations. Other large urban areas with research centers or active industrial/research parks may have similarly unique library make-ups.

As to the collection of data, this author believes it would have been beyond the scope of a master’s paper to do a survey on a large enough population to arrive at statistically significant findings. Given the circumstances, I am comfortable with the choice to use the DOCUSER database as the main source of data. And given the problems with self-reported numbers and survey non-response rates leading to possible selection bias, I am even more confident about this decision. Libraries that do not return
directory update requests wouldn’t be any more likely to respond to a master’s paper survey.

Conclusion

Given the structure of this study, nothing can be stated definitively about the characteristics of libraries that joined this multi-state reciprocal interlibrary loan consortia using DOCLINE routing tables. Factors other than those captured in this data analysis must play determining roles. The one trend that can be documented is the fact that libraries that do not show up on the professional radar for one measure will tend to not show up for others. Dutcher (1989) speaks of involving even the smallest medical libraries in the DOCLINE system. Dee, Rankin, and Burns’ findings of journal holdings diversity certainly points to the value of encouraging such libraries to participate in interlibrary loan networks. But Dutcher’s claims that providing serial holdings in a Level 3 machine-readable format is less difficult than the highly detailed holdings statements required by existing regional union list groups doesn’t mean the task is any less onerous for a library with limited technological expertise. As the NN/LM’s Internet Connectivity Survey shows, up to 11 percent of hospital libraries do not have Internet access and don’t know when, if ever, they will. However, with the speed with which technology is advancing, many of the perceived barriers to access reported in the connectivity survey may soon disappear. Issues such as computer cost and in-house expertise are being minimized as personal computers get faster and cheaper and email accounts become as ubiquitous as answering machines. Management support is an issue that the new JCAHO standards may go far to remedy. Much may have to do with the efforts of the regional
library network coordinators or other state-level outreach service providers, like the Area Health Education Centers in helping these unconnected libraries gain the access they need to be full participants in the DOCLINE system, and therefore truly potential members of groups like the newly-formed reciprocal consortia.


