Potential Educational Services from a National Biomedical Communications Network: Report of a Conference*

Cheves McC. Smythe, M.D.†

On February 25–26, 1969, the Council of Academic Societies of the Association of American Medical Colleges called a conference on "Potential Educational Services from a National Biomedical Communications Network." The 5 formal papers that were given at the Conference, which was supported by and held at the National Library of Medicine, were augmented by a panel presentation and small-group discussions.

Objectives

The objectives of the Conference were to initiate efforts toward:

1. Informing a selected group of medical educators of the potentialities of a biomedical communications network.
2. Estimating what aids not only are needed but are most likely to be used by medical teachers and medical learners to strengthen both the process and content of medical teaching as well as to increase the depth, scope, and efficiency of medical teaching.
3. Assessing experiences with the communication techniques already available.
4. Determining which technologies and additional materials are necessary to make such a network possible.
5. Taking first steps toward preparing the needed materials.
6. Educating the medical teaching community in the uses and manipulation of a network after it has been created.
7. Initiating the formation of specific task-oriented groups for the solution of stated problems.
8. Stimulating individuals to become involved in the attainment of these objectives.

Technology

Ruth M. Davis, Ph.D., Director, Lister Hill National Center for Biomedical Communications, National Library of Medicine, reported on "Technology in Support of Medical Education." In her opening remarks she stressed the fact that for the medical educator the content of what is transmitted by a communications network and the educational processes used will be primary considerations. However, she warned, he also must be concerned with the state of development and the constraints imposed by the technological base on which any such network will be built. He must comprehend what technology is ready for exploitation, prepare himself for the application of these techniques by planning ahead, and identify those problems ready for solution. Since the development of this type of technology is not a primary mission of medical educators, they will remain adaptive and not creative in this area until they acquire the necessary familiarity with these systems to apply them to their own needs. Such developments may take from three to seven years, but the ease with which medicine has accepted a whole range of new techniques in both teaching and practice engenders optimism about its rapid acclimatization to communication network technology.

Acceptance of the constraints of technology should lead to recognition that the proper objective for an educational communication network should be to give to the faculty

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control over content and generation of course material, teaching and testing procedures, and evaluation of results; to the students control over selection of the means of presentation of material to them, the pace at which each learns, and feedback to the teachers; and to the administrators a voice in planning the provision of materials and facilities and the definition of objectives of the school.

The Information Resource

The development of a communications network must also be viewed in the context that the modern medical library must handle more than the traditional printed page. William N. Hubbard, Jr., M.D., Dean of the University of Michigan Medical School, speaking on "What is Needed and What May be Consumed," defined the library as the locus for the management of information storage, retrieval, and transfer in an optimal manner for its users.

The production of a larger number of graduates, wider access to a medical education for students from many backgrounds, enrichment of educational experiences for students in less well-supported schools, and better control over costs in all aspects of the system are major problems which the medical school administrators must take steps to resolve now. It may well be that a biomedical communications network will be a significant factor in solving this complex puzzle.

Goal-directed learning, the definition of that body of knowledge which is necessary for the practice of modern medicine, and qualifying examinations all are related to the productivity of the medical schools. A central information resource could add enormously to the effectiveness with which core material might be presented and to the evaluation of the students' mastery of it. The possibilities for self-pacing in learning by those students from less well-endowed backgrounds are self-evident; and because medical education is centered on the clinical experience, all students and graduates would benefit by the clinical training that could be made available using newer communications devices funneled through a central resource.

Tomorrow's Medical Students

Those who would design educational experiences for medical students should recognize that the medical student population is derived from a general university population and is subject to the same attitudinal shifts as these students, declared Daniel H. Funkenstein, M.D., Director, Program for Research in Medical Education, Department of Psychiatry, Harvard Medical School. He outlined some of the characteristics and interests of tomorrow's medical students as follows:

Personal and intellectual characteristics.—Decreased emphasis on scientific attitude; decreased emphasis on research; decreased interest in basic sciences not directly relevant to clinical problems; shift to pragmatic use of science—biological, physical, social, and behavioral—rather than on being a "scientist;" increased interest in a shortened time span between secondary school and career; and increased interest in computers, television, movies, and other communication devices as learning tools.

Preparation.—Increased study and interest in social and behavioral sciences; decreased study and interest in biological and physical sciences not directly relevant to clinical problems; and a shift in college biology to achieve a balance among molecular biology, organ systems, ecology, and ethnology.

Career plans.—Increased numbers planning careers in family practice, public health, and administration; and decreased numbers planning research careers.

Community and economic orientation.—Increased concern for delivery of medical care to all segments of society with emphasis on ghetto and rural areas; increased interest in a revision of the medical care system to base delivery on needs rather than on finances; increased emphasis on preventive medicine; increased political activity; decreased interest in "fee for service" and greater interest in prepayment plans; increased interest in salaried positions; and decreased interest in accumulation of material wealth.

Interpersonal relationships.—(*a*) Increased representation of medical school faculty and administration on committees; increased evaluation of faculty and administration, and close student-faculty relationship but not *in loco parentis*; (*b*) increased concern for patients' emotional, social, and family aspects; (*c*) more leisure time spent with wife and family.

The emphasis on self-control or self-determination by each student over his own education is the most salient factor on this list. An approach which should allow oncoming students to learn to manipulate skillfully newer communications technologies for their own benefits is indicated.

Clinical Logic

Lawrence L. Weed, M.D., Associate Professor of Medicine and Microbiology, Case Western Reserve University School of Medicine, reminded conferees that medicine has abandoned very reluctantly the idea that physicians could commit to memory the facts essential to their practices. Attachment to this concept has led to the neglect of the development of any orderly system for recording the mass of material which is now collected on each patient and to the practice of evaluating physicians on their ability to retain facts, rather than on their capacity to manipulate these facts. The orderliness of the computer and the demands it makes for the application of logic to both storage and retrieval make this a peculiarly advantageous time to launch an attack on these problems.

It has been readily demonstrated that branching logic systems can be built to lead students through the physical examination, much of history-taking, and evaluation of the more important clinical findings as, for instance, anemia. The computer can free physicians from the burden of memorization just as acceptance of reductionistic vigor can restore order to clinical records. The provision of the necessary logic systems or question sequences through a central resource could be effected with far greater speed and conservation of talent than would be the case if each medical center developed its own system.

Sharing of Resources

Limiting constraints on medical education are resources: students, clinical opportunities, faculty, facilities, and finances. The quantity and quality of these resources vary radically among the medical schools. Yet, all schools face consistent demands to teach more medical students, train more health care personnel, do more productive research, conduct large postgraduate programs, support many national organizations, and deliver medical care on an expanded scale. It is the thesis of Jack W. Cole, M.D., Chairman, Department of Surgery, Yale University School of Medicine, that these resources must be shared. He declared that somehow communications technology must permit the knowledge, abilities, and insights of faculty to be extended beyond the departments in which they are physically present. The well-reasoned and -presented lecture, the ingeniously designed laboratory experiment, and the superior analysis or management of clinical problems can be shared. Faculty talent can be extended through a biomedical communications network.

Acceptance of Resources

However, the design of a system which can make such resources available must be accompanied by recognition that consumers, students, and faculty must be led to utilize them. This was the conclusion of a panel charged with exploring factors affecting student-faculty acceptance of externally designed teaching resources. The panel included George E. Miller, M.D., Director, Research in Medical Education, University of Illinois College of Medicine; William G. Cooper, Ph.D., Professor of Anatomy, University of Colorado School of Medicine; and Howard S. Barrows, M.D., Professor of Neurology, University of Southern California School of Medicine. Their experience indicated that the following factors are important, and attention must be paid to the details of each:

1. Environments in which teaching is conducted and learning takes place.

2. Clarity with which objectives are defined.

3. Relevance of the material presented to the needs of both the teacher and learner.

4. Quality of the teaching aid products used, and availability or accessibility and flexibility of use for both faculty and students.

5. Time consumed in the use of teaching aids and costs—in all parameters—time, money, and effort.

6. Rewards for those who invest their energies in developing teaching aids.

7. Objectivity in evaluating the potentialities of new teaching aids.

8. Consistency by faculty in relating the material presented to their student evaluation procedures.

9. Involvement of students in the preparation and criticism of teaching materials.

10. Promotion of familiarity with and ease of manipulation of necessary equipment.

Recommendations

From the group discussion reports delivered by William G. Harless, Ph.D., Chief, Instructional Systems, Center for the Study of Medical Education, University of Illinois College of Medicine; Ralph J. Wedgwood, M.D., Chairman, Department of Pediatrics, University of Washington School of Medicine; Ramon M. Fusaro, M.D., Ph.D., Associate Professor of Dermatology, University of Minnesota Medical School; and John K. Lattimer, M.D., Chairman, Department of Urology, Columbia University College of Physicians and Surgeons, a series of positive recommendations supporting the organization of a biomedical communications network emerged. Recognition of the educational potentialities of a network evoked broad acceptance and support for the concept. Most of the recommendations were not pointed at solutions of sharply defined problems but rather at definitions of some general attributes of the system.

1. There should be a nationally based central resource which should be designed to provide high-quality, carefully evaluated materials to expand the capabilities of medical faculties and enrich the educational experiences of medical students.

2. In addition to the capability for facilitating the distribution of contemporary information, the design of such a resource should also incorporate recognition of fundamental educational concepts including evaluation, provision of feedback mechanisms for guidance of subsequent developments, recognition of the role of the examination and subtleties in its methodology, and concern for the processes through which information is transmitted.

3. There is a body of knowledge and information which constitutes a base of data, skills, concepts, behaviors, and attitudes, all of which have a commonality for all medical schools and for all medical education at the national level. This body of information is in itself a national resource. It is dynamic and subject to continuous change. Not all medical schools can or do provide equally all of this body of knowledge through their own faculty expertise, nor do they provide equally ready access to it for all medical students. All medical schools cannot cover the increasingly broad body of biomedical information. Some segments of this information base can be made more readily available and can be more rapidly updated by modern communications technology. Use of such information can be controlled by local option to supplement the usual teaching processes within any individual institution. There is some urgency to pool experiences and make available nationally the many innovations which have been developed in individual institutions.

4. Many aspects of the nature of the organization of a national biomedical communications resource must be defined. These include identification of those areas of knowledge where attention is most needed, of the most relevant questions for modern society that are capable of solution, and of those mechanisms by which the content of the national resource is developed, obtained, and upgraded; definition of responsibility for control over quality; and elaboration of a mechanism

for decisions on priorities of input and the release of units.

5. Development of a council or committee external to the National Library of Medicine is advocated. Such a council should be broadly based and should include individuals from many backgrounds. A center-based secretariat or staff to support the function of such a council is necessary to provide continuity. Subject groups concerned with the informational content of specific areas should be appointed. In turn, each of these subject groups would require action committees to develop specific units. Such action committees might be helpful in the identification of the individuals or institutions best equipped to prepare such units. Some mechanism for review, including review panels and evaluation groups, is also a necessity.

6. The organization of a biomedical communication network provides a mechanism through which the National Library of Medicine can cooperate with medical educators in accomplishing educational goals by encouraging the development of educational resources at local, regional, and national levels. Thus, concern with educational standards of the teaching materials provided, reflection of the need for evaluation of teachers, insistence on measurement of the degree of attainment of stated goals, flexibility in communications, high technical standards, recognition that standards will change with experience, encouragement of compatibility, promotion of development of pilot projects, provision of educational material for many levels in the health sciences, involvement of those individuals who are experts and active in the various specialized fields in the design of material, attention to sophistication in the packaging of the various aids used, and the ability to translate the material into foreign languages—all are features which should be considered in the design of a biomedical communications network if it is to reach maximal effectiveness.

7. As new techniques are developed, final judgments should not be made until each has been given a thorough trial through usage. Every school eventually must become involved in the network if the system is to function to its fullest capacity. However, initial efforts should begin in individual schools and clusters of schools.

8. An inventory of what is already available is needed. Criteria for judging existing and newly designed materials must be created. More rapid development can be fostered by encouraging the interchange of ideas among those most concerned with the application of these techniques.

POTENTIAL EDUCATIONAL SERVICES FROM A NATIONAL BIOMEDICAL COMMUNICATIONS NETWORK

Report of a Conference held February 25-26, 1969
National Library of Medicine, Bethesda, Maryland
Sponsored by the Council of Academic Societies
of the Association of American Medical Colleges
Edited by Cheves McC. Smythe, M.D.

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Edited by CHEVES McC. SMYTHE, M.D.

Report of a Conference held February 25-26, 1969,
National Library of Medicine, Bethesda, Maryland.
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ACKNOWLEDGMENT

The Lister Hill National Center for Biomedical Communications was established as a part of the National Library of Medicine by the President of the United States on August 3, 1968 subsequent to a joint resolution by Congress. At the time of its establishment, Dr. Martin M. Cummings, the Director of the National Library of Medicine, extended the contact between the Library and the Association of American Medical Colleges (AAMC) by inviting the AAMC to look at some of the problems inherent in the organization of a biomedical communications network. In a talk before the AAMC Council of Academic Societies on October 4, 1968, he said, "The specialized information and specialized educational service components (of a biomedical communications network) are in the very early planning stages due to lack of involvement, lack of professional assistance, and lack of guidance from those who ultimately will use the system."

The conference described in this report came about as a result of the efforts of the Library to involve the faculties of the medical colleges at the very earliest time in planning the educational services to be provided by a communications network. The Executive Council of the Association accepted this invitation and asked the Council of Academic Societies to develop the opportunity extended by the Library. The Executive Committee of the Council of Academic Societies then appointed a Steering Committee for the conference.

Throughout the planning and execution of this project, the staff of the Library cooperated most helpfully at every step. Thanks are also due to Mrs. Patricia McColgin for her able and gracious assistance in mounting the conference. Finally, this report has profited greatly through the editorial skill of Miss Mary H. Littlemeyer, to whom all of its readers should be grateful.

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CONFERENCE STEERING COMMITTEE

ABSTRACT

An invitational conference of medical educators called by the AAMC Council of Academic Societies was supported by and held at the National Library of Medicine on February 25-26, 1969. "Potential educational services from a national biomedical communications network" was the subject examined. Against a background which included recognition that technology is available for greatly augmented communications in medicine; the urgent need for increased medical manpower and for more effective ways of training it; the increasing interest of today's medical students in the provision of medical services; the possibilities inherent in the application of the orderliness of the computer as an approach to many clinical situations; the need to increase the efficiency and effectiveness of scarce faculty resources by making their talents more broadly available through more effective communications; and the recognition that the application of newer teaching approaches requires careful tailoring of them to gain both student and faculty acceptance, the conferees concluded:

1. There is a need for a nationally based biomedical communications network.

2. There is a great range of educational services such a network might provide.

3. Among its various components should be an information resource to enrich the experiences of students and faculties and to enhance the capabilities of the faculties. This resource might also facilitate the distribution of contemporary information and serve as an innovative agent in such educational mechanisms as examination methodology and evaluation of teaching.

4. Such an educational resource should be organized with provision for a significant voice in its operation from faculty and students who are to use it.

5. It should utilize the most advanced techniques in the preparation of its teaching and learning aids including evaluation of their efficiency, effectiveness, and acceptance, but in no way should it directly or indirectly attempt to control curriculum content.

6. The biomedical community should support the National Library of Medicine in the organization of a communications center and do so without delay.

SUMMARY AND CONCLUSIONS*

On February 25-26, 1969, the Council of Academic Societies of the Association of American Medical Colleges called a conference entitled, "Potential Educational Services From A National Biomedical Communications Network." The conference was supported by and held at the National Library of Medicine. Condensations of 5 papers, a panel presentation, and the reports of 3 discussion groups, including some remarks from the floor, make up the body of this report.

The objectives of the conference were stated as initiating efforts toward:

1. Informing a selected group of medical educators of the potentialities of a biomedical communications network;

2. Estimating what aids are not only needed but are most likely to be used by medical teachers and medical learners to strengthen both the process and content of medical teaching as well as to enhance the depth, the scope, and the efficiency of medical teaching;

3. Assessing experiences with the communication techniques already available;

4. Estimating technologies and additional materials necessary to make such a network possible;

5. Taking first steps toward initiating the preparation of needed materials;

6. Educating the medical teaching community in the uses and manipulation of a network once it is created;

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7. Initiating the formation of specific task-oriented groups for the solution of stated problems; and

8. Stimulating individuals to become involved in the attainment of these objectives.

For the medical educator the content of what is transmitted by a communications network and the educational processes used will be primary considerations. However, he also must be concerned with the state of development and the constraints imposed by the technological base on which any such network will be built.

Technology has been defined as a codified way of doing things. The linking of communications modalities and computers makes a network possible. It is important then for medical education to comprehend what technology is ready for exploitation, to prepare itself for the application of these techniques by planning ahead, and to identify those problems ready for solution. Since medical education does not have development of this type of technology as a primary mission, it will remain adaptive and not creative in this area until it acquires the necessary familiarity with and applies these systems to its own needs. Such developments may take three to seven years, but the ease with which medicine has accepted a whole range of new techniques in both teaching and practice leads to optimism about how well this will be handled. The current use of dial-access audio information banks, a whole variety of television applications, computer-based information and bibliographic data banks, a number of applications of computers to clinical problem definition and solutions, and the presence and growing use of computers, television, and other communications modalities in medical centers are indications of the paths along which development can be expected.

Acceptance of the constraints of technology should lead to recognition that the proper objective for an educational communication network should be to give to the faculty control over content and generation of course material, teaching and testing procedures, and evaluation of results; to the students control over selection of the means of presentation of material to them, the pace at which each learns, and feedback to the teachers; and to the administrators a voice in planning the provision of materials and facilities and the definition of objectives of the school. Just as printing and books, the typewriter, and the telephone have resulted in greatly increased flexibility in the use and individualization of knowledge, the newer technology should be seen as inherently possessing the same potentiality for enhancing each individual's choice of and control over what information he will use.

The development of a communications network must also be viewed in the context that the modern medical library must handle more than the traditional printed page. The function of the library is to manage information transfer and serve as an informational resource in an optimal manner for its users.

The production of a larger number of graduates, wider access to a medical education for students from many backgrounds, enrichment of educational experiences for students in less well-supported schools, and some better control over costs in all aspects of the system are major problems which those responsible for leadership in the medical schools must take steps to resolve now. A biomedical communications network has major bearing on all of these questions. Goal-directed learning, floors of necessary knowledge, and qualifying examinations are related to the productivity of the medical schools. A central resource could add enormously to the effectiveness with which such core material might be presented and students evaluated in their mastery of it. The possibilities for self-pacing in learning by those students from less well-endowed backgrounds are self-evident. Medical education is centered on the clinical experience. In its clinical phases the lessons learned in teaching students and residents through the application of newer communications technology, if focused and funneled through a central resource, could more readily be applied to the learning needs of all physicians as they go about their clinical tasks through their professional lifetimes.

Those who would design educational experiences for medical students should recognize that the medical student population is derived from a general university population and subject to the same attitudinal shifts as these students. Some of the characteristics and interests of tomorrow's medical students may be outlined as follows:

A. Personal and Intellectual Characteristics

1. Decreased emphasis on scientific attitude
2. Decreased emphasis on research
3. Decreased interest in basic sciences not directly relevant to clinical problems
4. Shift to pragmatic use of science, biological, physical, social, and behavioral, rather than on being a "scientist"
5. Increased interest in a shortened elapsed period between secondary school and career
6. Increased interest in computers, TV, movies, etc., as learning tools

B. Preparation

1. Increased study and interest in social and behavioral sciences
2. Decreased study and interest in biological and physical sciences not directly relevant to clinical problems

3. Shift in biology in college to balance among molecular biology, organ systems, ecology, and ethology

C. Career Plans

1. Increased numbers planning careers in family practice, public health, and administration

2. Decreased numbers planning research careers

D. Community and Economic Orientation

1. Increased concern for delivery of medical care to all segments of society with emphasis on ghetto and rural areas

2. Increased interest in revision of medical care system to base delivery on needs rather than on finances

3. Increased emphasis on preventive medicine

4. Increased political activity

5. Decreased interest in "fee for service"; greater interest in prepayment plans

6. Increased interest in salaried positions

7. Decreased interest in accumulation of material wealth

E. Interpersonal Relationships

1. Medical School Faculty and Administration

   a. Increased representation on committees

   b. Increased evaluation of faculty and administration

   c. Close student-faculty relationship but not *in loco parentis*

2. Patients

   a. Increased concern for their emotional, social, and family aspects

3. Own Family

   a. More leisure time spent with wife and family

The emphasis on self-control or self-determination by each student over his own education is salient on this list. An approach which should allow oncoming students to learn to manipulate skillfully newer communications technologies for their own benefits is indicated.

Medicine has abandoned very reluctantly the idea that physicians could commit to memory the facts essential to their practices. Attachment to this concept has led to neglect of development of any orderly system for recording the mass of material which is now collected on each patient and to the practice of evaluating physicians on their ability to retain facts, rather than on their functional capacities in the manipulation of these facts. The orderliness of the computer makes the applications of its constraints peculiarly timely to an attack on these problems. It has been readily demonstrated that branching logic systems can be built to lead students through the physical examination, much of history-taking, and evaluation of the more important clinical findings as, for instance, anemia. The computer can free physicians from the burden of memorization just as acceptance of reductionistic vigor can restore order to clinical records. The provision of the necessary logic systems or question sequences through a central resource could bring the benefits of such advances more rapidly than if each had to be redeveloped repeatedly in each medical center all over the country.

Limiting constraints on medical education are resources: students, clinical opportunities, faculty, facilities, and finances. The quantity and quality of these resources controlled by the various medical schools are very uneven. Yet, all medical schools face consistent demands to teach more medical students, train more health care personnel, do more productive research, conduct large postgraduate programs, support many national organizations, and deliver medical care on an expanded scale. Resources must be shared.

Somehow communications technology must permit the knowledge, abilities, and insights of faculty to be extended beyond the departments in which they are physically present. The well-reasoned and presented lecture, the ingeniously designed laboratory experiment, and the superior analysis or management of clinical problems can be shared. Faculty talent can be extended through a biomedical communications network.

However, the design of a system which can make such resources available must be accompanied by recognition that consumers, students, and faculty must be led to utilize them. Experience indicates the following factors are important, and attention must be paid to the details of each.

1. Environments in which teaching is conducted and learning takes place;

2. Clarity with which objectives are defined;

3. Relevance of the material presented to the then and now needs of both the teacher and learner;

4. Quality of the products used;

5. Availability or accessibility and flexibility of use for both faculty and students;

6. Time consumed in the use of teaching aids;

7. Costs--in all parameters--time, money, and effort;

8. Rewards for those who invest their energies in developing teaching aids;

9. Objectivity in evaluating potentialities of newer material;

10. Consistency by faculty in relating material presented to practices in student evaluation;

11. Involvement of students in the preparation and criticism of materials they use; and

12. Promotion of familiarity with and ease of manipulation of necessary equipment.

Recommendations

From the conference a series of positive recommendations supporting the organization of a biomedical communications network emerged. Recognition of the educational potentialities of a network evoked broad acceptance and support for the concept. Most of the recommendations were not pointed at solutions of highly defined problems but rather at definitions of some general attributes of the system.

1. There should be a nationally based central resource which through provision of high quality, carefully evaluated materials should be designed to expand the capabilities of medical faculties and enrich the educational experiences of medical students.

2. In addition to being capable of facilitating the distribution of contemporary information, the design of such a resource must also incorporate recognition of fundamental educational concepts including evaluation, provision of feedback mechanisms for guidance of subsequent developments, recognition of the role of the examination and subtleties in its methodology, and concern for the processes through which information is transmitted.

3. There is a body of knowledge and information which constitutes a base of data, skills, concepts, behaviors, and attitudes, all of which have a commonality for all medical schools and for all medical education at the national level. This body of information is in itself a national resource. It is dynamic and subject to continuous temporal change. Not all medical schools can or do provide equally all of this body of knowledge through their own faculty expertise, nor do they provide equally ready access to it for all

medical students. All medical schools cannot cover the increasingly broad totality of biomedical information. Some segments of this information base can be made more readily available and can be more rapidly updated by modern communications technology. Use of such information can be controlled by local option to supplement the usual teaching processes within any individual institution. There is some urgency to pull common experiences together and make available nationally the many innovations which have been developed in individual institutions.

4. Many aspects of the nature of the organization of a national biomedical communications resource need to be defined. These include identification of those areas of knowledge where attention is most needed; identification of the most relevant questions for modern society, but yet questions capable of solution; identification of those mechanisms by which the content of the national resource is developed, obtained, and upgraded; definition of responsibility for control over quality; and elaboration of a mechanism for decisions on priorities of input and the release of units.

5. Development of a council or committee external to the National Library of Medicine is advocated. Such a council should be broadly based and include individuals from many backgrounds. A center-based secretariat or staff to support the function of such a council is necessary to provide continuity. Subject groups concerned with the informational content of specific areas need to be developed. In turn, each of these subject groups would require action committees to develop specific units. Such action committees might be helpful in the identification of the individuals or institutions best equipped to prepare such units. Some mechanism for review, including review panels and evaluation groups, is also called for.

6. The organization of a biomedical communication network provides a mechanism through which the National Library of Medicine can cooperate with medical educators in accomplishing educational goals by encouraging the development of educational resources at local, regional, and national levels. Thus, concern with educational standards of the teaching materials provided, reflection of the need for evaluation of teachers, and insistence on measurement of the degree of attainment of stated goals, flexibility in communications, high technical standards, recognition that standards will change with experience, encouragement of compatability, promotion of development of pilot projects, provision of educational material for many levels in the health sciences, involvement of those individuals who are experts and active in the various specialized fields in the design of material, attention to sophistication in the packaging of the various aids used, and the ability to translate the material into foreign languages, are all features which should go into the design of a biomedical communications network to allow it to reach maximal effectiveness.

7. As new techniques are developed, final judgments should not be made until each has been given a thorough trial through usage. Every school eventually must become involved in the network if maximal effectiveness is to be realized. However, initial efforts should begin in individual schools and clusters of schools.

8. An inventory of what is already available is needed. Criteria for judging existing and newly designed materials need to be developed. More rapid development can be fostered by encouraging meetings of those in the forefront on the application of these techniques.

Introduction

Thomas D. Kinney, M.D.,* Martin M. Cummings, M.D.,° and Jonathan E. Rhoads, M.D.+

We are delighted to welcome the group which has been convened to identify both the nature and extent of potential educational services from a national biomedical communications network. Our aim has been to call together individuals interested in medical education, particularly interested in teaching, to learn more about what is needed to help make us better teachers and to help us communicate the vast body of knowledge of medicine to our students. Deliberations and discussions from this conference will provide substantive input to further planning by the National Library of Medicine for the implementation of the biomedical communications network.

The library was once the trustee of the printed record of civilization. As one thinks of this trustee role, it becomes an even more awesome task now that the library no longer manages records in printed form alone but also faces the enormous responsibility of acquiring, preserving, and disseminating knowledge in many new forms, not the least of which is information in audio and audiovisual modes.

To satisfy students, educators, and scientists, our educational institutions need to adopt a new parietal arrangement within the institution to provide

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services to listeners and to viewers as well as to readers. This will force certain attitudinal changes on the part of librarians who will have to give equally delicate care and attention to managing these new forms. Reexamination of the acceptability of these new forms by both teachers and students is in order also. The staff and the Board of Regents of the National Library of Medicine are not satisfied with the speed and quality of the information services which are being provided in a world which is supersaturated with published information.

Dr. John Shaw Billings, first director of the National Library of Medicine, was also dissatisfied a century ago when he wrote, "If neither the librarian nor the readers are dissatisfied, then the library is probably dying or dead." The paradox which faces us is how to use the same community of science and technology which created the information overload to solve the information problem they brought upon us. In a nation which had led the technological revolution, it should be possible to use the same talents that created the mass of knowledge to learn how to manage and utilize it efficiently.

The Council of Academic Societies (CAS) of the Association of American Medical Colleges agreed to assist the National Library of Medicine in developing a network to serve medical education over a two- or three-year period. You, as medical educators, are being asked to foresee needs and applications of new technology to all levels of medical education but especially at the level of undergraduate and graduate medical education. This is the education now provided and controlled by your institutions.

We must do our planning now. Implementing systems to deliver new substantive informational packages to thousands of persons, particularly to students, is tomorrow's problem.

Through most of the years the AAMC has been concerned with undergraduate medical education. In planning the future role of the Association, the 1965 Coggeshall Report strongly recommended that the AAMC expand its sphere of interest from the four years of medical school to include the hospital years, particularly, and in a more general way, college and high school education leading to medical school, as well as in continuing medical education. The main thrust was, however, to include the hospital years. If this were to be done, the Association needed a broader base. Its previous base had been in the main the deans of the respective schools, whereas the hospital training programs had been carried on largely as a function of chiefs of services, which often in the teaching hospitals meant department chairmen. It was at first conceived that there would simply be added from each school a certain number of faculty representatives. However, the AAMC finally decided that rather than have administration and faculty represented school by school, they would try to get their faculty representation from professional organizations concerned with teaching. This led to the creation of the CAS, whose membership now totals 30 distinguished societies.

The preamble to the CAS Constitution states:

> The Association of American Medical Colleges, in order to provide for greater faculty participation in its affairs, has authorized and brought into being this Council of Academic Societies. This action was taken as a response to a broader conception of the role of the Association of American Medical Colleges which was set forth in the 1965 Coggeshall Report to the Association, Planning for Medical Progress Through Education. The specific objectives of the Council of Academic Societies are to serve as a forum and as an expanded medium for communication between the Association of American Medical Colleges and the faculties of the schools of medicine. This forum should serve to enhance faculty participation in the formulation of national policies to provide for the whole span for medical education. The mechanism of communication shall include election at appropriate intervals of representatives to serve on the Executive Council of the AAMC.

As a measure of its influence, the CAS was given representation on the Executive Council of the AAMC. Those who have been interested in fostering and encouraging the growth of the CAS feel that it is a peculiarly well-qualified organization to work with the National Library of Medicine in this important venture, and we are extremely pleased that the CAS should be called upon by the National Library and the AAMC to serve in this capacity.

Objectives of the Conference

Cheves McC. Smythe, M.D.

It has been my good fortune to listen to much of the discussion that went into the planning of this conference. It is my understanding that the conference is not to be about computer-assisted instruction, nor are we here to discuss the potentialities of electronically assisted recall of bibliographic material. The response to the announcement that we are meeting has been extraordinary. More interest has been shown than in many equally or even more significant ventures the Association has launched in the past two years. This response would seem to portray some level of either anxiety or immaturity in medical education for it suggests that to some very difficult questions, simple answers are being sought, preferably without too much hard work, preferably planned and funded by someone else, and preferably not requiring too many changes in old ways of doing things. On the other hand, a large number of medical teachers have exhibited a high level of skepticism which verges into flatly negative viewpoints about what a communications network might accomplish.

The title for the conference mentions potential educational services. With one exception, all of our speakers, panelists, discussion group leaders, and recorders are full-time and experienced medical teachers. This, then, is a conference about medical education. The Library is really presenting us with some questions which have to do eventually with the processes through which students learn and teachers teach, the content of the material learned and taught, and how one goes about presenting it.

When Dr. Cummings spoke before the Council of Academic Societies (CAS) on October 4, 1968, he said, "The specialized information and specialized educational service components (of a biomedical communications network) are in the very early planning stages due to lack of involvement, lack of professional assistance, and lack of guidance from those who will ultimately use this system. It is in these areas that we seek your help particularly."

Thus, the first objective of the conference is that the teaching community become involved with, assist, and guide the Library in planning the third or specialized education component of an educational network. More specifically, this is a planning conference, the exact objectives of which are to initiate efforts toward:

1. Informing a selected group of medical educators of the potentialities of a biomedical communications network;

2. Estimating what aids are not only needed but are most likely to be used by medical teachers and medical learners to strengthen both the process and content of medical teaching as well as to enhance the depth, the scope, and the efficiency of medical teaching;

3. Assessing experiences with the communication techniques already available;

4. Estimating technologies and additional materials necessary to make such a network possible;

5. Taking first steps toward initiating the preparation of needed materials;

6. Educating the medical teaching community in the uses and manipulation of a network once it is created;

7. Initiating the formation of specific task-oriented groups for the solutions of stated problems; and

8. Stimulating individuals to become involved in the attainment of these objectives.

We all realize all of this cannot be done in the next day and a half. However, it is not important to do all of these things but to get started with doing them. If we only begin to define or to study those educational processes which are effective within the very real constraints of the systems being visualized; if we have the courage (or the temerity) to define a floor of knowledge, or a floor of content in any area of medicine; and if we are willing to attempt to evaluate the effectiveness of what we recommend, we shall not be educational dial-twiddlers but will have confronted some of the tougher medical educational issues of the day.

Medicine is being asked to forge a national system. A national system needs a set of standards of performance. Our concern is not with satellites, computers, television, or electronically replaced teachers but with a definition of those educational considerations which should govern the design of the educational services component of a network.

Our contract with the Library calls for producing a report about the conference. The intent of this report will be to translate your deliberations into a series of substantive recommendations on which the Library can act. Therefore, we virtually must have the benefit of your thinking, and we hope that it will be as uninhibitedly critical as you wish. By calling for assistance and what expertise we can muster very early in the process of its planning, the Library is offering to those of us at the conference, the members of the Council of Academic Societies, and to the AAMC at large, not only a challenge but an opportunity, and in addition, a very real responsibility.

Technology in Support of Medical Education

Ruth M. Davis, Ph.D.*

Organization and implementation of technology in support of medical education requires, in most instances, five years. The number of possibilities coupled with such lead times requires that some choices be made. Costs, effectiveness, efficiency, and acceptability are among the many factors which have to be considered.

It is now technologically feasible to provide to all medical school teachers and students a console that they can carry as a briefcase, keep in their homes and offices, and use by connecting to some 20 or more computer systems. They can query these systems for information, learn to program, maintain their own files and use computer-aided instruction, and generate their own movies.

Costs involved in this particular technology would be those of operating computer centers, portable consoles, and transmission and telephone lines. It has been estimated that this would amount to (a) about $45 for computer center maintenance for each individual hooked up to such a computer center (b) about $7 an individual per year for each console, and (c) about $10 an individual per year transmission costs, assuming that average weekly access is thirty minutes. Based on today's medical student enrollment and faculty staffing, the annual cost for this portion of the medical community would be between $4 and $4.5 million.

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It is now technologically feasible to provide computer-aided instruction for medical students in all established medical schools at a cost of about $2 to $15 per student hour for console use that would allow a student access to such computer-aided instruction. One would need $200 thousand to $2 million to develop a one-year's course of one hundred hours of nontrivial instruction.

It is now technologically feasible to carry a microfiche viewer in our briefcases. This would cost about $40. One would also have to carry in his pocket 4" x 6" microcards or the IBM-sized microcards on each of which could be inserted the contents of a 400-page book.

It is now technologically feasible to have a communications system dedicated solely to medical purposes. There are many advantages in this: the network is not dependent upon common carriers; it is cheaper; one can call people when he wants; and television can be beamed from one college to another without having to program it through local educational television stations. Those setting up the Lister Hill Center are now planning for the application of technology to medical education.

The Lister Hill National Center for Biomedical Communications, part of the National Library of Medicine, was established by the President on August 3, 1968 subsequent to a joint resolution by the Congress. Among its functions are application of technology to improvement in biomedical communications, and design, development, implementation, and technical management of a biomedical communications network.

Application of Technology

Technology is essentially a codified way of doing things. The successful application of technology appears to be heavily dependent upon success in several areas. These may be summarized as follows:

- o DETERMINE ASPECTS OF TECHNOLOGY "RIPE" FOR EXPLOITATION
- o PROVIDE MEANS FOR TRANSFER OF TECHNOLOGY
  --movement of knowledgeable people
- o MAKE TECHNOLOGICAL PREDICTIONS
  --provide guidelines for long-range planning and resource allocation
- o IDENTIFY PROBLEMS AGAINST WHICH TECHNICAL APPROACHES ARE TO BE MADE

Successful applications of technology do not generally demand complete understanding of the intended customer community or the social, organizational, or other processes involved. Much technology is based on systematic theoretical knowledge which is science, much on practical knowledge which can be called engineering, and some on experience. In addition, technology can be characterized by a "time-specificity" product. The shorter the time scale on which "research" can likely find an application and the more specific the domain of application, the more "technology-oriented" and the less "research-oriented" is the technology in question. Certainly in the spectrum of technology available to medical education, the time-specificity product for each proposed application is one of the principal measuring sticks or indicators that a responsible technical group must determine.

The technologies that figure most frequently when discussing changes in education are communication technology and computer technology. The coupling of computers with communications is a presage of a new technology whose product is the extension of man himself in time, in space, and in intellect.

The technology that permits decentralization of education controls, more geographical independence of educational institutions, removal of geographical constraints on quality of education, better accessibility to technology itself, more individualization of learning, lessening of economic burdens on educational institutions, and a better cost-output ratio for educational institutions will be the needed technology. It in no way presupposes the form of the educational institution of the future: it assumes that teaching, learning, and planning are all part of the educational process. This technology is that of computers, communications, computer-communications coupling or networks, and systems analysis.

Technology in Medical Education

Proceeding from the general to the specific, it is useful to concentrate on the problems of transfer of technology to medical education, and, more particularly, on medical education as a formal process within medical schools. Any technology predictions must include predictions about the environment into which the technology is being introduced. Certainly, the education community including that of medical education has historically been adaptive rather than creative in its application of technology. The Lister Hill National Center for Biomedical Communications is intended to make possible the application of technology to medical education on a nationwide basis and with the interests of the entire community being served most economically and effectively.

Training in the new technologies, therefore, becomes training in present technologies and can be given a high probability of success. Application of technology to medical education for the next three to seven years will be dominated by introduction of existing and near-developed equipment and correlative software.

Protype Network

The first phase of the Biomedical Communications Network has always been considered to be a manageable set of already existing local capabilities linked together in such a way as to reach a selected user community. A crucial step in establishing this initial prototype is the formulation of procedures and criteria for determining the kinds of information and local capabilities to be linked together. We have formulated such a set of procedures and criteria for the Biomedical Communications Network and are using it in our approach to evolutionary system design. The steps involved are to:

1. Gather information on existing biomedical communications systems.

2. Screen known systems to identify those of broad enough interest to the medical community to justify inclusion in the network.

3. Determine the technical and economic feasibility of including in the prototype network those systems which have been identified as being of broad interest to the medical community.

4. Connect selected systems into the prototype network on a pilot basis for experiment and evaluation in actual operation.

5. Obtain an assessment or evaluation of pilot systems based on user responses and operational experience.

6. Recommend modifications of selected systems on the basis of the evaluation of the performance in the prototype network.

7. Assess or evaluate the resultant prototype network after system modifications have been completed.

In this system design process, the Lister Hill Center is already relying heavily on the medical community for information on candidate systems, identification of those systems with national significance, and evaluation of user response to system operation. We plan to have formulated a fairly firm list of systems selected for inclusion in the prototype network by the medical community by the middle of 1969.

Although several systems are currently under active consideration, no system has yet completed the entire 7-step system design process. Three examples will illustrate application of the process and the scope of the systems being considered for the prototype network:

Wisconsin Dial Access System.--This is a library of some 270 five- to six-minute tape-recorded medical-subject lectures which Wisconsin physicians can access by toll-free direct dial telephone from any point in the state. It is a prime candidate for inclusion in the prototype network. The system is oriented principally to providing the physician current medical information for use in the management of emergencies and specific patient problems. The Lister Hill Center had identified this system as a candidate in November 1967, has studied the system thoroughly, and with the cooperation of the University of Wisconsin Medical School, is now weighing technical and economic feasibility factors and designing the specific methods for linking the Dial Access System into the prototype Biomedical Communications Network so as to extend the tele-lecture concept to a vastly increased physician population outside Wisconsin. We hope to effect the linkage and commence the experimentation and evaluation phase of the system design process during early 1969.

Community Medical Television System (CMTS).--This is a network of Atlanta hospitals and medical teaching facilities linked together by television for broadcasting medical educational materials and conducting conferences. The system has already been subjected to some of the system design processes outlined above. The Lister Hill Center has established liaison with the Regional Medical Program and is arranging to have the CMTS assessed to determine its realistic potential for wider audience use through inclusion in the prototype Biomedical Communications Network.

SUNY (State University of New York) Network.--This is another local development being considered by the Lister Hill Center for linking into the initial phase of the Biomedical Communications Network. The present SUNY

Network consists of 6 medical libraries in New York state, NLM, and Countway Medical Library at Harvard. The data base available through the terminals on this network includes the bibliographic citations from the NLM MEDLARS file and the Current Catalog file as well as citations to publications held by only the SUNY institutions. In addition to its use for the on-line retrieval of citations, the network is also being used to support a cooperative cataloging program among the libraries at Syracuse, Harvard, and NLM.

The NLM is planning a Biomedical Communications Network of 5 major components:

1. The library component provides library services in the form of bibliographic references or actual delivery of documents or abstracts.

2. The specialized information services component delivers actual information on questions or problems of biomedical importance.

3. The specialized educational services component delivers educational services to medical audiences.

4. The audio and audiovisual services component delivers audio and audiovisual materials to a wide variety of medical and lay audiences.

5. The data processing centers and data transmission facilities support the above components.

Communications Modalities

Application of computer technology to medical education appears to be in a formative stage. The uses of computers have been essentially adaptive. No directed technology-oriented research or development programs have been undertaken against specific objectives or problems of medical education.

Although the communications revolution includes all the technologies used for the transportation of information, the electronic technologies provide the main thrust and direction of the revolution. Electronic communications technologies are interesting, simply because of their speed, versatility of application, and their flexibility; however, the real excitement and potential for greatest change lies in combining electronic communications with the digital computer. An important factor underlying the communications revolution is the development of machines that communicate with each other. The interesting point in this trend is that it will result in the development of a mammoth network of computers and information banks; this network, resembling the present common-carrier telephone network, can be accessed by a simple wire connection from home or office.

Institutions of higher learning will serve 3 essential roles with regard to communications and computer technology:

1. They will develop systems and conduct experiments that will extend the technology.

2. They will study and formulate philosophies and plans for assisting society in its adjustment to the new technology.

3. Most importantly, they will use the technology to improve the effectiveness of their programs of instruction.

Computers and communications technologies are already being used on a fairly broad scale in university management and scientific activities; however, we visualize pervasive developments which will encompass virtually every university function. We expect manifestations of these technological developments in the information-education enterprises of (a) inscribing or encoding information, (b) ordering or organizing information, (c) preserving or storing information, (d) recovering or retrieving information, (e) transforming or interpreting information, (f) reading or scanning stored knowledge, and (g) developing the uses and applications of knowledge.

Television is undoubtedly the single most important communications medium available to higher education today. The applications of television in higher education are already numerous and are continuing to increase. The real problem with television is not the technology but the development of program materials which are worth televising. As educators become more experienced in the use of television and as the number of multimedia facilities grows, there should be a significant surge in the educational utilization and expansion of television technology. It is difficult to see how such a trend can be avoided if higher education is to successfully meet the challenge of the student who has literally grown up on television.

Although there are other elements of communications technology involved in higher education, we have treated here only those few developments which offer the greatest potential for revolutionizing educational practices and changing the society with which college graduates will interact.

In communications technology, as in other technologies, the medical education community has assumed an adaptive role. Medical schools and their parent institutions have separately decided what communications modalities they want to experiment with or use. Although we have been unable to locate an authoritative, current, and comprehensive inventory, the best data available in February 1969 shows the following match of medical schools with communications modalities (1):

Communications Modalities	Number of Medical Schools Existing	Number of Medical Schools Planned
Closed-Circuit Television (CCTV)	22	3
Educational Television (ETV)	15	2
Two-way Television	2	-
Foreign Exchange (Telephone) Service	15	-
Tie-Line (Telephone)	16	1
TELPAK (Telephone)	16	-
Dataphone	7	-
Radio Station	2	-
Wide Area Telephone Service (WATS)-Outward	24	2
Wide Area Telephone Service (WATS)-Inward	3	2
Microwave (Private)	4	-
Teletypewriter Exchange Service	26	1
Private Line Telephone	16	1
Wide Band Service	4	2
CENTREX	4	3
Federal Telecommunications System (FTS)	2	-
Voice Net	1	1

Discussion of communications modalities or transmission means is best separated from discussions of the communications media now available or feasible for educational purposes.

Communications Media

Communications media (2) will be identified here as educational television (ETV), instructional television (ITV), motion picture films, listening laboratories and audio tapes, programmed instruction, mediated self-instruction, computer-assisted instruction (CAI), special multimedia facilities, telelectures, simulation, computer-animation, and computer-assisted group communications.

As is evident "media" involves not only what is normally deemed media in the dictionary sense but also media-oriented facilities and media-oriented techniques. This impreciseness of vocabulary does degrade clarity of thinking but is understandable and tolerable at this stage of development of educational technology.

Consideration of microwave transmission as contrasted to cable transmission involves primarily engineering and cost factors. One has to introduce parameters of distance, landscape obstructions, attenuation, interference, cost per customer per mile, multiple usage, bandwidth, frequency, and the like. Considerations of media as 16mm film vs videotapes or 8mm single concept film should center around such factors as purpose of use, cost of generation, cost and maintainability of equipment, costs and means of reproduction, ease of selection, and compatibility with planned techniques of teaching and learning.

In both cases, i.e., that of modalities and that of media, the role of computers enters and in many instances is a controlling factor in decisions. Computer considerations dominate discussions of CAI on computer-generated movies. Communications networks to permit sharing of educational information banks or programs are often dependent on the availability of computers to manage network operations. In the case of CAI, the coupling of computers and communications is essential. In the case of computer-generated movies it is not.

One must, therefore, in planning the applications of computer and communications technology, disentangle the several aspects and vocabularies which figure in any decision. One of the problems presently is the multiple usage of the same set of words to convey a variety of meanings. This is simply a manifestation of the "newness" of educational technology or of the merging of technology and education into a separable entity attempting to identify itself as a separate "science" or "profession."

In presenting one of the most important potential applications of technology to education one is again confronted by a problem in semantics. The technology in question is that which predicts the intellectual, the equipment, the substantive, and the management needs of medical education. It then measures these needs in terms of all the types of costs involved, the technology involved, and the resources required. Finally, it presents a time-phasing of products in terms of benefits, costs, experimentation and evaluation inputs, and customer interaction. The general objectives of this technology are to generate a sense of direction of intelligent, effective choice and a sense that evolving capabilities and evolving values will move hand in hand.

This technology of dealing with the future has as yet no accepted name. The techniques themselves, which are apt to be called systems analysis or systems planning, are now widely used both with and without help of computers. Cost-benefit or cost-effectiveness analysis is a major ingredient of the new techniques; this involves ways of arraying ends and means so that decision-makers have clearer ideas of the choices open to them and better ways of measuring results against both expectations and objectives.

Among characteristics of the new pattern are these:

1. A more open and deliberate attention to the selection of ends toward which planned action is directed, and an effort to improve planning by sharpening the definition of ends;

2. A more systematic advance comparison of means by criteria derived from the ends selected;

3. A more candid and effective assessment of results, usually including a system of keeping track of progress toward interim goals. Along with this

goes a "market like" sensitivity to changing values and evolving ends;

4. An effort, often intellectually strenuous, to mobilize science and other specialized knowledge into a flexible framework of information and decision so that specific responsibilities can be assigned to the points of greatest competence;

5. An emphasis on information, prediction, and persuasion, rather than on coercive or authoritarian power, as the main agents of coordinating the separate elements of an effort; and

6. An increased capability of predicting the combined effect of several lines of simultaneous action on one another; this can modify policy so as to reduce unwanted consequences, or it can generate other lines of action to correct or compensate for such predicted consequences.

Any desire to apply technology in support of medical education within medical schools must be sharply focused if it is to yield productive results. A variety of functions which can be served include (a) assistance to the teacher in designing a course curriculum, obtaining substantive material for a course, in the process of teaching large classes to obtain adequate teaching or demonstration facilities, individualizing instruction, obtaining training in changing education technology, evaluating the teaching process, continuing his own medical education, and evaluating students' performance or students' learning; (b) assistance to the student in selecting a curriculum, obtaining substantive material for courses, improving his learning process, speeding up his formal education, evaluating his own performance and his learning ability, doing research and/or experimentation, and becoming familiar with needed technology; (c) assistance to the administrator in determining long-range objectives, planning for accomplishing stated objectives, determining needed physical facilities, evaluating the organization's performance and product, assessing resource allocation and funding plans, and meeting community needs; (d) assistance to the professional supporting staff in meeting the resource material needs of the teacher and student, obtaining the needed number of computer console hours per student, meeting the AV programming needs of the teacher and student, properly locating facilities and equipment, and evaluating their support; and (e) assistance to the external supporting community in providing the proper media such as microfiche or Xerox copy, videotape of 16mm film, providing the proper message, meeting technology gaps, and providing needed communications channels.

Controls on Technology

Technology should have as one of its goals the provision to man of more of the means to control his own destiny. The word "control" has indeed been given high visibility in the last several decades. Fears of technology have been expressed as fears of a "controlled society," fears of "computer-controls," etc. Such statements are rather a direct manifestation of society's realization of the impact that technology has on control. One should perhaps organize an effort aimed at the application of technology to education around the types of controls that should be provided to the several customer groups involved. A possible first structuring along such lines yields:

TEACHER CONTROL OVER:	content and generation of course material teaching and testing procedures used evaluation of material and procedures available
STUDENT CONTROL OVER:	selection from available means of presentation of material pace and place of learning feedback to teacher time and place of access to resource material
ADMINISTRATOR CONTROL OVER:	planning to meet needs of community and profession resource material facilities such as libraries school objectives and means to attain them evaluation of school performance quality of teaching

Such a structuring permits the separation of needs of the learner from needs of the teacher and both of these needs from those of the administrator. It is advanced as one means of demonstrating the feasibility of applying technology to enhance rather than to detract from the roles of the individuals involved in the education process. Any other objective would seemingly depart from sound principles of technological prediction.

Technology applied without some focus on function and on audience can neither be directed nor evaluated. Nondirected technology cannot be adequately planned or funded. Technology that cannot be evaluated denies satisfaction to its sponsor and to its user. Technology without an audience or a function to be served is uncontrollable. Technology should either satisfy or improve its customer.

Technology can either be self-applied or externally applied. There appears to be a need for both in medical education. The design of curricula, substantive course content, and teaching methodology is normally the prerogative of the school. It is of course affected by external requirements of the medical community as manifested by professional societies, accreditation boards, and the like. But it is a day-to-day responsibility of the medical school.

This technology can be characterized by a set of instructions for the teacher suggesting means for utilizing the various building blocks of the Tinker Toy set: it provides a directory of available services. These services can include student consoles connected to a central computing facility available on site to the teacher with certain programmed capabilities; they may include a listing of 8mm single concept films with one 8mm film provided which explains how to use 8mm single concept films. The Tinker Toy set includes a possible console for the teacher which can be plugged in at home or in the office and a set of instructions on how to use the console and whom to call if the console doesn't work or the instructions aren't clear. The listing of services available from the console includes access to educational resource center information banks and to medical and bibliographic information banks.

In addition, training aids for the teacher are an essential ingredient in any self-application of technology. The subject of teacher attitudes and acceptance of new media has been dealt with voluminously. It suffices here to simply inject representative quotations on the subject (2):

> Faculty members have long-standing and firmly established attitudes and value judgments about methods, procedures, and techniques of teaching. These attitudes and opinions are often in conflict or inconsistent with attitudes that are necessary for uses of some kinds of new educational technologies. Changing such attitudes may be as difficult as developing new instructional and learning performance skills. Three lines of activity will provide a minimum approach to these changes:
>
> Faculty and student training and development programs in instructional performances are necessary for the introduction, acceptance, and use of new kinds of education technologies.
>
> A rational educational and information approach is also necessary for restructuring the attitudes and value judgments of students.
>
> Administrators, responsible government officials, leaders in professional content fields, and the general public need to be thoroughly informed about programs and uses possible through new educational technologies.
>
> But perhaps the gravest of all problems connected with the use of instructional television is the difficulty encountered in obtaining full participation and involvement of the faculty in developing and extending its potential. The contribution of television to college teaching is far from automatic; it is not a gift of the machine. Rather, it requires the energetic cooperation of a human teacher. There is at present no satisfactory technique to stimulate and to reward the effort that faculty members will need to make if they are to restate their behavioral objectives and recast their plans to bring about the marked improvement that television permits. Film and radio have fallen short of their maximum instructional potential for much the same reasons. Will higher education now be able to rise to the challenge of learning to cultivate the rewards of televised instruction?

Conclusion

The role of technology and the role of the Lister Hill Center are conditioned by certain facts about communication, your knowledge of medical education, growing appreciation of technology, identification of your needs, and filling in human deficiencies. The Center needs you to provide the guidance that will allow the optimal applications of technology. The territory is new. It needs both conquerors and colonizers; both must be in this room.

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What Is Needed and What May Be Consumed

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There is a very reasonable question as to whether the National Library of Medicine should properly concern itself with the impact of these new technologies in the transfer of information. So much needs to be done to optimize the handling of the traditional printed materials, starting with such simple things as trying to preserve the books that are now rapidly rotting because they were made with acid residual sulphite paper and developing microcopies of volumes not readily available. In the face of these kinds of needs, why become involved in information transfer mechanisms for which there is no expressed need and for which there is no model to which one can turn to demonstrate use value?

Rightly or wrongly, the policy has developed that the function of a library is to manage information transfer in such a way that it is optimal for the user and that a library as such has no social value, its value being entirely derivative from the uses to which it is put by consumers. To the extent that it is technically feasible, whether by hiring station wagons to haul copies more rapidly between libraries or by going to the most sophisticated kind of technology, the library should be concerned with all modalities of enhancement of information transfer.

Today there are 2 problems that must be dealt with. The first is trying to optimize what we are used to doing, and the second is trying to find new means of resolving problems that are not well approached by our traditional

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efforts. What is most needed are more effective ways of resolving some of the problems of medical education--the primary and the continuing education of the physician.

Urgent Demands

1. Our present educational system is not producing the number of physicians that this country needs. There is high anxiety in every faculty in the United States about the implications of the press for numbers, about whether quality can be continued in the face of numbers, about whether the existing pattern of education can be expanded, and about whether shifts of faculty activity that would be detrimental to research are required. Yet, the problem remains. The unique resource, the unique social institution in the United States for providing physicians, is the institution of medical education, and it is quantitatively failing. One either gets alarmed by this kind of observation or not. It is possible that some immediate effect may be had by applying new technology to our educational process with the objective that we begin to erode this terrible and pressing problem of numbers.

2. The medical student body is grossly unrepresentative of the economic and ethnic background of the people of the United States. This country faces a most serious social crisis whose resolution requires making equally available to all segments of our society the finest of the advantages that we have to offer. One of these is the opportunity to study medicine. Present inequality of access has a great deal to do with the kind of preparation that a student brings first to college and then to medical school. We are optimized in our educational processes for dealing with commonalities in students rather than with differences. If students do not meet the standard that we have set in common, then they are extruded from the system. This is a luxury we can no

longer afford from the pure social responsibility of giving wider access. Our present modes of instruction and evaluation are inadequate to this responsibility. The cost of the individualized tutorial effort by faculty members to remedy these accumulated deficiencies is too awkward and too expensive to deal adequately with the problem. Yet, the problem remains. New technology can be helpful in solving it.

3. The quality of medical education within existing and developing medical schools is uneven. We talk of, and we live by, a set of quality educational standards that are not available to all of the medical schools in the country. We get deeply concerned about potential erosion of our quality, and yet when we look at our 100 medical schools, we must admit that we have not established nor provided for that high quality in all of those schools. This is an urgent problem that we must face openly. New technology can improve distribution of educational resources.

4. An exquisite academic manpower deficit exists which increases with the evolution of each new special realm of knowledge. To illustrate, an anatomy department once was a fairly simple thing. Now the range of special competencies that must be present in a quality department of anatomy is a demand upon our manpower resources that really is quite unprecedented, and the present production system is not meeting the demand. This is replicated all the way through our faculty, and even the narrowest subspecialty needs a whole task force of supporting specialists. Is it really a reasonable goal of each faculty to be self-sufficient? Cannot improved communication overcome the need for geographic intimacy?

Potential Solutions

A communications center might possibly be useful for the survival of our present educational system, in which we are all involved and to which we are dedicated. Number of physicians, equality of access to medical education, distribution of educational quality throughout the system, rationalization of the health care team, control of educational costs, and provision of enough academic manpower, if left as unresolved problems, will require the development of an alternate means of providing education for health care. The problem is survival.

What is needed? What is needed in the use of this new technology is no different than what is needed in a general solution. That is to say, there are no goals peculiar to this new technology. We do not have to find new things to work on; we have to recognize the issues that confront us now and determine how best to utilize these new information transfer techniques to resolve these issues. Right at the heart is goal-directed learning for the student and the development of relevant qualification examinations. These qualification examinations may be internal, expressing the standards that we set as faculty. They may be survival kinds of qualification examinations to secure a step to a degree, or qualification examinations in a technical sense for licensure, or qualification examinations in a specialty.

The core curriculum.--Qualification examinations need to be more closely related to planned learning experience and the presentation of cognitive material. This is called the core curriculum. This core curriculum is not some intellectual fantasy; it is what a student must master in order to get where he wants to go by passing qualification examinations. We need to conceive of a closer relationship of this core to qualification examinations. This, in turn, suggests there is a kind of commonality that recommends the centrality of a system. If our qualification examinations are generally comparable, as they are imputed to be, then there must be generally comparable bodies of materials whose mastery meets those qualifications. There must be some body of information which is held in common if qualification examinations give common access to professional responsibility. All of us realize that any examination is incomplete and that it represents only one element of what is necessary to assert qualification. But surely the core is there even if we have not defined it well. We have traditionally felt that it is intellectually undignified to present material out of concern for qualification examinations. This is a kind of self-indulgence that may be too costly to continue. New technology can be a valuable asset to developing information cores and their related qualification examinations.

Clinical relevance of basic science.--Clinical relevance is extremely important to motivation for learning. Medical students by and large wish to be physicians, and by and large that is what they turn out to be. It is not the business of many of our faculty, particularly those in the basic sciences, to concern themselves relentlessly with the clinical relevance of the basic sciences. But that relevance is why the student is learning them. It should be possible to relieve some of the pressure for each teacher to provide examples of relevance with materials available from a central information resource. Such a central resource should be accumulated from a variety of local inputs. Students do not perceive the clinical relevance in the first two years of medical school. There is a proper reluctance on the part of the basic science faculty to cut the cloth of its discipline to a form foreign to it, but for the student of medicine it becomes the essence of his learning.

Individualization of instruction.--The medical schools are moving slowly and cautiously, but steadily to the recognition that medical students are individuals--unique, separate, and complete--each one different from the other. This has enormous implications for the kinds of educational materials that should be presented to each of these individual students. With the recognition of individuality, with the permissiveness that allows some early concentration according to the student's entrance level, and with the introduction of large bodies of elective materials, a faculty needs access to resources which may not be held within it. The faculty of a school that has 50 students is not the same as the faculty of a very large school. And yet, the student has the same rights and privileges for intellectual development in the first school that he has in the school with the larger and broader faculty. There does, then, seem to be within acceptance of individualization a requirement that we share across school lines for the sake of student-oriented individual interests.

Use of Information Network

Qualification examinations, core curriculum, clinical relevance, and individualized effort (both in early specialization and in electives) have been described as areas in which an information network could have much to offer. There is also the general problem of scientific explanation of phenomena at the clinical level. This can be a very time-consuming and difficult problem that converts grand rounds into shifting dullness as the harassed attending goes on and on into the explanation of a clinical phenomenon in basic science terms. This kind of scientific explanation has a high redundancy in it because the set of illustrative clinical conditions which lend themselves in each of the special areas to completely satisfying scientific explanation is small. These explanations can be shared.

Student goal-directed learning needs to give the student a strong feeling of the relationship to what he will do when he leaves medical school. What he will do when he leaves medical school is not to go into practice. He will enter four or more years of formal hospital training. Therefore, it is this interconnection that we need to be concerned with rather than the anachronistic notion that in medical school we are training people to enter practice. We are doing no such thing; we are training them to enter at least four, or typically more,years of hospital work.

There are some students in need of remedial work if we are going to provide the kind of social equality that has been referred to. Some others are going to have to be admitted to advanced standing unless achievement already made is to be wasted. There is no way at this moment to recognize with confidence the level of achievement of students and even less an ability to predict his capacity to adapt his subsequent instructional experience optimally.

These are among the very broad problem areas that an information system could address itself to.

The faculty must concern itself more formally with the hospital phase of the education of the physician. This is in contradistinction to the purely departmental responsibility. This hospital phase of medical education is now only nominally related to the "medical school" or the "medical faculty." It is prototypically the responsibility of the department or a subsection of that department. Furthermore, what is done in the hospital phase is very badly related, either to what went before or to what will follow in practice. Pediatricians have been most concerned about asymmetry between hospital and practical experience. Ask your best house officers to describe the relationship between their medical school experiences and their responsibilities as house officers. There is a rich and untouched field of endeavor within our faculties to do something about this problem of the clinical phase of training. It is no longer a sequence of instructions about where you cut and which pill you push. It is, in fact, an effort to bring objective scientific explanation to the phenomenon of the patient in the clinical setting. At this level we do have a kind of commonality confronting us, because each person who moves from a residency program to the community is the equivalent in responsibility to each other person who has finished a program in another setting. This is a kind of commonality that recommends itself to exploration of a common system of periodic self-evaluation and broad communication. The likelihood is that if we are to meet the needs of the physician in the community for his continuing education, it is going to be by the utilization of new technology of information handling. If the physician in practice is going to be able to utilize these new technologies optimally, he must learn to use them optimally while he is a medical student and while he is a resident. There has been all too little concern in medical education with whether the modes of instruction used in the formal phases of medical education are indeed available and applicable to the physician in practice. Except for the reading of a journal, most of them are not. It is not possible for the newly finished resident who goes out into the community to continue to benefit by the modalities of self-improvement to which he has become accustomed in his university-based residency. It is urgent to explore the application of these newer modalities because they are the ones that are likely to be most important to the practicing physician in the future.

These are new modes of information transfer whose utility has not been explored. After a full and conscientious exploration, it is theoretically possible that we may come to the conclusion that they are not useful. But it is not logically possible to come to this conclusion until a full-hearted effort has been made to address these technologies to the solution of highly defined problems. No one is yet in a position to make an informed expression as to their utility.

Summary and Conclusion

We are indeed faced with many problems in medical education. Ours are the problems of success. Our product is in enormous demand. We are like so many of the craft industries that had great difficulty surviving because of producing articles so highly desired that the early craft mechanisms of production no longer sufficed. Some crafts under this pressure died, and it may be that this is what is going to happen to our way of medical education. It is a very real possibility that our classic academic medicine will become one of the liberal arts, while somebody else takes care of people. On the other hand, we can adapt our insights into quality to utilizing technologies that are now foreign to us. I earnestly hope that we can. If we are to discover anything about the utility of an information network, we must tie our efforts to specific goal-directed learning and the solution of very highly defined educational problems. We cannot learn anything if we define our efforts so generally that evaluation of success is impossible.

Tomorrow's Medical Student

Daniel H. Funkenstein, M.D.*

Tomorrow's medical student must be viewed in the context of both yesterday's and today's students. In this analysis, the students now in medical school will be compared to those now in college who aspire to medical careers. One can go no further than this because we do not know what will come after them.

During the 20th century, medicine has gone through four eras, and in each of them the principal role of the physician has been distinctly different.

The General Practice Era 1910-1935

Modern medicine dates from the Flexner Report in 1910 which brought science and clinical research into the medical school. Preclinical science was taught in the first two years and, although not much was known, what was known was directly relevant to clinical medicine. The ideal physician was in the great tradition of Osler. He was a general practitioner, very much interested in science, in the personal and family components of the patient's illness, and not too concerned about whether the entire community was getting care. Although he did devote a certain amount of his time, without charge, to taking care of the poor, this was seen as a charity endeavor. During this era, the chief role of the physician was that of general practitioner and his social responsibility was defined as the art of medicine, meaning attention to the social, emotional, and family aspects of the individual patient's illness.

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The pragmatic use of science was included in this definition but was less important than the art of medicine. The characteristics of this period are diagrammed below.

Objective	Generalized Education
Curriculum	All Students study same subjects; Science in first two years related to Clinical Medicine
Extracurricular	Sports, fraternities, dating
Faculty	PATIENT CARE and TEACHING; Research
Student-Characteristics	Student-Clinician
Student-Faculty Relationship	Master-apprentice; Junior Colleague
Role Model	Clinician in Osler Tradition
Summer	Vacation; Work in Hospital
Family Background	Professional or affluent
POSTGRADUATE EDUCATION	Internship: Rotating, then practice 1910-1935 Residency: Specialized 1935-1959

The Specialized Practice Era 1935-1959

In the late thirties, medicine began to change. More scientific information became available as the result of astute clinical observation and research, largely at the bedside and in the operating room. Certain doctors began to develop great skill in certain aspects of patient care, and it became obvious that no one individual could know enough to be a highly competent physician. Thus began the rise of specialization. The boards for the certification of specialists were founded, residencies in specialties became the order of the day, and the decline of the general practitioner began. The era of clinical specialization resulted in improved technical aspects of diagnosis and treatment, but the increased emphasis on knowledge resulted in less attention to the art of medicine. Then, too, most patients with complicated problems were referred by general practitioners to specialists who referred them back to the referring physician who continued to practice the art of medicine. The role of the physician changed to that of clinical specialist, and the social responsibility of the physician was defined as a high degree of competence in his chosen specialty. The characteristics of this era are diagrammed below:

<u>COMPETENCE</u> — Specialization with increased skills based on clinical experience and clinical research

<u>Pragmatic Use of Science</u>

Art of Medicine

prevention by biological techniques

<u>ROLE MODEL:</u> — <u>SOCIAL RESPONSIBILITY:</u>

Clinical Specialist — <u>Competence</u> in a specialty

<u>The Scientific-Technological Era 1959-1970</u>

In 1948, medical schools, society, and the government decided that in order to solve many medical problems, research in the sciences underlying medicine must be increased. This resulted in the founding of the National Institutes of Health, the availability of foundation funds for research, and the campaigns to raise funds for medical research by societies such as the March of Dimes and the Heart Fund. Vast sums were expended for research in medical schools, and with the discovery of DNA in 1953, rapid advances began in molecular biology. It is naive to think that this change was due to the availability of government funds alone. It was related to the convergence of many forces that can only be understood in the term that the "time was ripe" for this development.

Although clinical medicine benefitted from this research, the more spectacular advances were made in the laboratory sciences unrelated to clinical medicine. This was justified on the basis of promising great advances in "curing" diseases in the future. The reaction to the launching of Sputnik in 1958 caused an acceleration of the research trend and many opportunities became available for students at all levels to do research. The increased research in the basic sciences became not only a part of the medical school but also a part of the hospitals affiliated with the medical schools. The basic sciences became more basic and were being increasingly taught in other parts of the university. The preclinical sciences were no longer preclinical. Graduate schools in the same universities as the medical schools also pursued this type of research, whereas in the previous era, all medical research was confined to the medical school and its hospitals.

In background, the students came from professional and educated people. After internship they went on to a residency and many to a postdoctoral fellowship. By 1965 about 50 percent of the interns in the United States had such plans.

As a consequence of these changes, much of the science taught in the first two years of medical school bore little relevance to clinical medicine. It was now necessary to become a scientist and to do research to become a good physician. The attitudes, methods of approach, and new knowledge of the scientist improved the diagnosis and treatment of disease. The role of the physician was that of the academician who spent 30 percent of his time with hospitalized patients often with rare diseases and 70 percent of his time in basic research with little interest in the art of medicine or the community.

The social responsibility of the physician was to be a scientist doing research. The characteristics of this era are summarized on the following page.

Objective	Highly Specialized Scientist: RESEARCH, Patient Care; teaching ACADEMIC MEDICINE
Curriculum	1. All students study same curriculum 2. Research in free time 3. Division of first two years into basic sciences with little relevance to medicine taught by basic sciences faculty 4. Preclinical sciences relevant to medicine taught by clinical faculty 5. Omission of some areas of preclinical sciences relevant to medicine
Faculty	RESEARCH: Consultation; teaching
Student-Characteristics	Student-Scientist
Student-Faculty Relationships	Distant except on research project; proselytizing; Dean of Students and Psychiatrists
Summers	Research
Role Model	Physician-Scientist in Academic Medicine 30% time with patients; 70% research
Family Background	Professional, educated, affluent, and middle class
POSTGRADUATE EDUCATION	Internship: Straight Residency: Specialized Postdoctoral Research in Basic Sciences

The Community Era 1970-

The dawning of the community medicine era is now here and is the result of the convergence of many forces. There is a tremendous concern for the community and for the delivery of medical care. Other forces include demands by students for more attention to the admission of minority group members and the delivery of medical care to all segments of society; the demands by the community for more, better, and different health services; the government financing of health care by the medicare and medicaid programs; and the changing emphasis by foundations away from research in natural sciences to medical education and the delivery of health care. The administration of most medical schools is concerned with trying to get the delivery of more medical care by various ways, but most of the faculty is still involved in the scientific research area, and patient care is concentrated in the hospital. The curriculum is becoming less specialized in most medical schools. Sixty are changing, and 40 more are said to be ready to change. Extracurricular activities are not sports but working in slums and settlement houses. The students are rejecting the medical academician as a role model. A large number also reject the practitioners in the community because of their conception of his lack of concern for giving care to all segments of society. The features of this era are summarized below.

	Administration	Delivery of medical care
Objective	Faculty	Scientific research; patient care concentrated in hospital
	Students	Delivery of Medical Care; Student Health Organization; Student AMA
Curriculum	Multitracked; specialization in medical school	
Extracurricular	Working in slums; settlement houses, politics	
Faculty	RESEARCH: Consultation, teaching	
Student-Characteristics	Marked Diversity with common core of interests in patients and delivery of care in community at large	
Role Model	Rejection of medical school professors and community practitioners. Generation Gap	
Summer Activities	Summer projects in slums; hospital work	
Family Background	Educated and affluent. Plans for Disadvantaged	
POSTGRADUATE TRAINING	Internship: Straight: Eliminated?	
	Residency: Shortened due to specialized medical education	
	Payment for services rendered	
	Programs for delivery of care	

Today's Medical Students

The impressions to be described are based on data gathered from a large group of medical applicants to and men admitted to medical schools at such universities as Harvard, Vanderbilt, Colorado, and the University of Michigan. The years mentioned refer to the expected date of medical school graduation for the cohorts described.

Among the changes from the late 1950s to the class of 1971 are almost total absence of premedical concentration in college, a large increase in biology majors, a very large increase in chemistry majors, a few physical scientists such as engineers and physicists and mathematicians, and not so many students in the humanities. The students who have been coming to medical schools recently are highly specialized individuals.

Of the class that entered in 1958, about 5 percent had had graduate courses in the sciences but ten years later, toward the end of the scientific era, almost 25 percent of the students admitted to medical school had studied science at the graduate level. The conclusion that is about to be described that entering medical students' interest in science is waning is derived from such background data as these. In addition there is the political fact that the draft of graduate students in sciences has come about, the lack of any increase in science funds, and the change in emphasis by the foundations and the government toward funds from scientific research to the areas of health care and of education.

The aspirations of applicants to medical school have changed. A tremendous number now seek a career in practice in the community. A study of a pool of about 1,500 applicants to Harvard, most of whom are now in medical school, shows that in ten years there has been a shift from a majority pointing to academic medicine to less than 5 percent recently. One gathers the same impressions from students in colleges all over the country. Even the students with Ph.D.s and recent recipients of other degrees who come to medical school want now to practice in the community. The physics Ph.D. and the molecular biologists are coming in large numbers to medical schools or to urban studies and city planning. Their hope is not to apply their science to biological research. There is a marked decrease at Harvard, MIT, Yale, and Princeton in graduate school applicants in the sciences for next year. In biochemistry, for example, the application rate is about half of the previous levels. Conversely, there is a 2,000 percent increase in applicants for urban studies and city planning at MIT. Applicants for the study of economics have doubled as is true of government. The emphasis is again on the community.

Some deplore this shift of attitude. The natural sciences are facing difficult times. Dr. Weisner of MIT thinks the changes are good. On the other hand, there are enormous problems in the society. The attraction of these issues for the best minds of our time should be seen as a salutary change and a source of optimism.

It should be noted that psychology is not prominent among the areas of concentration for the large number of medical school applicants who have majored in the social and behavioral sciences.

Changing Areas of Major Interests

The results of areas of interest tests are also changing. When students are asked to indicate primary interests in either people and service, science, or human behavior, most will check only one major interest. In the class entering Harvard in 1958 interest in people and service was high and in science low. Five years later this had reversed, with interest in science dominant. In other words, the students were responsive to the changed environment of the medical school in the scientific era. This incidence of attitude has persisted until very recently, when interest in science began to wane rapidly, interest in people and service to increase slowly, and interest in human behavior to soar.

There is another change in today's students. In past years their interests were relatively pure or narrowly focused. Those who were interested in science were interested in science, or those who cared about people and service cared only about people and service. Today, however, we find students who combine science with an interest in human behavior or combine being a scientist with being a person who wants to work with people.

The increased interest in human behavior is not in psychiatry. The number of students prepared in psychology or psychiatry had increased in the sixties, but there is a dramatic fall in these interests in the students now entering medical school. As sociology, social psychology, anthropology, economics, and government are all thought to be more relevant to the practice of medicine in the community, these areas have become attractive. Psychiatry is not included.

In the future there will be greater diversity among students. They will come from all segments of society, and all medical schools are making a large effort to find such students now--not only blacks but from all those backgrounds which have become conspicuous by their absence.

In preparation for the study of medicine, there will be increased interest in the social and behavioral sciences, economics, sociology, and cultural anthroplogy. There will be decreased interest in biological and physical sciences not directly relevant to clinical problems. There will be a marked shift in biology in college, and the balance between molecular biology, organ systems, ecology, and ethology, will change. Note that the Ford Foundation is now going to put a very large sum into chairs in ethology in colleges. At

Harvard there has been almost nothing in biology but molecular biology, but now courses in ethology, ecology, and organ systems control are being introduced.

In terms of career plans, there will be increased numbers in family practice. This will continue to be the internist and the pediatrician rather than the new family physician, but these specialists will become more concerned with the role of public health than the typical bedside clinician of today. In our school last year, the 29 students in the first-year class who have indicated a career interest in public health indicate that greater numbers will seek careers in this long-neglected field. There will also be increased numbers interested in medical administration. A large number of students now indicate a desire to manage the hospitals in which they find many faults. There will be increased use of paramedical and allied health personnel. The decreasing interest in scientific research has been mentioned.

The community orientation will involve the delivery of medical care to all segments of society, emphasis on prevention, and much more concern with politics.

Relations with the medical school faculty and administration will be marked by representation on committees evaluating the teaching and actions of the faculty and administration. Teaching will improve as a result, as will counseling and guidance. Closer student-faculty relations can be expected but in quite different roles with rejection of the in loco parentis concept.

As for intellectual characteristics, the prediction that there will be less emphasis on scientific attitude and emphasis on action before reasoned analysis is based on what is being seen in students in college and in freshmen medical students. Responses to hypothetical questions stress action rather than an analysis of the causes of what is happening or the gathering of facts on which to base an action program. The requirement of analysis of a problem is rejected as researching an issue to death. The word "passion" is constantly used and a passion for change will frequently be based on the trial and error method. (It will be a great challenge to clinicians to change this viewpoint when these students get into the clinical years.) There will be less interest in research and less interest in basic sciences not directly relevant to clinical problems, and the sciences--biological, physical, social, and behavioral--will be used more pragmatically. Students would like to get through school and out into the world more quickly. There is a tremendous increase in the interest in and familiarity with the use of computers, TV, and movies. Students are suggesting that these can be used as learning tools and applied to the expansion of medical schools.

Revision of the medical care system so that access to care is based on need rather than on finances and little interest in fees for service with preference for prepayment plans, salaried positions, and less interest in material things for themselves--all mark economic attitudes. Whether these will change when their responsibilities increase remains to be seen.

Increased concern for the emotional, social, and family aspects of care is striking. This is epitomized by the heated criticisms of patient management in the teaching hospitals' outpatient departments. The criticisms are not accompanied by solutions.

High on any list of liabilities of this new breed of students is the propensity for action before reasoned analysis. The lack of interest in the scientific aspect of medicine carries over to lack of interest in the scientific aspects of community programs. It is hard to get cooperation with the public health people and others already at work in these areas of their concern. Research and the basic sciences are seen as irrelevant. However, only a very small percentage, about 2 percent, feel that our established institutions, whether medical or otherwise, will never work and that their ends justify their tactics. This small percentage is supported by a much larger number than anyone thinks, and this is a grave danger in many, many areas.

Demands

The medical students are demanding (a) increased admission of minority group students, (b) improvement in teaching, learning, and facilitation of their personal development, (c) attention to the emotional, social, and family aspects in the care of the individual patient, (d) delivery of medical care to all segments of society without regard to finances, (e) attention to and consultation with the community about the preventive aspects of medicine through social action involving housing, education, and employment, and (f) a voice in their own educations and the policies of the medical schools. About 90 percent of the many medical students to whom such questions have been put come out with answers like these. The students agree with this kind of program, and it should not be confused with the issues raised by those activists who would be destructive. Recognition that we must produce more physicians and we must do something about the medical care is imperative. Otherwise, the scientific part of our establishment is apt to topple down. The faculty is still in the scientific and technological era, but the students are not. The shift in attitude from seniors to the sophomores is impressive, but the real split comes with the freshmen and the students coming in. The foundations are identifying with this last group. They are putting their money into the delivery of care and into medical education to try and produce more physicians. The government is still split but moving toward concern with distribution of care. These divergent goals produce tremendous tension in any social system.

To save the scientific and research part of medicine, better ways to deliver medical care must be found. The students have ideas to which attention must and will be paid. Many of these students are going to go into the community for a while, and they are going to try to solve these particular problems. That this is another pendulum swing, like the swing away from the clinicians to science in the fifties and sixties (which was a great gain), does not minimize its significance and the fact that it must be dealt with. The scientific aspect of medicine cannot be abandoned and our students, in their great surge to change things, cannot be allowed to lose out on becoming very competent and very scientific physicians.

Clinical Logic

Lawrence L. Weed, M.D.*

The viewpoints to be expressed are based on strongly held convictions, so strongly held that the conclusions will seem biased and even irrational.

Solutions to some of our most urgent problems are available, and we are ready to use technology and use it now in a big way. Clinical medicine must combine and couple these with technologies, with what they are learning, and with what they now know, and must do so immediately.

There are major problems in our current approaches to students and records. Students and doctors, as they go to do something for a patient, should be confronted with a standard or a pathway to optimal performance. How are students now taught to analyze a clinical problem? Theoretically, they are taught to define problems of patients, and then, based on these definitions, theoretically they are supposed to come up with a plan of treatment for each problem, whether it is social, surgical, medical, demographic, or psychiatric. Supposedly, they then follow these conclusions as if they had been trained as scientists. We all know that we never know what or how we are doing until we keep track, correct ourselves, and hence act like a guidance system. Since one is always wrong to one degree or another, he needs to keep running such feedbacks like an analog computer in which the shape of the path is not known until the input stops. In clinical medicine, if a given patient follows a path of a certain shape, this does not mean the next patient will have that shaped path. There

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is a unique path for each patient.

Obviously, formulation of the problems of a patient should depend on a data base. We know that theoretically and practically the patient must first be examined and those data recorded before a verifiable data base can be formed. We are theoretically teaching the students to do this, but do we in fact examine critically the adequacy of the data base or the nature of its format? No one ever picks up the records of a practitioner or a third- or fourth-year student to examine the adequacy of the data base as related to the problems of the patient. Do we judge doctors or students on thoroughness and reliability? Are the problems defined and was each planned for? Are the progress notes related to each problem? Are records examined this carefully?

Rather our records look like a scientific sewer, and we do not use them. What sort of a scientific system have we if the data are not in order? One of the difficulties is that it is not possible for a given individual to ask 900 branching logic questions and do so every time without getting tired and confused. One never finds a place on a chart where there is a table of contents or a list of all the patient's problems. There is a scribbled impression here, and then a few scribbled progress notes there next to globulins and serum cobalts. Our data are recorded in disordered fashion. Medical science has tried something that no other group ever tried. It source orients the data. Lab data are put on lab sheets, the X-ray reports on gray sheets, and something else on green or pink sheets. What does an X-ray of the ear have to do with the X-ray of the heart? True, they both come from the X-ray department, but that is all. Ear cultures are mixed up with urine cultures and blood counts with serum sodiums. What does an ear culture have to do with a urine culture? Did the patient urinate in his ear? If one wants to track down what was done for the ear problem, as he reads the record he stumbles over arthritis, gout, and fragments here and there. After three to four hours of trying to put together a coherent picture of what is happening to see if it is sensible, one is still left guessing.

All of this is true and is no joke. The fact is that American medicine has never thought of itself as a guidance system. Physicians have all thought of themselves as oracles with answers. But this is not the way scientists function; only we play such a game, and we are prisoners of our system to this day.

What are the reasons? Medicine really thought that it could get all the necessary facts in a single man's head. No discipline was ever developed for keeping the rapidly increasing mass of facts in order. Then medicine just got lost in the resulting mess. Next, medicine stopped examining students for what they do. Since one was expected to master the facts, and in no systematic fashion at that, emphasis fell on randomly recalled facts with no evaluation of the actions derived from them. Medicine has thus fallen into an unbelievable trap in which what one knows is equated with what he does. Further, specialty board examinations are given at thirty, and so what one knows today is equated with what he will always do. This trap does affect the whole medical educational system, and it will affect the whole technology to be applied to it if we do not recognize it and the reasons for it. Failure to take corrective steps would be disastrous.

What is wrong with the practice of medicine is not not knowing enough. Rather, we seem to have a character defect; we are sloppy, disorganized, and do not keep track of things. We have not taught and indeed have not recognized that the most important part of our whole practices is our records. Everyone has been too busy memorizing. Everywhere in the whole educational system if students learn that they are tested on what they know, they will memorize.

This leads to specialization. Any fool who is going to be tested on what he knows will narrow down the area. Once having specialized, the medical ego evidently demands that one still think he is the most important person on the faculty, and, as an inevitable consequence, specialists have become more important than generalists. The sequence from examinations for known facts to memorization by students to specialization must be recognized.

Instrumentation such as the Digiscribe is available and, tied to a computer, will allow one, by writing on a screen with his finger, to gain access to branching logic. This permits application of the orderliness the computer demands to clinical data bases, programs of treatment, formulation of problems, or choice of drugs. The original data base--history, physical, or lab data--can now be exactly defined. We have developed sets of questions and linked them to computers. A student or intern from any medical school in the United States, once he becomes familiar with sequences and terms, can easily manipulate the logic and displays. At first, he is stopped at each term to find out if he knows what it means; leukoplakia or druzen, for instance. Next, he is checked to find out if he has seen these conditions and if he knows what they look like. By this process one can determine quickly what students know and do not know and define the limits of their knowledge. Thus, both student and instructor know and do not guess at what is known. With the displays a student can work through an orderly examination of the ear, for instance. Normal or abnormal-internal ear or auricle? Wax? Discharge? What kind of discharge? Green? Yellow? Black? Bloody? And so on. In seconds that ear is examined at a level of thoroughness never expected of medical students.

There are now literally thousands of displays, and this makes it ridiculous ever to try to use the student's mind for memory or retrieval. We ourselves must remember and teach our students that people do not memorize telephone numbers. With the alphabet and a telephone book, literally millions of phone numbers can be reached.

We must learn to approach our students by saying, "Now here are the data, you formulate the problem. Go to the library, and I would like to read your solution after a reasonable amount of time depending upon how acute the nature of the problem is." We should not care whether he copies his solution from a friend or goes to the library or calls up the Pope. How he gets his information is unimportant, just so long as he sticks with his patient and solves the problem.

If we really understood this, examinations would be different. Proctors and written logic sequences would fade, and examinations would become connected with doing. We must learn to watch what doctors do and not worry how they do it. No exam will tell you if a man was up until 2:00 a.m., whether he is over forty, dumb, takes drugs, or is overextended financially. We do not examine the behavior of doctors. We examine their memories and then for only one thing at a time. This is not what defeats a doctor. Think of an office with 30 patients, a stack of telephone calls, and a sick secretary. Priorities, choices, and confusion are what confronts physicians, and their capacity to handle these things should be included in evaluations of their ability.

The order imposed on information or data by the computer can help them do better work. The system must be designed to feed them information they need. For instance over 900 branching logic questions are better than any single doctor we have ever seen can reproduce. With such a data base, problems are readily formulated, and the goal of getting the problem precisely defined is more easily reached.

Until we get the responsibility for memory and retrieval of data out of the doctor's head and use the technology to do these things for us, increasing chaos in our records will result. In the teaching system I am advocating, ward rounds might be handled like this. First, there would be an announcement of what the rounds were to be about, followed by a statement from the instructor: "I will come the night before, read what has been happening to that patient, and inspect the record. My approach will be problem oriented. At 10:00 a.m., I will start to discuss with you your capacity to be thorough, your capacity for sound analysis, and your capacity to stick with that patient and solve that problem. You may be told your solutions are unacceptable and may be required to go back to the library and keep at it until I, the teacher, functioning as your auditor, find the quality of your management of each patient's problems satisfactory." After a student has been through this twenty or so times in a row, he can go out in practice. You all will recognize that some will be ready in two weeks, and some will not be for twenty years. That is how education is individualized.

The same system can be used for instruction in drug usage and the incidence of side effects. At this time, I want to make a plea for the absolute and immediate necessity of writing more displays. A year has gone into creating those we use for the physical examination, and we are just starting on a new set for drugs. There must be a nationally based library of these so that what is new and known can be made available to doctors anywhere. All of this is all possible today. Libraries have to be turned into depositories of information and must deal with this information and couple it to the user.

Sharing of Resources

Jack W. Cole, M.D.*

Certain disparities exist in our medical education system with respect to the numbers and quality of teachers, investigators, and practitioners. This inequality may be found within departments, within medical schools, and between medical schools; and, indeed, the prospects of ever moving forward without some disproportion is remote. Nevertheless, certain forces are at work today within our medical education system that are demanding modification of the educational process and will change immutably the way in which knowledge will be dispensed, stored, retrieved, and exchanged. An examination of some of these forces and their implications seems in order. A brief recapitulation of a few of the problems and the magnitude of these problems may serve to provide the basis for our further deliberations and underscore the urgency for long-range solutions. Never before in the history of this nation has society demanded so much of its medical schools, and never before have they been so ill-prepared to fulfill these expectations.

Irving Page (1) has indicated some of the tasks that our medical schools are expected to perform:

1. Teach medical students
2. Train paramedical personnel
3. Do the major part of medical research
4. Conduct large programs of postgraduate education

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5. Serve on governmental committees

6. Participate in the activities of voluntary health organizations

7. Practice medicine

To this impressive list one can now add the acquisition of additional duties as we witness the implementation of regional medical programs.

Few medical schools will shirk these responsibilities. The difficulty in discharging these responsibilities is compounded by other factors which warrant attention; perhaps the most important is the relative reduction in the number of qualified individuals to implement satisfactorily these many programs. As new medical schools become established and established medical schools enlarge, the need for qualified teachers is seemingly insatiable.

In a study of the trends of medical school faculties made by the AAMC in 1960, it was estimated on the basis of projected expansion of existing medical schools that there would be in the year 1975 estimated vacancies in our full-time faculties numbering 1,680. If one adds to that the demands for full-time faculties in the new and soon-to-be-added medical schools, it is apparent that there will be many unmet needs. The seriousness of the situation is all the more evident when one introduces the matter of quality into the equation and recognizes that even the filled positions are not invariably held by outstanding, inspirational teachers.

If one thinks for a moment about the quality of medical education, consideration must inevitably be given to the so-called explosion in scientific knowledge and the impact of this on the individual teacher's qualifications. For many years, as stated by Frederick J. Moore (2), the "total body of knowledge to be mastered by the student and implemented by the practitioners appears to have been quite static. Today, however, applicable medical knowledge is increasing exponentially in amount and complexity, at least as judged by the numbers of publications, the amount of research work, the number of research workers, duration of clinical training, amount of continuing education, extent of specialization, number of drugs and biologicals, and the diverse nature of such disciplines as biochemistry, physiology, radiology, surgery and other such efforts." This dynamic characteristic of medical knowledge, with its attendant increased specialization, is immensely important to society and places the entire matter of health manpower in a somewhat different perspective by adding the function of time to the task of providing good medical education for all. We not only need more and better teachers, but we needed them yesterday.

The rapid growth of this medical knowledge has fundamental manpower implications in terms of both our undergraduate and postgraduate medical educations.

If the medical schools are expected to not only be the repository for current medical knowledge but also the wellspring for new information, one is staggered by the magnitude of the task. The present system for conveying knowledge was designed during the phase of "imperceptible growth" in the exponential curve. "Because the continued growth of knowledge and its effective use are socially imperative, there is an urgent need to find new mechanisms that can sustain continuing medical progress. For purposes of this discussion, let us assume that the growth rate of valid--that is, applicable--medical knowledge is about 5 percent a year. It is probably true that this rate has not yet made the present system of medical education obsolete. Excellent training has remained possible by modifying the undergraduate medical curriculum and prolonging and specializing the internship-residency programs. Nevertheless, these compensatory measures are reaching their elastic limit, while the requirements for medical education continue to increase unremittingly. The need for new approaches to undergraduate medical education will, therefore, probably become critical within the next few years."

Another aspect worthy of our consideration is the apparent maldistribution of teaching talent and other educational resources. The unevenness and inequality of educational opportunities at our various existing medical schools is all too apparent. One example of this is the lack of full-time teachers and adequate leadership in the field of otolaryngology in some 20 medical centers. That discrepancies in educational and research opportunities are far more widespread and recognized publicly than this isolated example was underscored by the Presidential directive in 1965. At that time, President Johnson called for federal agencies to be more attentive to the aspiration of the "have-not" institutions and indicated that, in dispensing research monies, agencies would take this into account. A good example of one such spin-off of this anxiety was Project Themus of the Department of Defense, which attempted to strengthen the nation's universities, increase the number of institutions performing research of high quality, achieve a wider geographic distribution of research funds, and thus enhance the United States' academic capabilities in science and technology. Although, in some respects, this effort is not totally germane to a consideration of medical education, it serves to emphasize the disparities and lack of uniformity in institutional capabilities throughout this nation and the public's awareness.

Further elaboration of educational problems would belabor the point. The central issue is, as I see it, that there is a substantial shortage of qualified medical educators, who are burdened with peripheral responsibilities from which there is no avenue of escape and are harassed by the spectre of intellectual obsolescence which is occasioned by increased scientific specialization and the information explosion.

It is a national crisis and requires a national solution. The extent to which modern communication technology can abet our efforts to overcome educational inequities and use more efficiently the talents of outstanding teachers will depend in no small measure on our capacity to overcome our institutional arrogance and petty parochialism. With the recent accomplishments in the nation's space program, there can be few doubts of man's capacity to devise the necessary instruments to link our medical centers in one vast educational network.

To make available to all of our students the excitement of a lecture well-prepared and well-delivered by a brillant teacher, or to witness the execution of a basic science experiment ingeniously designed and clevely conducted, or to share one's diagnostic skills and clinical acumen with a colleague many miles away in the management of a clinical problem, and to accomplish these goals at a time and a place and at a pace convenient to both student and teacher seems a worthy goal as we approach the 21st century.

The versatility of the electronic age in devising new and worthwhile educational techniques is limited only by man's own imagination (3). One can only speculate on the impact that such a network might have on medical education in terms of physical facilities if new patterns emerge through sharing.

We have already witnessed changes in laboratory design, as the artificial boundaries between disciplines have disappeared and the multidiscipline lab has emerged. In some instances, this has been a substantial saving in space and more efficient use of equipment and faculty time. Is it not conceivable that these same approaches might well, through the use of networks, be extended to embrace one or more geographically separated schools, pooling their talents by a sharing of resources to correct each other's deficiencies and in so doing improve the overall quality of education and effect certain economies in time and space? One cannot help but wonder what the future role of the classroom and amphitheatre might be if the concept of sharing through networks were to be universally applied. There are large classrooms and amphitheatres, beautifully equipped, that now sit idle for substantial periods of time during an academic year. It seems likely that it would no longer be necessary to herd large classes of medical students from one lecture hall to the next at prescribed times in order to listen to an inept lecture or a poorly prepared demonstration, when the better material may be made available at a time convenient to him, at a place that's convenient to him, and in an environment devoid of distraction.

In the Foreword to Lifetime Learning for Physicians (3), Dr. Ward Darley points out that the revolution in medical education that followed the Flexner Report of 1910 was precipitated by the fact that the then-developing body of scientific knowledge was not being translated into medical practice by the then-existing system of medical education. He goes on to say:

> Now more than fifty years later, we find again that medical education has much in common with the era of the Flexner Report--the gap between what is known and what is taught is wider than can be justified. But this time the gap is widening for reasons differing from those that accounted for the difficulty of a half-century ago; for instead of suffering from the blight of pedestrianism, we are belabored by the fruits of progress--progress within medicine itself and progress within the Society in which medicine must serve.

Whether modern day technology can help to close this gap remains to be seen. Certainly, one approach to the challenge will be the capacity of medical schools throughout this land to cooperate and share their resources through the judicious use of television, radio, teaching machines, memory storage machines, and satellites.

Although the thrust of the work undertaken by a Joint Study in Continuing Medical Education some nine years ago was directed toward the continuing education of the practicing physician and entitled, Lifetime Learning for

Physicians, the concept of a "university without walls" was enunciated. In my opinion, there is much food for thought contained in this report that might be appropriately applied to undergraduate medical education.

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Factors Affecting Student and/or Faculty Acceptance or Resistance of Externally Designed Teaching Resources

PANEL DISCUSSION: George E. Miller, M.D.* (Chairman)
William G. Cooper, Ph.D.°
Howard S. Barrows, M.D.+

Dr. Miller: Three panelists have been assigned the task of attempting to focus your attention upon the factors which affect student and faculty acceptance of or resistance to the introduction of automated devices to facilitate learning in undergraduate programs in medical education.

There are almost no systematically accumulated data from which we can build our comments; and so we must substitute instead a collection of experiences to share with you, not as a contribution of ultimate truth, but rather as a set of items to which attention must be directed.

Dr. Cooper: My area of expertise is mainly involved in trying to coordinate the use of multimedia with regard to their augmentation of the educational programming for health science students. During the past few years, I have been actively involved with my basic science colleagues in developing a multidisciplinary laboratory setting for basic science medical students, graduate students, and students of the allied health professions.

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In the design, use, and acceptance of multimedia resources, several important factors must be considered.

The environment.--Most rewarding have been our attempts to tie together the various components of the learning environment so that both faculty and students feel comfortable in their use. This effort is also directed toward providing means by which one can communicate efficiently as well as be involved in educational program and software development when so motivated. In the Office of Educational Resources the laboratory setting where the students really are living is seen as the setting where they are also learning. Much depends on how that is measured. We are confident that the students are pleased with this kind of environment for any kind of learning activity. This setting is an important factor in student acceptance. The same is true of faculty. However, faculty have pointed out some real problems. We have heard more from faculty and less from students about acceptance and lack of acceptance of some areas of change. Of course, all of our basic science or clinical colleagues are not resisting change.

Clarity of objectives.--It is very apparent that neither software nor hardware nor the media of production are ends in themselves. Educational objectives and program planning toward those educational objectives must always remain in focus. Serious cutbacks in funding, not only for research but also for educational program development, have been among the obvious reasons our faculty has had reemphasized to it the importance of really examining why any given piece of audiovisual material is being developed.

Although an awareness of what is available is of importance, the individual faculty member must first establish the educational objectives of any teaching aid or learning unit. Most members of faculties hesitate to spend the time necessary to formulate these objectives and subsequently develop the required packages of educational software. There needs to be some way of rewarding faculty members who do devote significant chunks of time to produce meaningful educational programs worth using in their own institutions much less worth sharing with other institutions. Those who sit on promotions committees and in deans' offices must be made aware of this and should develop mechanisms required to get more faculty involved in effective educational programming.

Need for an inventory.--It is important to realize that from the management standpoint we are not adequately aware of what teaching aids are currently available. There is a desperate need for a comprehensive cataloging of currently available audiovisual materials which can be rapidly searched and retrieved from regional terminals or libraries throughout the country.

Relevance for learner and teacher.--Each program must have some degree of relevance to the learner. The title of this panel points out that anything external is something external to one's individual teaching ego. Every faculty member has his own way of teaching. Relevance to an instructor means what is helping him achieve his educational objectives. The students are asking the same questions. Are multimedia programs relevant to what the students envision as their career goals in society? Are the materials relevant in helping achieve their educational objectives? Hopefully these are the same as those of the faculty members, so that they will pass exams and become standardized or certified at a prescribed level of competence. Relevance is very important with regard to the acceptance of any program by faculty or students.

Quality of product.--The quality of production of educational software can be a critical factor in its acceptance by the learner. We are competing with the entertainment industry for our learner's attention. We are, as we should be, competing with industry when we recommend seemingly elaborate television and film production facilities with special effects generators, animation stands, and all the things that are required to help television commercials sell their products. This sort of approach is needed in the development of our software. It has to have pizazz. It has to be meaningful to the learner and convenient enough to catch him where he lives. The very sophisticated programming seen on television and motion picture films forces us to simulate this quality of production to the best of our ability in order to assist us in achieving our educational objectives. There is nothing wrong with the "quick and dirty" type of production such as the self-instructional device that individuals use in order to gain experience in utilizing the media. But if we are talking about sharing these resources from institution to institution, these production dollars can and should be pooled to produce effective programs worth sharing.

Access to faculty.--The medium must be brought to the faculty member. He should not be forced to go to studios and bear those hot lights and rigorous restrictions in order to produce a film or videotape. We must bring modern communication techniques to the individual faculty members in their classrooms in an attempt to overcome hesitance about using these aids. Faculty like to see classes in front of them, and so we should bring the medium to them in the classroom setting so that teacher-student interactions can occur.

Access to students.--Packages must be easy to retrieve, and the setting in which the student retrieves them must be comfortable. One of the big problems regarding the use of multimedia in American education today is that most of them are kept under lock and key when the student is most highly motivated to use them. In order to provide maximal ease of use of media by faculty at Colorado, we have incorporated a system whereby each faculty member can decide whether or not his lectures will be taped at the time and place that the lecture is delivered. He just pushes a button on the lectern. We take the master tape, dub it onto tape cassettes, and distribute them to the study carrels for student retrieval. They have access to these carrels on a twenty-four-hour-a-day basis in the multidisciplinary laboratories. There was much concern about the use of the audio tape cassette for this program in view of the widespread use of the cassette format in the home and car recorders to which my response was, "If students want to listen to a biochemist lecture on amino acids on their way home, that is motivated learning." If one wanted to do a cost accounting on an hour's worth of learning, it would be easy to balance the losses of tape cassettes against the gain in knowledge acquired by the "expensive" students in the health sciences.

Length of production.--The productions that are currently available on videotape or film are extremely long. There will be a time when there is no such thing as a rigidly prescribed length for films and videotapes. The sixty-second commercials have taught us a lot. There should be varying lengths of productions dependent upon the educational objective of each production and not necessarily to fill a time spot.

Cost effectiveness and compatibility.--It is also important that we do a better job of establishing the validity for the use of these media packages (cost effectiveness) so that the large numbers of dollars needed for producing these materials do not cause this activity to be looked at as some sort of wayout, blue-skied, very expensive component of a medical center. If you're going to expect them to motivate the student and help enhance his motivation for learning, these aids have to be conveniently available and of top quality and acceptability.

Mechanical factors can be passed over for the moment because the technology is here. There are some problems in compatibility, but they can be worked out. The industries will be very, very glad to have our inputs as educators if some guidelines are drawn up for them.

Dr. Miller: Dr. Barrows, who has developed some educational programs of his own, can speak from past experience.

Dr. Barrows: When one considers the term "external," the question is, external to what? External to the faculty? External to the department? External to the medical school? External to the regional program? It probably does not make much difference. The problems are the same as far as the faculty member is concerned. Students are not much of a problem along this line, as Dr. Funkenstein has already indicated. They readily adapt to newer things with a hunger. However, in reference to more complicated teaching devices, students do reinforce the rule that if something is apt to go wrong it will.

Rejection of externally designed resources is based on a number of things. One is the faculty member's prior experience in his own education with blackboard, lecture, syllabus, true-false examinations, and so on. Second is his ignorance. "One is always down on what he is not up on." Even more important is the lack of any real recognition on the part of the faculty of a need to be able to work with this equipment or the need for this equipment in their teaching programs. Every faculty member thinks, "My method is good and effective, and the students are learning what they need to learn." Until we generate in the minds of most faculty the need to understand, appreciate, or develop an interest in behavioral goals for learning and not content goals for teaching, we are going to have a hard time getting them to adapt to new methods, no matter how appropriate they may be. There is a great need to generate in the faculty some appreciation of appropriate goals in teaching and to look at what methods might be available for enhancing attainment of these goals.

The faculty is conditioned by their conviction that there is not enough time in their busy teaching and researching activities to develop skills and resources for any new teaching method. Acceptance on the part of the faculty must be based on a realization, a self-educational response, that external resources enhance individual learning by the student--learning based on his needs, his background, and his individual method or style of learning.

Underlying all this is a need for the faculty to realize that education is a science and not some sort of art based on guesswork. There seems to be a tendency for 2 types of people to develop in faculties, Type A and Type B for lack of better terms. Faculty A has a great ability for working with the students, guiding students, teaching students, and developing better learning methods for the student. Faculty B is more effective as a living archive or resource of scientific information for the student to go to when he needs this sort of help in his educational activities.

In addition to problems of acceptance and rejection on the part of the faculty, there is over-acceptance on the part of the faculty also. Many faculty members are incorrigible gadgeteers, who love anything new and assume just by its newness and complexity that it makes for better teaching. Unfortunately, evaluation techniques for the effectiveness of new media are very poor. Other faculty members are the one-modality type who feel one medium, whether it be slides, carrels, film cartridges, etc., is the answer to all his needs. We need to know more about media effectiveness in passing of information.

Dr. Miller: In your comments the focus is predominantly on faculty resistance. Does this mean that the major problem to be dealt with is not noncritical faculty acceptance or student acceptance or student resistance, but really the key element in the educational program is the faculty member who ultimately must dictate what takes place?

Let me cite a few factors that do heighten student acceptance of automated means for facilitating their learning, since this may be the best way to work out a correction of this problem. Increasingly apparent is that student pressures are forcing their faculties to reexamine the nature of their own behavior both in patient care and in education. Some attention to what leads students to accept and resist may help an analysis of the issue.

Availability and flexibility.--Dr. Cooper has noted availability and Dr. Barrows individualization by which flexibility can be achieved in providing learning aids students can use at their own time and pace. This assumes that they are available and not kept under lock and key as treaures but rather as materials to facilitate learning. Contrarily, if they are kept in a place of difficult access there is no more flexibility than with a rigid curriculum that demands that students be in a specific place at a specific time with specified faculty.

Relation to examinations.-- One of the most important elements in determining student acceptance of any instructional mode is the nature of the examination program. Examinations really are the best communication device we have to tell students what kind of learning will really pay off. If the payoff is to be achieved most efficiently or most effectively by utilizing materials of great variety on their own time in the fashion that meets their needs best, then these are the things that will be used. On the other hand, it must be remembered that examinations may also be the greatest deterrent to the use of all sorts of individualized aids to learning. Most specifically this is true of the one that has been around the longest, which is the book, because there is almost no department or even individual teacher who seems to convey to his students that there are books that satisfy the needs of his discipline. Each must tell the students what they should know even though there is a mass of material available in the library. Yet that available material will not be very helpful if students are tested on those things the teacher believes rather than the identification of a problem, its analysis, and how one works his way through a problem.

Student involvement.--A third factor that does seem to excite students to accept the newer devices particularly is getting them involved in the creation of these new tools. This also provides a mechanism for lessening the load on the faculty because students are remarkable in the identification of those things that can be useful to their colleagues.

Time factors.--In terms of student resistance, next to examinations, many of the things offered are too time-consuming. Instead of saving time, they cause excessive investment of time. It is not very helpful for a student to have to go through forty-five minutes of a film in order to see a three-minute segment that represents the meat of the film. Similarly, some early programmed instructional materials did not provide enough branching opportunities so that students could skip past the things that they already knew. It is characteristic of our educational system that we rarely try to find out where students are and then help them move from that point to some fixed terminus. Rather, everybody is put through the same program with the assumption that all come at the same level and will leave with the same knowledge. They are tested at the end, rather than at the beginning, so that if they end with what is wanted we can assume that they got it from the faculty, when the fact is that many of them may have already come with what we wanted them to take away.

Familiarity and unfamiliarity.--Unfamiliarity is another of the things that leads to student resistance even though many are familiar with television, computers, and programmed instruction and have had a variety of experiences with them before medical school. It is important to recognize that when they enter medical school they enter new social media with all sorts of new pressures and expectations and value systems. Whether true or not, the message that comes through to medical students too often is that the best way to get along in medical school is to listen and to be unidentified and to tell teachers what teachers want to hear. Thus, when faced by independence or new modalities of instruction, their immediate reaction may be some skepticism about the relevance of such aids to helping them meet the standards the faculty arbitrarily sets. To the extent that they cannot answer this confidently and affirmatively, then resistance to these modalities is certain to be established.

Enthusiasm and disillusionment.--Faculty do accept some of the things that we have been talking about. One of these is enthusiasm for the new. People aren't all just resistant to the new; they are only resistant to the new things that don't strike them as appealing. Those new things which capture our fancy often become the things for which we develop a missionary zeal. This fact relates to the faculty commitment to an approach or method, whether it has any relevance to educational objectives they are trying to achieve. But naive enthusiasm contributes to disillusionment which leads to resistance.

The idiosyncratic nature of teaching.--In terms of all these resistances, perhaps one of the most important and most difficult sources of resistance to deal with relates to the idiosyncratic nature of much of teaching. A teacher is inclined to believe that what he teaches is what ought to be learned, rather than defining first with colleagues, associates, peers, students, and others what learning is appropriate for the end toward which the student is preparing himself. Courses of instruction depend far more upon what teachers are interested in teaching than what students are required to learn to fulfill a professional role. Until we identify what it is we are trying to help students to become and what contributes to this end, we will have trouble in most effectively utilizing the available materials and methods of instruction to achieve a given goal. However, teachers will persist in teaching the way that pleases them, and they can defend, rationalize, and persuade themselves, at least that what they are doing is right, no matter whether they can persuade anyone else.

Discussion

Dr. Cummings: To each of the resistances which have been mentioned there is an obverse factor promoting acceptance. Relevance would be a factor for acceptance by the faculty just as nonrelevance would lead to resistance. Excitement for the new is a factor for acceptance, but fear of the new provokes resistance.

Dr. Weed: There are certain things one can resist on a basis which could never accept any alternatives. For instance, these methods could be resisted because they take time away from the teacher being a Socratic-type auditor. Or one could say all this is too much content-oriented and would be resisted on that basis.

Dr. Miller: What is being highlighted here is that resistance may be conditioned by educational philosophy. One educational philosophy might not allow you to utilize a lot of things that others with a different educational philosophy would think were superb.

Dr. Weed: This is a point where the computer comes in. The computer has a feedback that allows it to act in a different way and audit as a film cannot. For this reason I can get along with a computer; whereas, I cannot with certain other media. I have never been able to figure how the other type of audiovisual aids allows for interaction. This makes the computer a completely different type of aid than any of the others.

Dr. Cole: You are also dealing with dehumanization. This is of ultimate interest to the panelists. How does this factor enter your analysis? I am referring to the sort of sequence from a whole lecture hall filled with students and the lecture played on the tape recorder to be followed the next day by tape recorders in the seats where the students are.

Dr. Cooper: This is a concern of the here and now generation of teachers and learners. Our faculties are not quite ready to go completely modern with regard to having many audiovisuals piling over into their teaching. The current feedback from our faculty suggests that they want better means of augmenting what they are now doing. Most of them want the class in front of them when they use the media. This is very important because there is obviously some concern over the dehumanization of the learning process. Faculties appear to be resisting the national production of audiovisual materials.

Dr. Barrows: Performance in teaching is usually not one of the criteria by which the faculty was chosen. A faculty interested in educational principles should be selected from the beginning.

Dr. Wedgwood: The absence of money for the development of new curricula often inhibits faculty interested in such innovations. If a faculty group works hard to develop a syllabus, publish a new program, design new teaching aids or slides or movies, and then finds that the department chairman or the dean cannot provide the money to implement the innovations, it becomes discouraged.

Dr. Miller: It is interesting that this is one of the purposes for which the educational improvement grants were established for every medical school in this country. One wonders to what extent they have been used in this fashion.

Dr. Cooper: The educational improvement grants have been one of the sources of funding we have used at Colorado to support the medical center's Office of Educational Resources. This office coordinates the multidisciplinary laboratories, the audiovisual component, and the research in education activity for all of the schools in the health sciences. As director of this office, I can establish priorities of spending for educational programming. Thus dogs, adrenalin, or movies can be equated with educational software production. This allows the basic science faculty to see that all of these teaching devices are really in the same ball park. A meaningful piece of educational software can be as important to a student as 50,000 L cells in a tube.

Dr. Merrill: If we are to get started with a network at this time, we want it to help make our teaching more professional and to help us do a better job in our teaching. As has been brought out repeatedly there are 2 elements to this. One of them obviously is a knowledge of the subject. The other aspect is the ability and freedom to allocate instructional resources, such as methods of teaching, materials of instruction, whether films, television, books, or tape loop, and also techniques of instruction. Part of the professional job of teaching is to be able to take these resources and allocate them so that they assist in taking the student from where he is now to where you want him to be. Looked at in this fashion, this national network of biomedical communications is going to be a visual resource, which should be made available to good professional teachers.

Dr. Barrows: Remember what was said about books and teachers' difficulties in finding books they like. We're talking about developing rather elaborate resources in this biomedical communications network and the consumer remains the teacher. Its success will be based on teacher acceptance.

Dr. Merrill: Then access to what is wanted from this network and the ability to reject what is not wanted must be insisted upon.

Dr. Cooper: This is one of the advantages of using these kinds of media over the written word. One does not get involved in copyrights or typesettings that cannot be changed. The beauty of all film, film strips, videotapes, and other kinds of software is that it can be modified in order to make it relevant to a wide variety of audiences. This capability must be built into the plan for any network. The program content must have an immediacy and relevance to the educational objectives of both the student and the teacher.

Dr. Barrows: The way to get faculty to become aware of teaching as a profession is to get the faculty concerned about the nature of the product they are trying to turn out--how they want their product to behave. Once they decide this, it is rather easy to define evaluation methods that test the performance goals you have decided you want your product to display. The student should also know the objectives of the teaching program, how he is being evaluated, and by what evaluation technique.

Dr. Miller: As Dr. Hubbard said this morning, examinations should be in terms of professional competence and not based on the parrot-like skill we seem to have encouraged so effectively in the past.

Dr. Cooper: In the final analysis, a good education is one that teaches the student the art and skills of acquiring knowledge. To start worrying about detailed content is one of the worst things we could do at this time.

Dr. Smythe: Is there some sort of general trend toward the stand that since we are in a crisis and need a lot of manpower, we therefore have to be willing to define in quite specific terms some minimum content which the faculty will accept as what a medical student ought to learn? We are also concerned about the techniques by which that minimum content will be transferred.

Dr. Barrows: You are talking about the student and the objectives purely in terms of content. It is performance we are really concerned about. A certain type of performance is expected of the product of a medical education not a person who can just parrot information.

Dr. Wedgwood: Isn't change in student behavior one of the things that should be classified as content in the educational process?

Dr. Miller: You are suggesting that behavior is a part of the content to which Dr. Smythe referred.

Dr. Wedgwood: It is one of the major facts.

Dr. Miller: That is a very desirable view to take, but how widely is it shared if we look at what goes on in medical schools rather than to what we give assent in meetings such as this?

Dr. Kinney: We are not trying to define the content that everyone should know. The medical schools have come to the realization that whatever happens in the future, doctors are going to be of many different types, with many different capabilities. Against the background of this realization, a National Library resource could open up tremendous opportunities to students all over the country for exposure to all sorts of new ideas, techniques, and possibilities, many more than any one school could possibly give them. Applied correctly, such a resource could strike sparks all over the country where such capabilities never existed before. This is an exciting concept, not because we are trying to find ways of teaching what every medical school does pretty well already but to find ways to bring new concepts to more students. The faculty is not as afraid of change as it used to be.

Dr. Smythe: Dr. Weed has suggested that there should be in the National Library of Medicine a series of displays on branching logics used in clinical medicine. This calls for very rigid standardization. If there is going to be a system which is national, it implies that there will be standards. A national system of any sort without standards will simply not work. If we are willing to accept the fact of a national educational center in the Library, then we have to be willing to face up to the fact that we are prepared to say something of which content we think is most important. After this you can argue about the process by which this content is transmitted. I find myself incapable of escaping this conclusion and to talk about process without concern over content, that is, the message to be transmitted, is futile.

Dr. Cooper: Referring to some of the urgencies that Dr. Hubbard pointed out this morning, it is obvious that educational software productions must be considered in the planning and implementation of the systems necessary to provide the flexibility for a three- to six-year medical curriculum. One of our institutional objectives should be to create more meaningful opportunities for educationally disadvantaged individuals by providing remedial programs to accommodate this degree of flexibility. Many of the remedial programs could be implemented through the use of these packages that we are talking about today whereby an individual learner could move at individual rates thereby permitting them to take two years to do one year's work or vice versa.

Dr. Miller: Whether local, regional, or national, in terms of education, until we specify what it is we want the people to learn, it is virtually impossible to develop a program that allows us to achieve goals. A national resource should be a resource to help students learn things and not a means of teaching them more. The focus should be on learning so that students can reach their goals in the most efficient, effective, and individualized manner possible. No one advocates imposition of some national curriculum.

Report of Group 1*

Our discussion group endorses the biomedical communications idea. It is very positive concerning the need for such a system and wishes to encourage the National Library of Medicine to continue the investigation of the potentialities of this network.

Initially, an attempt was made to identify the educational objectives of the network. The point of departure was from the charge by Dr. Hubbard that we address technology to the solution of highly defined problems. It soon became clear that more time and feedback would be needed to respond precisely to the stated charge.

Attempts were made to identify the attributes that such a system might bring to the educational task. These attributes are:

1. To act as an information resource which will enrich the students' and faculty members' learning experiences as well as enhance the capabilities of the faculty members;

2. To provide a new examination methodology;

3. To facilitate the distribution of contemporary information; and

4. To be an educational feedback system which is available, usable, and economically justifiable.

These attributes should be evaluated in pilot projects that involve resources already under development at local levels. The evaluation may be accomplished in terms of the use of the system and the behavioral changes that result from using the system. This is most important when measured for its crescendo or diminuendo effects during the process of operation of a system.

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*Submitted by William G. Harless, Ph.D., Chief, Instructional Systems, Center for the Study of Medical Education, University of Illinois College of Medicine.

It was the general consensus of the group that a first step would be a questionnaire to gather attitudinal data from faculty and students. Four such groups are recommended:

1. Users of a system;
2. Nonusers with access to a system;
3. Nonusers in the same institution with no access; and
4. Nonusers in different institutions with no access.

Behavioral tests should be used rather than information tests but, information tests should not be rejected as an information source.

The Kind of Evaluation That is Available

Appropriate pretest, posttest, and control groups should be used in an intra-institutional pilot project to measure the behavior change caused by network material. It is suggested that a correlation study be made relating the usage of the network and the performance on simulated patient problems. It is felt that if the use of the system by individuals can be related to their increased performance proficiencies, the result will be a long-range control of the effectiveness of the system.

Efforts to collect data concerning the impact of the network contribution or effect on manpower, clinical practice, and knowledge should also be made. A conference to provide feedback concerning the effectiveness of the network should be planned.

NOTE: During the discussion of these recommendations, it was brought out that efforts at evaluation should be addressed to 3 discrete areas. First, effectiveness, is it a good informational transfer method? Second, efficiency, does it save dollars, consumer time, or time of the buyer? And third, acceptability, is it acceptable to both the consumer and the buyer and the seller? All of these areas are susceptible to testing.

Report of Group 2*

This group was assigned the task of discussing educational services from a nationally based communications network. The very idea presented an unusual opportunity to define what is most needed or most superfluous in medical education. Are there basic processes or basic contents in medicine which can be transmitted electronically as supplements to the usual forms of teaching? How does one define such inputs and on what data should be based decisions for activating the various components of the system? In other words, we were asked to pay attention to the potential contents of a biomedical informational resource.

There was considerable initial discussion which could be summarized by saying that the group dismissed the concept of a national curriculum or the imposition of a minimum or core curriculum upon the medical education community. The concepts of "minimum standards" or "thought control" were rejected.

There was broad agreement that a national informational resource, which might be made readily and rapidly available through modern communications technology, could significantly strengthen medical education.

The following points emerged from the discussion:

1. There is a body of knowledge and information which constitutes a base of data, skills, concepts, behaviors, and attitudes, all of which have a commonality for all medical schools and for all medical education at the national level.

2. This body of knowledge constitutes a national resource.

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*Submitted by Ralph J. Wedgwood, M.D., Chairman, Department of Pediatrics, University of Washington School of Medicine.

3. Such knowledge is dynamic, not static, and is subject to continuous temporal change.

4. Not all medical schools can provide equally all of the body of knowledge through faculty expertise within each individual institution, with ready access for all of the students, nor can all medical schools cover the increasingly broad totality of biomedical information.

5. Some segments of this information base can be made more readily available and can be more rapidly updated by modern communications technology.

6. Such information could be made available, with local option, for use to supplement the usual teaching process within any individual institution. Thus, a national informational resource should be considered as a resource that could be made available to users if they so wished or felt so inclined.

Acceptance of these 6 points lead to the conclusion that there is a content through which a national biomedical communications network can be made available as a national resource. Indeed there is an urgency for us to pool our experience and make available nationally the very many innovations which have been developed in individual institutions, so that these efforts can contribute to the totality of national biomedical education.

Accepting then the concept of a national biomedical communications network, how does one determine or define those areas of knowledge which are most needed? What inputs are most needed from the viewpoint of relevance to our modern society, and which fit within the limits of resources and capabilities? Who should develop, obtain, update the informational content or input preparation, and who should be responsible for quality control? On what should we base our decisions for activating the individual components of such a system or network? Obviously, someone is going to have to decide on priorities for input, for the development of the units, and for the release of the units as available items for medical education.

The development of an external council system for this type of decision-making was favored. Such an external council should be broadly based and should accommodate the necessary feedback mechanisms from the consumer, such as the medical student, the house officer, and the individual in the practice of medicine, as well as feedback from the teacher and the specialist. The external council should determine the areas of knowledge in which development is most needed within the terms of relevance and resource limits. It should act as a focus for gathering together information concerning existing systems that have been developed or planned so as to economize on national effort.

To function, such an external council would require a center-based secretariat or staffing to provide continuity of staff work necessary for such an objective. However, the council should not participate in the development and processing of the learning-teaching units.

Thus, in a fashion somewhat analogous to the system used in the National Institutes of Health, a series of subject groups would also be needed and would presumably relate to the external council. These groups should outline the informational content of the areas that the council decides need to be developed. Each of these subject groups would require acting committees to develop the specifics of the content and the methodology. These committees would then be the actual working groups or producers of the informational units for the national network. In this particular area the professional or learned societies could and would probably be willing to provide very necessary inputs. Practitioners should in actuality as well as in theory be incorporated into such committees.

Following the development of informational units for the national network, it would obviously be necessary to review the units for content. Review panels should therefore be established. Such a review would require 2 sets of experts: one to determine whether the information within the units is accurate and another to determine whether it is pertinent to the educational process in the broad sense. The review panel would provide the specific feedback loop both to the subject committees and to the council to determine the efficacy of the units produced for the national biomedical informational resource and network.

Report of Group 3

Part 1*

The National Library of Medicine should cooperate with a broad variety of medical educational organizations and invite them (medical schools, specialty boards, academies, etc.) to set up educational committees consisting of specialty boards or discipline areas; students at a variety of levels; knowledgeable physicians or health teachers not in specialty area under study; educational experts; and media consultants. These committees are to develop, maintain, and update educational "standards" (The choice of the word "standards" is poor; the need for standards is that in contrast to books, indiscriminate duplication of nonprint materials will be financially prohibitive.) for all levels of competence; that is, develop core competence for various educational objectives in undergraduate, graduate, and continuing medical education. These "standards" require a codification of knowledge and performance (behavior).

The National Library of Medicine can cooperate with medical educators in accomplishing educational goals by encouraging the development of educational resources at the local, regional, and national levels.

The establishment of educational goals by medical educators will assist the National Library of Medicine in the development of a Biomedical Communications Network which can relate to institutions of medical education:

1. In reviewing educational standards of teaching materials for content competence, teacher evaluation, and measurement of attainment of goals;

2. In reviewing mechanisms of communication and flexibility in methodology of communication;

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*Submitted by Ramon M. Fusaro, M.D., Ph.D., Associate Professor of Dermatology, University of Minnesota Medical School.

3. In reviewing technical standards for the development, production, storage, and delivery of information (teaching-learning data);

4. In accumulating data (bank of experience) in effectiveness or lack of effectiveness of the materials collected or sponsored by the National Library of Medicine;

5. In developing a sliding scale of standards to encourage the development of information early and later to raise standards at a future date;

6. In promoting effective communications by encouraging the compatibility of technical equipment in each communication medium;

7. In promoting the development of pilot projects to evaluate areas of information retrieval and communications;

8. In insisting that all projects sponsored by the National Library of Medicine have as an integral part of the project an educational evaluation process or procedure; and

9. In establishing a source of educational materials for all health sciences to have a means available for self-evaluation of professional competence.

The effectiveness of communication might better be served if the concept of unifying all educational resources were encouraged, that is, the concept of the Library-College. In that manner the maximum use of funds, equipment, and professional personnel will be obtained.

Report of Group 3

Part 2*

The content of material gathered for a network should be organized by the people active in each field. This would bring in all of the various regulatory, educational, and professional groups.

Content should be organized at different levels and should have different targets. One such target could be the undergraduate student work related to each specialty, so that all graduates attain a minimum or core level of competence. Just as electives are being organized in the schools, at another level content should be organized and aimed at more sophisticated levels for students who might be interested in each specialty, and finally for specialists within each specialty. Education experts could assist in the best possible organization and presentation of material. Voluntary, easy-to-take self-evaluation should be a prominent characteristic of the system.

Pilot studies should play a large part in this initial effort. Packaging and media specialists should be looked to to make the various materials more attractive. Just as television commercials are compact, they are also powerful and effective. Industry could be invited to help. Translatability is an important feature, so that other nationalities could be brought into the American resource picture. Compatibility of equipment should be stressed. Some evaluation machinery should be a requisite of everything that is done.

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*Submitted by John K. Lattimer, M.D., Chairman, Department of Urology, Columbia University College of Physicians and Surgeons.

Discussion

Dr. Wedgwood: Let us look for a moment at the business of getting experts to develop and revise informational units. In actual fact, if such informational units were developed, even if they were not developed by authorities in the field, as soon as they were released they would be criticized very rapidly. Because of the general availability they would be brought immediately to the attention of experts, and the feedback mechanism would inevitably start the interaction between the authorities responsible for the development of the units and the experts in the field. In fact, one can argue that it would not be necessary to have the experts developing the units, but it might rather suffice to have less expert people doing the work and making sure that it was brought to the attention of the authorities for accuracy and of the consumer for relevance.

Dr. Smythe: We ought not run away from the evaluation idea just because it is difficult. On a national basis, a group of people who represent quality, concern, enrichment, resource upbuilding, and better education ought to have the courage of their convictions and insist that material be good before it is accepted for national distribution. This is not a policing role. We are willing to evaluate other portions of medical education. We accredit medical schools.

Dr. Livingston: The government does not accredit medical schools, and the government does not accredit residencies. It is very different if a professional society does this. Evaluation has to be so fair in terms of making possible the emergence and encouraging the emergence of all sorts of teaching contributions that are not under the umbrella of any official agency. The country must remain elastic rather than become standardized in terms of medical education.

The development of curriculum is going to be very jealously guarded by the faculties of the various medical schools in the country. Any attempt to develop curriculum at a national level is likely to interfere with long-range progress and to interfere with potentialities for improvement that spread like a contagion rather than by some federal edict. I would be cautious about endorsing a program which aims to define teaching standards and teacher evaluation on a national basis. Whether that was intended or not is not clear, but if it was, it should be a matter of some discussion before it is admitted as the consensus of this group.

A network presents the possibility of tapping the best resources in the country for special knowledge, and for special competence in communication of that knowledge, and for particular ability to evaluate the progress of student learning. If you try to pick the best experts in the country in various disciplines, in effect you are making some kind of measurement, but you are not imposing these as a standard. A national network or resource could look about the country and make contributions which should be taken on an ad lib basis in part or in whole by any or all of the schools. There is no school which has across-the-board competence, the equivalent of what such a national network might provide. Evaluation of curriculum content and evaluation of teaching performance, I think, would be irregular for the National Library of Medicine to undertake and probably not anywhere near top priority in terms of national needs.

Neurosciences is my concern. I would be embarrassed to be on a national panel concerned with what should be in a neurosciences curriculum. It is bad enough arguing in a committee of our own faculty. Any effort to develop a national core curriculum would tend to stifle rather than encourage the development of all the excellent neurosciences resources in this country.

Dr. Feldman: This is an unfortunate and unnecessary hangup. Only specialized forms of information for specific purposes have been suggested. The proposed committees and panels have nothing whatever to do with a national curriculum. In such a system, control over content would be entirely in the hands of nongovernmental people.

Dr. Cole: No one suggested that use would be anything but optional. A network is simply to assist an individual effort.

Dr. Miller: The intent was to try to focus the attention of these subject groups or working committees, however they are established, upon the identification of what behavior it is that we are attempting to achieve by whatever means is offered. This is the idea captured in Dr. Fusaro's suggestion of core competence. At some level students ought to be able to do a certain number of things. At a certain more advanced level, they ought to be able to do some other things, and at a further advanced level, some additional things. Thus, the aids or the resources ought to be designed to help people toward the defined levels of competence rather than just develop them at random with the hope that they will achieve all of these goals and the assurance that they will achieve none.

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*This list includes only those who actually attended the Conference and their titles as they were in February of 1969.

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