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ABSTRACT

The results of research work undertaken by the University of Pittsburg, and the Interuniversity Communications Council (EDUCOM), in behalf of the National Library of Medicine on the general subject of biomedical communications and information networks is summarized. The prinicpal purpose of the project is to explore the potential of the new communications technology for the distribution of medical information to physicians in support of their clinical, research, and educational interests. The research indicated that the world of medical information is a multi-dimensional problem. Medical information varies not only as a function of the physician's speciality, education, environment, and personal interests, but also as a function of his relationships with his patients and as a function of time. (Author/MM)

SUMMARY OF RESEARCH MEMORANDA

January 1969

Joseph Becker

Prepared for the
Lister Hill National Center for Biomedical Communications
Bethesda, Maryland

Under contract with the
University of Pittsburgh
NIH Contract No. PH-43-67-1152

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I. INTRODUCTION

This report summarizes the results of research work undertaken by the University of Pittsburgh, and the Inter-university Communications Council (EDUCOM), in behalf of the National Library of Medicine, on the general subject of bio-medical communications and information networks. The principal purpose of the project was to explore the potential of the new communications technology for the distribution of medical information to physicians in support of their clinical, research, and educational interests.

The project, which was begun in October 1966, embraced in its investigations the total environment within which a bio-medical communications and information network might someday function. Several research objectives were formulated: 1) to develop a comprehensive, basic, and detailed appreciation of the health sciences community - - its nature, location, functioning, and trends; 2) to survey the status of health sciences libraries in the United States in order to ascertain the extent to which such libraries can be integrated into a operative biomedical information network; and 3) to identify those elements of the new technology which may be applicable to the design of future biomedical information networks.

The project embarked on a comprehensive program of interviews, meetings, and conferences. Almost 200 persons were contacted during the first year. More than half were M.D.'s;

the remainder were technicians and specialists, such as engineers and librarians. Interviews were conducted with general practitioners, specialists, medical researchers, and educators. Meetings were held with NIH and PHS representatives. Visits were made to the hospitals, medical schools, and government agencies, such as the Veterans Administration and the Pure Food and Drug Administration. Conferences were arranged with medical librarians and with knowledgeable persons in the various medical professional societies and in industry. Three EDUCOM Task Forces - - one on clinical applications of the computer to medicine, one of information networks, and one on continuing education - - were briefed on the project so that they might most profitably express their views and contribute constructive criticism.

Furthermore, since most of the medical schools in the U.S. are at EDUCOM universities, their staffs were continually called upon to furnish information and guidance to the project. Throughout the research period the project staff examined pertinent biomedical literature and, with assistance from NLM, was able to remain abreast of new materials in the field.

In 1968, the National Library of Medicine created a separate division, dedicated to research and development, whose mission is the creation of a national biomedical communications and information network. During the second year, therefore, the project worked closely with the Associate Director for Research and Development and her staff, in order to ensure that the research data assembled by the project would support NLM's on-going plans and programs. In this connection, EDUCOM supervised four sub-contracts designed in each instance to either test a basic assumption or develop an idea to the point of implementation.

The philosophy of the project has been to understand the nature of the medical information problem in all of its ramifications in order to develop the perspectives needed for planning the design of a network. Technology, while far from forgotten, was temporarily set aside while the project concentrated its attention on the question of <u>what</u> should be communicated on a medical information network, and <u>for whom</u> - - rather than <u>how</u> - - the network should be constructed.

Our research has taught us that the world of medical information is very difficult and complex in structure, and at times it seems limitless in scope. From the standpoint of the physician, information in medicine is clearly a multi-dimensional problem. It varies not only as a function of the physician's specialty, education, environment, and personal interests, but also as a function of his relationships with his patients and as a function of time. One researcher has dramatized the physician's dilemma by saying, "The more patients he sees, the less he can keep up; the more he keeps up, the fewer patients he sees."

In sum, it is important to observe that the idea of automated information networks--inside or outside the medical community--is a very young concept. The project has been unable to locate examples of operating systems now in existence. There are,however, many organizations in the federal government and in the private sector that are aggressively working toward the networking of medical information. From the evidence gathered in the medical world, one can sense that momentum is building up for some form of multi-media networking. At some local and regional points plans are already in being designed to satisfy information needs specifically expressed by individual segments of the health sciences community. Diverse efforts toward interconnection will, in the years ahead, require leadership from the federal government to assist them in linking their resources together for the common good.

We wish particularly to acknowledge the support of EDUCOM's Committee on Continuing Medical Education which assisted in reviewing project plans and objectives; and particularly to the sub-committee on Health Sciences, under the chairmanship of Dr. Kelly West. To them, and to the EDUCOM community at large, the project wishes to express its grateful appreciation for their advice and guidance.

This summary document and the research memoranda which accompany it constitute EDUCOM's final report to the National Library of Medicine in connection with the research activity of the past two years. In addition, at the request of the Project Officer, EDUCOM has also turned over its basic files of raw data to the staff of the Lister Hill National Center for Biomedical Communications.

II. THE DOMAIN OF BIOMEDICAL COMMUNICATIONS

Broadly speaking, biomedical communications is the process by which data, information, and knowledge in the field of biomedicine are transmitted, transformed, and transferred. A loose definition of this sort will probably suffice until the health sciences community has had more experience with applied problems in the medical information world and perceives, through much more profound understanding of communication systems, how to work with them. As of 1969, the need for deeper inquiry into biomedical communications appears evident. Moreover, it is highly probable that between now and the year 2000 A.D. at least 10 and possibly 100 times more biomedical information will be discovered or created. As the size of this information base increases, the complexity of biomedical communications will grow -- but at an even faster rate than the information base.

Given this broad view of the subject, the following section briefly describes the realm of biomedical information and communications, its special characteristics, size, problems, and current status.

More than any other field in the life sciences, the field of biomedical information is viewed from a perspective which acknowledges that it deals with the domain of human experience and activity embracing the following attributes:

A. The most elementary, primitive and personal goals which men seek, i.e., relief from suffering ascribed to illness, the maintenance and improvement of health, and the knowledge of the parts, functions, and behavior of oneself and of others;

B. a nearly universal and personal interest in the means to these goals -- an interest which sustains and extends the traditions associated with professional medical care and science; and

C. an ever-growing number of discernible medical

1. phenomena which attract attention, prompt the construction of theories, inspire research investigations, and generate information;

2. techniques of a mechanical, electrical, chemical, intellectual, economic, and organizational variety;

3. people, who, in every conceivable context, both private and public, use biomedical information not only for traditional purposes, but also in order to obtain the "results" or "outcomes" associated with that vast range and number of abstract, collectivized, and relatively impersonal goals (e.g., defense, control, and profit) which invigorate life in its modern institutional settings.

Taken together, these attributes of biomedical information can be expressed in four ways:

a. A wish for relief from that suffering believed to be due to an extraordinary and undesirable condition (or set of conditions) which afflicts men as individual living organisms and which limits their ability to act in desired and desirable ways.

b. A search for health - a state of optimum well-being, given an account of one's circumstances. The study of health values and ideals of individuals and societies indicates that at one time or another most human activities have been critically related to the "health" of the individual person or to the "public health" of a society of individuals.

c. The use of remedies, treatments, and other techniques which directly (as in clinical practice) or indirectly (as with laws and agencies pertaining to health) prevent or mitigate the effects of disease and promote or encourage the attainment of health.

d. The requirement for knowledge which, immediately or remotely, renders illness intelligible, health definable, and practices effective. At the present time -- and as a result of the rapid development of science and technology during the past one-hundred and fifty-years -- the types and quantities of information which are accepted as biomedical frequently surpass the methods available for using it, either for the realization of practical objectives or for the answering of scientific questions.

It is when many varieties of information are used in a specific context of human events, purposes, and expectations that information becomes distinctly biomedical. In America, the concept of biomedical information refers to all that is known and distinguished concerning the varieties of traumas, diseases, and disorders; all that is known of the actions taken in dispensing and receiving preventive measures, therapies, and healing practices; and to all the findings of the empirical sciences that bear upon the structures, functions, processes, and conditions of life.

People in the health sciences share biomedical information for a variety of reasons. If investigators could clearly identify in historical, social-cultural, economic, political, or technological terms, people's reasons for sharing biomedical information, they would be in a better position to plan for the future of biomedical communications. However, this particular area of understanding is extremely subtle and elusive. While researchers have conducted quantitative studies on the use of such sources of information as libraries, journals, drug detailmen, symposia, and post-graduate education, little research has been conducted which sheds any light on the qualitative aspects of the use of information in medicine. We suspect that the information-sharing and -seeking roles of the patient, clinician, educator, and researcher differ significantly. But research has yet to reveal which specialists in health sciences share what types of biomedical information, and what motives lead them to seek and use such information.

The probable need for and use made of biomedical information among various segments of the health sciences community may be expressed in terms of the key people who use the information:

A. The <u>citizen-patient</u> has at least two reasons for being interested in medical information. In the first place, he is solicitous of his own health and seeks assistance when he believes that his health or that of his dependents is in any way threatened. He thus reflects the initial training in the culture of health-care which he has received from his family and school. Subsequently, he is likely to reflect the efforts of agents, both public and private, who purvey biomedical information to him throughout his life. These agents are as diverse as the physicians he consults, the directors of the mass media of communications which he views or hears, and his own "voice of experience" which records his history, enabling him to interpret private experiences. Second, most citizen-patients expect to contribute something to the political, social, or communal processes whereby decisions are made regarding the public aspects of health and medical practice. For example, as more public legislation affecting biomedicine is proposed and enacted at every level of government, the citizen-patient should be increasingly eager to know the positions of his elected representatives on various matters of health legislation. The citizen also has a stake in the economics of continuing health services, the research practices within the biomedical sphere, and the organizational techniques employed in the conduct of such services and investigations.

B. The practitioner-physician, dentist, nurse, and a host of paramedical personnel are primarily interested in biomedical information in the context of practice. There is a large amount of oral communication among practitioners and between practitioners and patients, for practice is geared to taking practical action in particular cases. Practitioners are leading producers of bio-medical information. Much of the information which they use and produce is not recorded, though practice is often conducted according to a general plan: history-taking, physical and laboratory examinations, treatment, and continued observation.

Many medical practices are aimed at the preservation or restoration of the health of the individual person. But not all medical practice is case-centered. The <u>public health official</u> generates and uses different sorts of information from those of the traditional practitioner, for his task is to observe, to moderate, and at times to define the variables of community health measures and practices. Though the public health practitioner tends to have little direct contact with patients, his role is closely linked with that of the citizen, the scientist, the traditional practitioner, the medical administrator and the expert in communication techniques.

C. The <u>scientist and researcher</u> is engaged in the quest for knowledge. His purpose as biophysicist, biochemist, geneticist, physiologist, or psychologist is to discern scientific laws and to generate theories that will allow him to demonstrate whether or not "X is the case." Thus the scientist in this context is not immediately interested in his own health, as is the patient, nor is he directly concerned with the health of the members of the community, as are the citizen and the public health official. Questions of validity rather than of care, cure, or prevention are primary when information is organized from the vantage point of the basic scientist.

There are other features of biomedical science which should be kept in mind when one surveys patterns of communication among present-day theorists. Both basic and applied research is often carried out by teams of scientists. The efforts of scientists who work in applied fields are frequently linked with activities which are immediately practical in nature - e.g., the physiology of man in space is being determined in the process of sending an astronaut to the moon; physicians are learning about the dynamics of intracardiac blood pressures as patients are evaluated for heart surgery. Finally, it should be mentioned that oral communication with fellow investigators is vital to the work of the scientist. According to Winch, the application of concepts in science is influenced both, "by the phenomena to which they are applied and also by the fellow workers in participation with whom they are applied. But the two kinds of 'influence' are different. Whereas it is on the basis of his observations of the phenomena (in the course of his experiments) that he develops his concepts as he does, he is able to do this only by virtue of his participation in an established form of activity with fellow scientists."(1)

D. Health Science Administrators attempt to manage a variety of historical and social institutions -- professional organizations, clinical facilities, research corporations, communications networks, and government agencies through the exercise of legitimate authority in prescribed areas of jurisdiction. The administrator must be a good communicator if he is to exercise a measure of control over the performances of subordinates, not offend the public which his agency serves, and remain responsive to the directives of superiors.

The administrator's work affects large numbers of professional personnel and patients. His need for biomedical information, therefore, is self-evident. Unless he remains continually alert to new developments, and thoroughly conversant with medical trends and progress, the organizational entity for which he is responsible -- hospital, foundation, or research institute -- will function at less than full effectiveness.

E. Information and communication experts inhabit the biomedical field for a number of different reasons. Some, such as medical sociologists, study how communications in biomedicine do in fact occur. Others devise schemes which suggest how communications (especially of the mechanical-electronic type) could or should occur - e.g., systems designers and computer engineers.

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(1) Winch, Peter. The Idea of a Social Science, New York: Humanities Press, 1958, p. 86.

Still others traffic directly in the day-to-day tasks of producing, handling, and processing knowledge -- librarians, publishers, documentalists, and producers of audio-visual aids. There are others who occasionally list themselves as communications experts -- e.g., medical educators exploring the use of teaching machines and an assortment of medical publicists. It may be noted that the new circuits, both social and electronic, are colorful, exciting, and newsworthy. The greatest changes in biomedical communications will occur as the new technologies prove themselves useful in the context of the goals and purposes of patients, practitioners, scientists, and medical administrators.

Thus the biomedical information area is a special domain of human affairs identifed at any given time by those people, engaged in complex patterns of associations, who give meaning to the conditions and processes we have described as health and disease and to the actions which have been called treatment, prevention, and the quest for knowledge. There is little reason to believe that the central meanings or importance of the realm will change in the near future; individuals and groups will continue: to have requirements for the maintenance of health, to suffer diseases and traumas, to desire remedies, treatments, and preventive measures, and to attempt to broaden and deepen their knowledge in all these matters. It is this understanding of the current situation that indicates that the business of biomedical communication is not new and that it involves the problems of sharing and of failing to share untold volumes of information emerging from a great number of disciplines. It has been noted that the forms of information which are communicated may be quite simple or extremely complex, concrete or abstract, primitive or highly rationalized, and intensely personal as well as highly impersonal. It has been acknowledged that numerous devices are used in communicating biomedical information. Further advances in science and technology should permit the design of new devices which may be engineered to meet nearly any specification that is suggested in the future. In regard to these latter developments, it may be expected that the basic forms of biomedical information which were distinguished earlier in this section, through which and about which communications are made, will not change. They will, however, certainly be elaborated and compounded as new communications technologies become available.

III. BACKGROUND FOR BCN SYSTEM DESIGNERS

Forming an appreciation of the basic precepts of medicine is an essential prerequisite to planning a biomedical information and communications network for the health sciences community. This chapter aims to provide that background. While much of what it presents may be familiar to the practicing medical professional, the information included here is to assist the computer specialist, the communications technician, the librarian, the information scientist, the systems designer, and others who plan supporting roles in the health sciences community or who are otherwise concerned with understanding the medical environment.

The material in this chapter is organized by the component of the Center for Biomedical Communications to which the content most directly applies. It consists mainly of summaries of the highlights of more comprehensive studies which are included as Research Memoranda with this report. The Research Memoranda themselves represent the results of collaborative effort between the EDUCOM research staff and one or more individuals in the medical world who served as consultants. The Memoranda are generally quite detailed and include supporting bibliographies and references. (In certain instances, where a particular original report was reasonably brief, the entire content has been placed in this Chapter rather than attached as an Appendix.)

Following NLM Board of Regents action in 1968, the EDUCOM research staff was directed to give priority to the development of the Specialized Education component. This direction resulted in the preparation of a unique compendium of medical school extra-mural programs found in Research Memorandum 8.

Also, it should be noted that the memoranda relating to the Data Processing and Data Transmission Component are generally applicable to the interests of all other components of the BCN because of obvious functional inter-relationships.

LIBRARY SERVICES COMPONENT

- Composed of four levels of network participation:

  1. Center for Biomedical Communications
  2. Decentralized MEDLARS Centers
  3. Regional BCN Access Centers
  4. Local BCN Terminals

- Processing functions include:

  1. Acquisition
  2. Surrogation
  3. Storage
  4. Announcement
  5. Retrieval and dissemination

- Services to be provided:

  1. Bibliographic listings
  2. Access to the literature
  3. Response to specific requests for information

(CBC Technical Development Plan June 1968)

RM 1*
SOME REFLECTIONS ON THE HISTORY
OF BIOMEDICAL COMMUNICATIONS

The vital question in setting up a Biomedical Communications Network is whether the user for whom it is intended will in fact use it. This report underlines the innate conservatism of the medical profession and its distrust of governmental regulation.

This report traces communication back to the time when it was all by word of mouth. When writing was developed, few could benefit since most were illiterate; in any case the records of medicine were kept secret as its practice was a secret art controlled by the priests. Furthermore, as the method of making cheap multiple copies was not invented until the 15th Century, in many cases there was only one copy of works produced earlier.

The invention of printing led to the scientific journal and to the development of the forerunner of the present-day medical library. Learned societies exchanged publications, but already in the 18th Century readers were complaining of the difficulty of keeping up. In the 19th Century the abstract journal was created; but the need for some guide to the literature had become evident before that. Albrecht von Haller, a Swiss, had begun publishing

*We have referred to the various Research Memoranda throughout this summary as RM 1, RM 2, etc. These same Research Memoranda also have the date of publication added in some references, i.e., RM-169. Thus, RM 1 is identical to RM-169.

medical bibliographies in 1747; but others were not eager to undertake the immense work involved. One of the exceptions was a Dane called Callisen, whose 33 volumes give excellent coverage of the last half of the 18th and the first third of the 19th Centuries. The first secretary of the Smithsonian Institution tried to interest the regents in 1855 to compile an extensive bibliography of science. Although he failed to persuade them, the task was taken up by the Royal Society of London, which was to publish complete coverage of the 19th Century. Only an author index was issued, and the First World War effectively stopped any further work on it.

In medicine, however, John Shaw Billings had issued a catalog of monographs in 1872 and followed it up in 1879 with Index Medicus, for current awareness, and in 1880 with the first volume of the Index Catalogue, for retrospective search.

The Index Catalogue survived until 1961, but over the years, delays in publication time led scientists to explore faster means of making the literature available. In the Second World War, a weekly listing of medical literature known as the Current List was circulated to serving physicians and first microfilm, and later photocopies of articles were supplied on request. The microfilm copy distribution service was responsive to the information needs of physicians who, during the war years, were widely scattered throughout the world. Physicians not only received copies of articles but were also provided with a hand optical viewer. This is one of the earliest examples of network distribution of medical information to bridge the communications gap between medical research and practice. More recently computerization has made it possible for the listings of periodical articles (Index Medicus) and monographs (Current Catalog) to become more current and hence more useful.

The report then deals with the information position in agriculture, and contrasts the vast strides which have been made in this area in transmitting research results to the practicing farmer with the very slow progress in medicine. As far back as 1862, when the Department of Agriculture (USDA) was first created, the Morrill Land-Grant College Act was passed, which created the first link in a direct communication chain from the federal and state governments to the farmer in the field. The Hatch Act of 1887 provided grants to states to support experiment stations for agricultural research and development. There was nothing like this in medicine. In 1914, county agents, operating from the experiment stations, were authorized to advise farmers on agricultural matters. Thus scientific information from the laboratory was rapidly disseminated at the place and time it was needed. The new communication modalities were early exploited: in 1920 market news was transmitted by radio in Morse, and the next year saw the establishment of a regular program for farmers broadcast from the world's first broadcasting station in Pittsburgh. This was followed, in 1928, by a nationwide agricultural program, broadcast from Chicago. In 1946 a regular television program for farmers was inaugurated in Schenectady. This was all backed up by massive infusions of instruction and literature. Farm equipment manufacturers had provided instruction and literature since 1910, while instruction in livestock improvement was started by packing companies in 1917, and in better seed-handling methods by seed companies in the 1930's. The report ascribes the tremendous progress in agriculture to its communication network, based on 72 land-grant universities and colleges, 53 experiment stations, 6000 county agents, 95,000 4 H Clubs (which encourage scientific agriculture among farm youth), 120,000 USDA employees, and 50 state departments of agriculture with information outlets in the form of over 700 farm journals and newspapers, 1000 radio stations, 400 television stations,and 200 farm organizations.

The lessons for the Biomedical Communications Network are clear; but how is the doctor to be persuaded to abandon his longtime conservatism?

New ways of packaging and disseminating knowledge to the medical profession are needed to insure that the practitioner of the future has the information he needs when he needs it and, as new information is generated.

RM 1 provides perspective for the BCN systems designer in the

Library Services Component. It is a prefatory statement concerning the historical development of the field of medical libraries and communications. Included are vignettes of past failures and successful attempts to make the information content of medical literature more directly available to the practicing physician, and the medical researcher and educator.

RM 2
HEALTH SCIENCE
LIBRARIES TODAY

The purpose of Health Science Libraries Today (see RM 2) is to present a picture of the nature and extent of biomedical communications as it occurs in the medical world through institutional libraries and information centers. It is a factual study prepared for the systems designer of the resources and shortcomings of existing health science libraries and an evaluation of their effects on the national health effort. In addition, the report includes a suggested plan for interconnecting health sciences libraries into a biomedical communication network.

During the past 15 years, a number of surveys have been made of health science libraries. Most of these focused on the activities of libraries at medical schools. In recent years, however, special surveys were conducted of institutional libraries in fields allied with medicine--hospital libraries, nursing libraries, and others.

Despite these reviews, there exists very little information about the basic characteristics of medical libraries and even less about the standards by which their value to the field of medicine is measured. This report therefore is designed to present a more complete understanding of the relationships health sciences libraries have to the full domain of medical experience and practice.

There is no doubt that health sciences libraries will play an active and probably innovating role in the development of the national biomedical communications network. Traditionally, these libraries have represented the primary sources of medical information and their roots are deeply embedded in the educational and research processes of all the health professions.

For this reason it is essential to develop as comprehensive a view as possible of the health sciences library community. Advance knowledge of the location of health sciences libraries, their geographic distribution, their facilities, their collections, their use of the new media, their clientele, and their cooperative undertakings is a prerequisite to network planning.

RM 2 offers the most comprehensive review of the subject to be presented in a long while. It provides a quantitative summary of medical library facts, an analytical review of function and services, and a very complete bibliography. It reveals that health sciences libraries are unevenly distributed across the country, with numerous and rich collections concentrated in the metropolitan centers while other areas are virtually devoid of biomedical information services. It points out that facilities, where they exist, are limited, and that most health sciences libraries have outgrown their physical quarters. It indicates that few health science libraries have developed long-range programs embracing the newer media. And it exposes the need for much greater cooperation and communication among health sciences libraries if they are expected to function as an "information community" in support of medical research, education, and practice.

These findings of course antedate the Medical Library Assistance Act (1965), which was designed to remedy some of the above mentioned ills; but its benefits are yet to be felt. RM 2 makes it crystal-clear that medical libraries can and should become an important element in a national biomedical communications network. To do so, however, they must be strengthened and supported on a continuing basis for some time to come.

Of special interest in the report is a description of how health science libraries meet and support the information needs of practicing physicians, physicians with teaching responsibilities, research-oriented physicians, biomedical scientists, medical students, paramedical personnel, and other individuals who function as part of the allied health professions. For each of these users the report sets forth a vignette of their interaction with sources of medical information.

Because a future biomedical communications network will undoubtedly strive to serve individuals directly, the report places considerable emphasis on the information habits and needs of the practicing physician. Interviews were conducted with a number of general practitioners and specialists with the object of obtaining greater insight into their information-seeking behavior, and a detailed treatment of their responses is included as a supplement to the report. In particular, EDUCOM wanted to learn in greater detail about the information sources which practicing physicians routinely consult during a typical working day and what, if any, retrospective use they make of the library. From these interviews, the report concludes that a definite requirement exists to increase the responsibilities of tomorrow's medical library network so that it can play a more practical and more active role in providing information directly to practitioners.

Since pre-Christian times it has been true that physicians who wanted to use a library effectively had to visit it personally. However, the ever-accelerating tempo of the twentieth century is likely to deny the physician this opportunity because of lack of time. This trend will probably continue rather than abate. Consequently, it is appropriate to consider establishing some new communication channel between physician and library that will allow medical information to be conveyed to his office or home in a timely and efficient way. While recent advances in electrical communications have made such communications technically feasible, it is not yet clear what information should be transmitted over these channels or how the telecommunications network should be organized in order to make the library's total information resources most available to the physician. The interviews shed considerable light on these unknowns and the reader's attention is invited to the basic data (see RM 2, Appendix B).

Even though the interviews constituted a very small sample of physician reaction, they quickly established an information dichotomy which is likely to be maintained in the future, namely, that the nature of physician information needs can be classed as being immediate and continuing. Dr. William H. Stewart, Surgeon General of the United States Public Health Service, speaking on "Health and the New Technology" at EDUCOM's Conference on Educational Communications at Duke University in 1966, stressed the difference between the two needs when he said, "I am particularly concerned about...the practitioner of medicine, who is at the end of the line. . .,whose job is one that (relies on a) minute-by-minute need for information which he can't predict he will need at a particular moment." About the physician's continuing need for information he said, " [the physicians]are also responsible in large part for communicating with the oncoming generation [of medical practitioners] in their own like who are going to communicate with one another and they need the information for this purpose."

Immediate refers to the kinds of information a physician normally obtains from desk handbooks, pharmaceutical looseleaf service, county health department releases, drug detail men, the poison control network, person-to-person communication, and so forth. It is "hard" information and it is immediately useful to him in patient care. It is information that he needs all day long and which he trusts will be current and accurate. Continuing information, on the other hand, can best be described as the classical literature a physician is accustomed to using when he consults bibliographic sources in the library. It includes the journals, the monographs, and the society publications which form the professional foundation for all medical knowledge. Although the practicing physician may refer only infrequently to this source for immediate information, it in no way affects his general view of the library as an indispensable source in the medical research and educational process.

Systems analysts planning a biomedical communications network can learn much from direct interviews with practicing physicians. Such interviews are highly educational and they inject realism and practicality into systems design. A few hours in a doctor's office very quickly gives the interviewer a "feel" for the kind of functional system which will truly help the practicing physician do his job. From RM 2, and other sources, EDUCOM has gradually built up the following description of the practicing physician and of his reliance on information:

> The practicing physician may first and foremost be characterized as the man "with little time". He usually has a large and busy practice and makes hospital rounds, and, in some cases, house calls. Time is short, and his information needs, critical as they may be, cannot compete with time

devoted to patients. He sees drug detailmen during his busy day and considers them an important source of information on new drugs. Drug firms inundate him with free material, brochures, house organs, and the like, and he feels that he must read most of this material to be informed on current medications. He subscribes to journals, (usually between four and ten titles), and reads these when he can to "keep up". When he is baffled by a diagnostic problem, he picks up the telephone to call a colleague whom he trusts. Sometimes, when he finds a review of a book that is critical as well as descriptive and tells him something about the book, he buys it. He relies heavily on a number of handbooks, the most important of which is Physicians Desk Reference. This volume, published annually, and supplemented quarterly, supplies him with information on drug names, dosages, side effects, and the like.

He attends what meetings he can, mostly out of town, so that he can devote his attention entirely to what is being presented,and does not have to worry about the omnipresent telephone. Sometimes, when he feels that he needs to read something more than is presented in his journals, he goes to a nearby library. As a rule, he is not aware of the various indexes or abstracts beyond those he used in medical school. Current Contents, Science Citation Index and the various continuing bibliographies and specialized abstracts are not known to him. He often continues to rely on the library of the medical school from which he graduated, but if he has moved to another area, he does not always realize that he can use the nearest medical library there. While in the hospital he may drop into the hospital library, but he may find that what he needs is not there. The farther away he is from library resources, the less likely he is to think of them as an information source.

He generally feels that he keeps up as best he can, and that his information needs are reasonably well met. He complains of the multitude of printed materials that come across his desk; "separating the chaff from the wheat" is a time-consuming task and he wishes that somebody would do it for him. He would particularly like more review articles; current, concise, and presenting only the best writing. When he learns of the various selective dissemination techniques available, either on a manual or automated basis, he feels that a service such as this, tailormade for him, would be extremely important, would save his precious time, and would, he hopes, perform the evaluative function for the literature which he desires.

He believes in the importance of continuing education for practicing physicians but his reaction to seminars and meetings is varied; some are too theoretical for him to be of immediate value, although he recognizes that theory ought to be part of the continuing education function. When given a choice, he prefers the practical approach, in seminar form; there he can ask questions and benefit from the discussions of the group.

The average physician in the United States is a solo, private practitioner who owns his office, employs one or two assistants, is affiliated with one or two local hospitals, sees a total of 110 patients per week, 91 in his office, 18 in the hospital, and one at home, works 50 to 64 hours per week, has a net profit of $26,680, an operating overhead of 60% to 70%, faces an improving financial situation but a rising overhead, faces a slight improvement in physician-to-population ratio, and is considering joining two or more local physicians in group practice.

The economics of medical practice and the level of paramedical support vary according to institutional affiliation. Solo and group practitioners divide their time between office and hospital. Clinic physicians are full-time employees and do not engage in private practice. Teaching associates practice in offices provided by the hospital.

The pattern of physician behavior also varies as a function of solo or team practice and generalization or specialization. For example, Mayo Clinic and Cleveland Clinic advocate team approaches to diagnosis. Mayo and Cleveland are also predominantly referral centers. The University of Minnesota and Kaiser Permanente in Oakland, California, have introduced screening techniques and are now training medical interviewers who will specialize in interpreting screening information.

Information used by a physician is developed through the diagnostic method. It is this process that sets the first rule for the design of a system to serve physicians.

In 1963 Crombie[1] described the computer in the diagnostic process as a store of estimates of the probabilities that given symptoms will be associated with specific diseases. In that same year, Engle and Davis[2] wrote a series of papers on the past, present, and future of medical diagnosis. In 1966 Trueswell[3]

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(1) Crombie, D.L., M.D., "General Practice Today and Tomorrow," The Practitioner, Volume 191, October 1963: 539-45.

(2) Engle, R.L., Jr., and B.J. Davis, "Medical Diagnosis: Present, Past, and Future. I. Present Concepts of the Meaning and Limitations of Medical Diagnosis," Archives of Internal Medicine, Vol. 112, October 1963: 512-9.

Engle, R.L., Jr., "Medical Diagnosis: Present, Past and Future. II. Philosophical Foundations and Historical Development of Our Concepts of Health, Disease, and Diagnosis," p. 520-29; III. Diagnosis in the Future, Including a Critique on the Use of Electronic Computers as Diagnostic Aids to the Physician," p. 530-43, "Archives of Internal Medicine,"Volume 112, October 1963.

(3) Trueswell, R.W., and A.H. Rubenstein, Program of Research on the Management of Research and Development--Information Searching Behavior of Physicians, Department of Industrial Engineering and Management Sciences, Northwestern University, Evanston, Illinois, October 1966.

and Rubenstein[4] attempted to convert this process into a formal diagram showing relationships, input, and results of data used in the patient care process.

The average private practitioner completed four years of medical school and three years of internship and residency approximately ten years ago. For new information on medications, diagnoses, therapy, and patient care techniques he depends strongly on colleagues and others who have had clinical experience with that information.

The physician belongs to one or two colleges or boards serving his area of medical interest, reads their publications, and supplements this intake by attending lectures arranged through the hospital to which he belongs or through the local medical society. For a subscription costing $70 a year he can receive commercially produced audio tapes. If he is not a surgeon or anesthesiologist and is in a metropolitan or near a metropolitan area he may view special TV broadcasts of medical lectures. The courses that he does attend are short, concentrated bursts of instruction designed to fit in his practice schedule.

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(4) Rubenstein, Albert H., Gustave J. Rath, Richard W. Trueswell, and David J. Werner, Program of Research on the Management of Research and Development, Department of Industrial Engineering and Management Sciences, Northwestern University, Evanston, Illinois, October 1966. This paper is based on a talk presented at the Twentieth National Conference on the Administration of Research held October 26-28, 1966, at Miami Beach, Florida.

Experimental medical techniques, advanced clinical or animal research, and advances in tutorial methods are treated casually by the practitioner. His immediate interest is in clinically confirmed medical experiences. The fact that these experiences are not analytically and rigorously controlled is not so important to him as to his colleagues in the allied sciences of biology and chemistry.

These data are heavily pictorial in content and narrative in form. The narrations are designed to provide the physician with extensive descriptions and therefore, a vicarious appreciation of the information.

Some primary rules can be developed from the knowledge of information-seeking behavior of physicians. The information system serving the private practitioner must be based on a request-to-response design attitude. The total transfer function of the system must include all facets of the turnaround cycle, including the search and retrieval function, the location of information, the transfer of the request to that data location, the determination of data availability, and then delivery to the requester.

The system must accommodate data in all forms and of all lengths. Versatility of handling is a key design requirement.

The Biomedical Communications Network must handle a variety of data forms and multiple length messages. It can be assumed that a number of communication media will be used. There will be three basic message forms: 1) A direct response; 2) a call back; and 3) a mail back.

A well-structured file, a distinct inquiry, and a short reply will be handled within a three-minute period. Some poison inquiries will be direct reply messages. Not all poison inquiries will fall into this category and the more complex may be referred to a laboratory. "Mail back" replies will typically include materials, such as films, which are not easily transmitted.

The aggregate system will be an expanding intermingling of information sources and physician users. Each primary source used by a physician will have a complete system information directory. The directory will be similar to a union list. The directory will be supported by a circulation control record which will notify the requester of data availability. In the event of nonavailability the request will be switched over to a second source. That source will transmit the data to the user. The expanding network will extend from user-to-source, from source-to-second source, and from user-to-user.

The network will include multiple media of multiple length located at various centers. A spirit of cooperation between participating institutions and a certain degree of commitment must precede the establishment of such a network. Although no systems now handle such a variety of data, there are examples of networks which illustrate the trend in cooperative ventures.

In sum, the excursions to physician's offices demonstrated that there are certain reference information-type services which a biomedical communications network can provide directly to the physician in order to help him conserve his professional time and thus allow him to see more patients. RM 2 ends with the conclusion that health science libraries should be considered charter members of any future biomedical information system designed to serve the practicing physician. It recommends a hierarchical relationship among health science libraries through a network configuration consisting of primary libraries (the library available locally to the physician); district libraries (of medium size and serving many primary libraries); reservoir libraries (serving the needs of a region with a comprehensive collection and larger services to support education and research); and the National Library of Medicine as the apex of the pyramid).

The network of libraries proposed in the report is highly user-oriented. It is based not only on a quantitative and qualitative analysis of the different types of users and their geographical location, but also on the use of new channels of communication, and on methods for obtaining feedback from users to make any future biomedical information network more and more responsive.

RM 3
SURVEY OF INTERLIBRARY
COMMUNICATIONS SYSTEMS

Interlibrary communications describes the nature of electronic and other communications methods and practices that have been used during the past 15 years. It provides the Biomedical Communications Network with hard information about the experience of others engaged in the planning of more effective communication between and among libraries. Written in the form of a bibliographic essay, RM 3 traces the development of computer and communications technology in cooperative library systems and, in the process, gives special emphasis to the experience of medical libraries.

A variety of different communication forms are highlighted. They range from the simplest use of the U.S. mails up to the telephone, teletype, radio, and even remote access computer-operated systems. Each historical vignette is supported by a bibliography and detailed substantiating facts.

Of all of the different kinds of equipment used by libraries for interlibrary communications, the one which has received widest acceptance for its practical value and immediate usefulness is the teletype machine.

The earliest use of the teletype machine in libraries took place in 1927 at the Free Library of Philadelphia. The machine was part of a closed circuit teletype system used for communicating book request information from the loan desk to the stacks and vice versa. Following World War II, the first installation connecting two distant libraries was established between the Milwaukee Public Library and the Racine Public Library in Wisconsin. Racine's limited collection was considered inadequate to the demands of its patrons and, rather than increase the book budget significantly, its Director negotiated an access arrangement with the larger collection at Milwaukee via teletype. Daily messenger service was instituted between the two libraries to effect pick-up and delivery of library materials.

The teletype machine enabled the libraries to use the speed of the telephone with the authority of the printed word. This advantage continues today and is the one which is mainly responsible for the proliferation of teletype communications. Teletype communications between and among libraries are beginning to emerge in both informal and formal network configurations. In addition to their obvious application to interlibrary loan, teletype has also been used to augment library holdings on a reciprocal basis to provide for general communications with other libraries, to serve as a channel for querying union catalogs, to accommodate reference questions and services, and to handle internal communications.

Within the past few years, Warren Bird at the Medical Library, Duke University, established the protocols for a teletype interlibrary loan network which connects six medical libraries with the National Library of Medicine. Mr. Bird produced a procedures manual to govern the use and operation of the network and also adapted the American Library Association's Interlibrary Loan Code to the communication processes.

Perhaps the most important benefit to accrue to users of medical library teletype service is the immediate ability it provides to communicate with any other teletype user anywhere in the world. Thus, it becomes possible for any participant in the Duke teletype network to communicate reference inquiries to information points outside the formal network. As reference demands increase, it is likely that medical libraries will begin to make wider use of the teletype machine even though it may have been initially acquired for an entirely different purpose. In addition, expanded uses in the future are a virtual certainty both because of the low cost of teletype operation and the technical improvements in the equipment itself.

In general, RM 3 reveals that, although the advantages of advanced means of communications have been known to medical libraries for many years, their utilization has been retarded by questions of cost and systems planning. Implicit in the report's conclusion, however, is that the development of computer and communications technology and of regional and national library network programs, when combined with the day to day pressure for increasing services, will cause libraries to devise more effective ways of applying communications technology so as to facilitate interinstitutional services.

RM 4
RATIONALE AND NODE SELECTION FOR INITIAL PHASE OF BCN

This report further develops the discussion of the Library Services Component of the Biomedical Communications Network. An essential step in the planning of a communications network is developing acceptable rationale for selecting the individual nodes which will comprise the net. This step can only be taken, however, after the role and functions of each component of the network are clearly defined and well understood. Thus RM 4 sets out (a) to identify the library functions and activities to be considered in planning, (b) to classify existing facilities as candidates for inclusion as nodes in the system, (c) to suggest minimal requirements for participation, (d) to estimate the manpower, resources, and cost implications, and (e) to outline a general plan for implementing the initial phase of Development of the Library Services Component. RM 4 specifies the library activities to be included and selects specific libraries for participation in the initial phase. The proposed Biomedical Communications Network (BCN) is defined in the report as a set of libraries, selected by NLM, and interconnected by electronic links primarily to afford wide access to computerized user services or support services now available at only a few institutions.

Included in RM 4 is a chart developed for the national survey of medical school libraries detailing user services, and another listing support services performed for one library by another.

Direct user services, performed for patrons of that library, are differentiated from indirect user services performed for another library. A user service corresponds to a specific request, while support services cover a wide spectrum of general services with no one-to-one relationship.

An hierarchical model, based approximately on the four levels of libraries envisioned in the Technical Development Plan, and including the users, is presented. Quantitative data are at present available only for "on demand" provision of specified documents; for the total volume of service requests, which could be more useful in estimating the computer and communications capability required at each level, data are not at present available.

The model estimates the number of elements at each level. Level 1 is the national facility (NLM), Level 2 comprises the 10 regional facilities, Level 3 the 100 subregional facilities, and Level 4 the 1000 local facilities (closer to 10,000 if all document collections called libraries are included). There are 100,000 potential users, (closer to one million if nurses, dentists, and allied health professionals are included). For each level the direct and indirect demands are stated, expressed as a mean number per element, and as a ratio.

The model does not take into account the fact that some regions have no Level 2 facility and that in such a region a consortium of Level 3 facilities may be approved as the regional library (e.g., East Central Region--Michigan, Ohio, and Kentucky). Where a Level 2 facility exists, the role of Level 3 facilities has not been defined; in other words the system seems to be evolving as a three-level one, rather than as a four-level one.

Minimal requirements for BCN nodes at each level are then presented, in terms of budgets, materials, service tools and staff. Tentative budgets of $300,000 for Level 2, $30,000 for Level 3, and $3,000 for Level 4 facilities are postulated. In materials, Level 2 is seen as having more than 2,500 current serials and, generally, more than 100,000 books; Level 3 more than 250 current serials and over 10,000 books; and Level 4 more than 25 "essential" current serials and over 1,000 books. In service tools, Level 2 is pictured as having all "standard" document, citation, and answer service tools; Level 3 the "major" ones; and Level 4 the "essential" ones. In staff, Level 2 is expected to have over 10 full-time professionals with, usually, an equal number of clerical and technical staff; Level 3 more than quarter time of an "adequately" trained individual. Operational definitions of "adequate", "essential," "major," "minimal," and "standard," are not given although they will surely need to be developed.

The functional role for Level 2 is to provide indirect services and support services to an NLM-designated multistate area (estimated at 10 Level 3 facilities, 100 Level 4 facilities, a[illegible]0,000 users), and direct services to users lacking other facilities. Level 3 is to provide similar indirect services either to a specific geographic area or to a specific group of Level 4 facilities (generally 10 facilities and 1000 users) and sometimes some direct services (as at Level 2), while Level 4 is seen as providing direct services to its own user population and limited system services to other Level 4 facilities in the area.

In a series of tables, facilities in regions with approved or funded programs as of October 1, 1968, are classified at the various levels and compared with the previously specified minimal requirements for BCN nodes. These regions are I (New England), II (New York), III (Mid-Eastern), IV (Mid-Atlantic), V (East Central), VII (Mid-West), and X (Pacific Northwest). Data given include, for Level 2 facilities: name, number of interlibrary loans per year, automation plans, and whether the facility has TWX (Table A). For Level 3 facilities: total number in each region, libraries of health science schools being in Table B, and libraries of medical societies, hospitals, and other organizations (sub-divided into profit and non-profit) in Table C; for each health science school facility, the name, median borrowing time, annual number of interlibrary loans, number of professional staff, automation plans, and availability of TWX are noted. For the other facilities, the type, the name, the location, the number of serial subscriptions, the number of professional staff, and the availability of TWX are included. Table D has an estimate of the number of hospital libraries in the same regions which would probably meet Level 4 requirements. Data given include: the number of American Hospital Association (AHA) members, the number accredited by AHA, the number approved for residency training, the number affiliated with a medical school, and estimates of the number with libraries, of the number of libraries with staff, and of the number of librarians requesting interlibrary loans (taken as the criterion of whether the library is "adequately" staffed). A forthcoming AHA survey should provide more accurate data.

Libraries of schools of nursing and of other allied health professions were not considered in the report; these would number several hundred. The biomedical document resources of large general libraries were also not taken into account. Some groups of users have special problems. Dentists, for example, are a very large group with no institutional base, who need to be provided with at least "remote" access to system resources.

In order to select priority functions in the initial phase, four questions had to be answered affirmatively:

1. Can current technology materially improve the function either by making services now enjoyed by few available to many or by making possible services not otherwise feasible?

2. Are the hardware and software either available now, or so far evolved that modest developmental effort can result at least in pilot operations within two years?

3. Does the function involve either a very large volume of transactions, or a widely expressed user want?

4. Does the function represent a bottleneck limiting expansion of other services, or is it closely coupled with other functions so that improvement in volume or quality will have a major impact on these other functions?

The user service functions selected for top priority are (numbered as in RM 4):

1A: Packaged "Level 5" facilities managed as branches of Level 2 or Level 3 facilities, which would supply small hospitals with a basic collection, maintain this collection, and provide staff-medicated document, citation, and answer services via no-toll phone lines.

1B: No-toll 2-way voice channels between users with no institutional facility (especially dentists) and staff at BCN node.

1C: Hierarchy-dictated 2-way channels among nodes for interlibrary requests and service output.

1D(2): On-line computer searches of MEDLARS and multifiles.

1G(1): Batched recurrent computer searches of MEDLARS files on individual profiles.

1H: On-line and batched computer searches of multi-files.

All support services were listed to receive top priority. They are:

2A(1): Computer files of regional (all Level 2 and 3) holdings data.

2A(2): Computer files of combined holdings/availability data.

2B: Decentralized cataloging input to NLM files and remote on-line query.

2C: Remote processing of "housekeeping" records and management data.

For the top priority functions, suggestions are also made on the levels which should be operational and those which should operate as pilots. Certain other user service functions were listed, but not given top priority. These were:

1D(1): Batched computer searches of MEDLARS files.

1E: On-line computer searches of multifiles.

1F: Batched recurrent computer searches of MEDLARS files on group profiles.

1G(2): Batched recurrent computer searches of multifiles on individual profiles.

1I: On-line computer searches of multifiles.

1J: Computer-aided instruction for teaching use of information resources.

1K: Transmission of document contents (telefacsimile, etc.).

Criteria of selection for initial phase involvement included: (a) locating a BCN node that has a regional medical library funded or approved and (b) is able to meet minimal requirements of functional responsibility. Taking into consideration (c) funding limitations, (d) need for concentrating resources, and (e) building lower-level nodes where higher-level nodes are already operating, the report suggests that not more than two regions should be involved in the initial phase. Region II (New York) and Region V (East Central) are selected for involvement, since, in New York, the State University of New York (SUNY) already has a functioning network which could participate less expensively than any other, and, in Region V, a consortium-type regional medical library (Level 3) will provide a good working environment for pilot projects at Level 4. The report concludes by recommending specific implementa-[illegible]n of BCN projects for the first phase in these two regions.

RM 5
INITIAL PHASE DEVELOPMENT OF
THE LIBRARY COMPONENT OF THE BCN

This report addresses itself to five tasks:

1. To elicit information feedback from selected leaders in the biomedical library community regarding the rationale and plan for node selection recommended in the earlier study (RM 4).

2. To develop an approach for estimating probable traffic flow among BCN nodes.

3. To define, in greater detail, the role of nodes at each level.

4. To prepare a "strawman agreement" outlining the obligations and responsibilities that nodes might be expected to assume if they are to participate in the BCN.

5. To identify further tasks that must be accomplished to implement the initial phase of the BCN.

To obtain feedback from medical libraries, six were chosen, the Countway Library, the Upstate Medical Center of the State University of New York, the New York Academy of Medicine, Wayne State Medical School, the College of Physicians of Philadelphia, and the Welch Medical Library of Baltimore. Four of them have primary responsibility for an NLM approved or funded Regional Medical Library program. Of the two who have not, one was chosen as a "disinterested" party, the other as the foremost pioneer of networking.

The six were sent a copy of the Rationale and Node Selection plan and reactions were obtained by interview. Only minor changes have been suggested, particularly in regard to the criteria set for minimal budget and resource requirements; no major criticism was voiced, even with regard to the controversial choice of regions for implementation. This general concurrence gave tentative assurance that the plan was sound and ready for further exposure to interested parties.

The basic approach to estimating possible traffic flow was the use of available data on current service demand to predict the total messages that will have to be handled in the demonstration regions. The report points out that such data is scarce and incomplete.

Interlibrary loan figures provide the only available data. On the basis of a survey made in Region III (Mid-Eastern), the annual number of requests to NLM is known, as is an estimate of borrowing from all sources. Hence a figure can be obtained for the proportion of NLM requests to total borrowing. Using a corrected form of this, estimates of total borrowing in other regions can be derived from the number of requests made to NLM by that region, assuming that the proportion of NLM to total borrowing is the same in all regions (Table 1, RM5). This obviously does not hold for Region IV (Mid-Atlantic), and it is further assumed that NLM provides 50% of the loans in this region. When this correction is made, total borrowing is estimated at 910,000 requests. Table 2 of the report relates the demand in the various regions to parameters such as percentage of practicing MD's, of approved residencies, of AMA-accredited hospitals, of medical school affiliated hospitals, and of PHS research and training funds. Good correlation suggests that the assumptions underlying this method of estimation are essentially valid.

Further predictions are then made on the distribution of demand at various levels, using Region II (New York) as the example; a ten percent annual increase is assumed. This gives a base of 194,000 total requests for Fiscal 1970. Fifteen percent of these will be generated at Level 3, the remainder at Level 4. Level 2 will then receive all Level 3 requests (assuming no interconnection between same-level nodes) and those requests from Level 4 unsatisfied by Level 3, assumed to be 10%. This means that Level 3 to Level 2 channels will carry 45,000 requests in all or average about 1000 to 2000 requests per channel, depending on the number of nodes. Similarly the channels between Levels 3 and 4 will carry about 165,000 requests assuming several hundred Level 4 nodes. If the regional library can supply better than 85% of the requests, this would mean a maximum of 7000 passed on to Level 1 (NLM).

Very tentative estimates are also made of the demand for the user and support services listed in Table 6 of the earlier study (RM 4). These must necessarily be tentative since there are no studies on which to base the estimates. Interlibrary loan is the only measure for which detailed figures exist.

The role of nodes at each level has been defined further in terms of consumer versus supplier function by considering the general nodes providing a broad range of system services. When tapping the resources of other nodes, a node is a consumer. On this basis nodes at Level 4 are expected to devote resources to supplier versus consumer in the ratio of 1/100. Level 3 nodes providing system services to a group of between 5 and 30 Level 4 nodes should be furnishing indirect services to a user population of about 1000. They may also furnish library support services and direct services. The proportion of effort at Level 3 to supplier versus consumer activities will range from 1/10 to 1/100.

Level 2 nodes are expected to provide backup services to about 10,000 users, as well as library support services and direct services. Supplier to consumer effort will generally range from 1 to 1/10, but may in some regions approach 10, in the case of the "libraries' library".

Since NLM will be dealing with requests that lower levels have not been able to fill, its role is likely to be quantitatively different.

On the basis that the aim of the BCN is to equalize the biomedical community's access to library services while upgrading the services available, the report postulates five requirements for agreements: (a) that its own institution should maintain or increase the support received by each node as total support for the network increases; (b) that users' demands are met at the lowest appropriate level in the network; (c) that network compatibility is assured; (d) that data necessary for monitoring the network's function are collected; and (e) that each node in the network is responsive to the needs of the levels it serves.

Since specific agreements can only be worked out in the context of a particular region and of a particular stage of network development, only general principles of agreements are detailed between nodes at one level and those at the next lower level. Responsibilities as a consumer will include maintaining resources at specific standards, observing rules in referring unmet requests to higher levels, and supplying data on resources, direct services, and consumption of system services to higher levels. As a supplier of system services, a node will have to meet minimal standards in providing services to lower-level nodes, to observe rules in passing on unmet requests to higher levels, to supply data to higher levels on system services, to develop a mechanism to insure responsiveness to lower-level needs, to provide direct user services to those without other facilities, and to provide specified system services to specific nodes. These last two responsibilities are appropriate for all Level 2 nodes and may be also for some Level 3 nodes. The requirement to supply data to higher levels on system services is the only supplier requirement appropriate for Level 4 nodes. At present, to determine responsibilities, minimal requirements for expenditures, materials, service tools, and staff will have to be used. In the future, more relevant measures can be determined.

Difficulties can be foreseen in specifying maintenance of appropriate institutional support where a Level 2 node is already a wholesale library; in specifying responsibilities of nodes which are part of other library systems; in specifying eligibility for free indirect user services; and in deciding how much standardization within and between regions is desirable and necessary.

The report suggests five other tasks to take priority:

1. To involve medical library leaders. First, a 2-day meeting of NLM staff and the 6 librarians already involved in the feedback process, to produce a paper for discussion by Regional Program policymakers and thereafter the MLA membership, so that feedback may be obtained.

2. To closely work with regions selected for the demonstration phase to work out agreements, priorities, schedules, and specifics, and decide how special facilities (such as industrial libraries) can be tapped, and investigate such possibilities as automated citation verification with MEDLARS and _Current Catalog_ tapes. These will provide a sound basis for implementing the plan.

3. To develop criteria and cost-benefit measures for evaluation, collection of base-time data for evaluation, and design of a program for obtaining follow-up data.

4. To establish a conceptional framework and data for computer simulation of network traffic.

5. To conduct logical analysis of how the library component might articulate with the other components and share common links, files, programs, and hardware.

All these require only small expenditures now, and could insure that a rational network evolves. Later this may be very costly