REGIONAL ADVISORY COMMITTEE ON COMPUTERS IN HEALTH

First Meeting

PAN AMERICAN HEALTH ORGANIZATION
Pan American Sanitary Bureau, Regional Office of the
WORLD HEALTH ORGANIZATION
1970

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Buenos Aires, Argentina
13–17 April 1970

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PREAMBLE

In accordance with a recommendation made by the Fifth Meeting of the Regional Advisory Committee on Health Statistics in November 1968, planning for the Regional Advisory Committee on Computers in Health was begun late in 1969.

In the fall of 1969 the Director of the Pan American Sanitary Bureau established a Computer Science Section by consolidating all the existing computer personnel and activities within the Organization and then appointed a Computer Scientist as the Section Chief. The Director charged this Section with promoting computer science throughout the Region as well as with supportive functions for both the technical and the administrative activities of the Organization itself.

The new Computer Science Section was responsible for planning and conducting the First Meeting of the Regional Advisory Committee on Computers in Health.

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I. INTRODUCTION

The Regional Advisory Committee on Computers in Health met in Buenos Aires, Argentina, from 13 to 17 April 1970. Facilities for the meeting were graciously provided by the Argentine Ministry of Public Health. In his welcoming address, Dr. Abraham Horwitz, Director of the Pan American Sanitary Bureau, pointed out to the Committee members the important role that the use of computers will undoubtedly play in the development of health services and medical knowledge in the countries of the Americas.

He commented further that one serious dilemma which developing countries now face is how to reconcile centuries of tradition and customs with an extensive explosion of scientific knowledge and complicated technological methodology, oriented toward the progress and well-being of the entire population. The critical stage in this dilemma is reached when it becomes necessary to accept and make decisions which entail commitments for action drawing on already scarce resources. More and more frequently, it is being realized that such a stage should not be reached without having available a mechanism to synthesize large volumes of information which cannot be conveniently processed by traditional methods. Computers introduce the possibility of handling large volumes of data, and promise a great deal for the consolidation of knowledge upon which to base immediate decisions and subsequent actions particularly essential in the field of health.

This, and many other considerations, prompted the Director of the Bureau to call this Advisory Committee to review the present situation and future prospects and to make recommendations regarding methods for introducing and applying computers in health and medical services in the countries of the Region.

Recommendations of the Fifth Meeting of the Regional Advisory Committee on Health Statistics, November 1968

The recommendations made to the Pan American Health Organization,[1] which included seven major items, were read to the Commit-

[1] *Scientific Publication PAHO* 177, 14-15 (1969).

tee by the Rapporteur. These items together with brief comments made by the Secretary are listed below:

1) That a survey be conducted to determine the computers available for use in the health field in the countries of the Region and the personnel trained in this field.

A survey has been conducted; the results are being summarized and will be published at a later date.

2) That a meeting of a Regional Advisory Committee on Computers in Health, comprising representatives from various countries of the Region, be convened.

This document represents the work of the above-mentioned Committee.

3) That the Organization study different types of computing equipment available, their cost, capability and reliability, and make this information available to the Region.

A publication containing this information—*Computer Characteristics Review*—is commercially available and is published quarterly by Keydata Corporation, 108 Water Street, Watertown, Massachusetts 02172, U.S.A. This publication will regularly be made available to the Zone representatives of the Pan American Health Organization.

4) That the Organization promote the training of personnel to use, understand, and appreciate computers.

Some staff training has been in progress for several months at the Washington Headquarters. A more formal and structured training program is being planned. Also, it is hoped that, with the assistance of the United Nations Development Program, a major activity of the Computer Center in Buenos Aires will be to provide training for health personnel in various countries in Latin America (see Committee recommendations, page 24).

5) That the Organization expand its advisory services to national health services and other health institutions.

The Director charged the Computer Science Section with providing such consultative services. Several consultative visits have taken place during the last few months and many more are planned for the future.

6) That the Washington Headquarters function as an exchange center for computer programs and technical information.

Such an exchange service has begun and will be in full operation by the end of 1971.

7) That the Organization explore the possibility of securing central locations for data processing services.

It is expected that the Computer Center in Buenos Aires can operate as a central location. The recent computer survey suggests other computer centers which, with additional assistance, could provide services. The Organization is planning to promote the development of several computer facilities in the Region.

Computer Demonstrations

A third generation electronic digital computer, an IBM360/50, has recently been installed in the José de San Martín Hospital, a major teaching hospital of the School of Medicine of the University of Buenos Aires. The establishment of the Computer Center for Health was made possible through the cooperative efforts of the University and the Ministry of Health of Argentina and consultative services of the Pan American Health Organization.

The computer was made available to the Committee for various types of demonstrations. Mr. Leonard McGann, of the U.S. National Center for Health Statistics, demonstrated a program for selection of the underlying causes of death, logically determined by the computer from the various causes provided in death certificates. At the same time, Dr. Salvador Bozzo, of the Pan American Sanitary Bureau, demonstrated one of the Center's "Medical Information System Programs" developed for scheduling outpatient appointments, which include a wide variety of alternatives for special or general treatment and which automatically match the patient with an appropriate available physician.

Inauguration of Computer Center

On Wednesday, 15 April, the Committee was invited to participate in the official inauguration of the Computer Center for Health located at the José de San Martín Hospital. Those present included Dr. Ezequiel Alberto Dago Holmberg, Secretary of State for Public Health, and Dr. Alberto F. Mondet, Under-Secretary, Argentina; Dr. Abraham Horwitz, Director of the Pan American Sanitary Bureau; Dr. Andrés Santas, President of the University of Buenos Aires; Dr. Carlos García Díaz, Dean of the School of Medicine; and Dr. Marcelo Díaz Cano, Director of the José de San Martín Hospital.

II. SUMMARY OF PRESENTATIONS

Five reports dealing with the uses of computers in health and medical services provided a background for the discussions and recommendations. These presentations have been summarized for this report, as follows:

Systems Approach to Planning of Health Care Services, by Erling Dessau

The cure of patients and the maximum allocation of resources for preventive medicine activities are two basic components of a balanced health care system; and the third, and perhaps most important, contribution to the health care system is the optimum interplay between the physician and his patients. This paper discussed the potentiality for the development of the health service system through the application of various analytical procedures.

Modern diagnostic procedures, the advances in medical technology (and electronics), the demand for efficiency and for optimal allocation of scarce resources, and the requirements of management of the complex health system have justified the introduction of computer technology and the use of operations research methods, econometrics, and systems engineering in the field of health care.

The paper dealt with the potential advantages of applying computer procedures for the planning of health care systems and discussed the idea and concepts of the following:

a) Program planning and budgeting for health care.
b) Econometric studies in health care.
c) Cost-effectiveness and cost-benefits in health care and evaluation procedures.
d) Selection of systems optimization criteria.
e) Systems approach and integrated systems in which needs and efforts are closely related.
f) Operations research methods.
g) Application of advanced statistical analysis of health data for health planning.
h) The role of the information technologist in the health care system.

The training and education requirements for introducing these methods into the health care area and the possible role of the UN/WHO in advancing these ideas were discussed. Special reference was made to related activities at the UNDP Computing Research Centre in Bratislava and to the recent meeting of the Working Group of the WHO Regional Office for Europe, held in Bratislava in February 1970.

The Computer Resources Program of the U.S. National Institutes of Health: An Introspective Review, by William Raub, Ph.D.

The National Institutes of Health of the United States, as part of its Special Research Resources Program, provides grants to academic and other nonprofit institutions for the support of computer centers serving life-science research. These computer resources generally have three component activities: service, technological innovation, and training. As foci of multidisciplinary endeavor, they facilitate the application of computer science, mathematics, and engineering to health problems. The resource mode of support has proved to be a near ideal administrative form for continually interjecting the latest computer technologies into the biomedical area and, even more important, for making the resource's own computer research activities responsive to the unfulfilled needs of the surrounding user community.

This paper described how NIH-supported computer resources relate, both organizationally and operationally, to life-science research programs. Aggregate funding levels and trends involving the various types of computer centers over the past several years were reviewed. A num-

ber of specific resources were highlighted and examples of their scientific and technological accomplishments were given. Finally, the strengths and weaknesses of this NIH program, as derived through reflection on almost a decade of activity, were presented.

Use of Computers in Processing Health and Vital Statistics, by Leonard McGann

The paper identified three major characteristics of a computer: (1) its enormous ability to take numerous different actions on values, (2) its accuracy, and (3) its speed. For example, a human may take, say, 60 meaningful actions in a minute, and the computer perhaps a billion meaningful actions in a minute. We have not yet begun to utilize the power of the computer as a tool. We must also be warned that with this tool we can produce nonsense at almost infinite speed.

The primary goal of the Division of Data Processing at the National Center for Health Statistics is to produce health and vital statistics for the United States. Secondary goals include strong training programs and some computer science activities.

The Division is organized into four major sections. These are, with the number of employees, as follows: Data Preparation (102), Operations (24), Research (6), and Programming (45). The office of the Division Director (8) has two special units: Training (5) and Consultation (8). The total number of employees in the Division is 198.

The paper described the major activities of the Division in the following five fields:

1) Direct keyboard to tape operation (no card punching).
2) Production of vital statistics (first priority).
3) Processing medical examinations from surveys.
4) Determining health resources.
5) Research and development in data acquisition and reproductive devices.

An important function of the administration of the Division is the establishment of time schedules for all aspects of data acquisition. Activities of the Division are organized according to a predetermined time schedule.

Other activities of the Center in the development stage were discussed, namely:

1) Programs for determining the underlying causes of deaths.
2) Natural language coding.

3) Use of the current medical terminology for coding.
4) Sampling procedures for health interviewing.

A Medical Data System for Health Services, by Morris F. Collen, M.D.

The paper pointed out the increasing emphasis that is being given, in all parts of the world, to the development of new methods for the efficient delivery of health care. Systems analysis, operations research, and computers have been applied successfully to general business, industry, and defense areas. The time has arrived to exploit new technology for health by utilizing modern systems, data processing, and communications techniques in the medical industry.

There is an increasing need to implement computer applications in the delivery of health services. The paper described such an application in a large computerized medical data base for hospital and outpatient services, including automated multiphasic screening.

Currently, the medical data system at the Kaiser-Permanente medical care program in Oakland, California, is providing the following applications:

1) *Health services:* In one year the program processes the automated multiphasic screening data for 60,000 periodic health examinations, physicians' diagnoses for 500,000 office visits, 300,000 prescriptions for outpatients, 1,000,000 chemical laboratory tests, and 100,000 X-ray reports. It maintains identification files for almost 1,000,000 active patients.

2) *Research:* Population standards are being developed through the establishment of normal values. Epidemiological research is now being conducted economically for large population groups over long time periods, using the large data base provided by the computerized system for such common and important conditions as diabetes and heart and kidney disease. In addition, a computerized drug reaction monitoring system, using an epidemiological approach to the monitoring and detecting of adverse drug reactions, is actively in progress for a total of 125,000 people in San Francisco. Health services research to investigate innovative methods for providing medical care is being conducted to evaluate cost-effectiveness of the traditional versus multiphasic periodic health examinations, to assess the impact of a computerized information system upon a hospital, and to test the feasibility of automated multiphasic screening as a new entry into an innovative medical care delivery system employing allied health personnel in a health education center with monitoring clinics for common chronic conditions (e.g., hypertension, diabetes, obesity).

Organization and Activities of the Computer Center for Health at the José de San Martín Hospital, Buenos Aires, by Carlos Poljar

The agreement of 19 June 1968, entered into by the School of Medicine of the University of Buenos Aires, the Secretariat of State for Public Health, and the Pan American Sanitary Bureau, for the conduct of a "program of training, research, and development of the applications of electronic data processing in the health field in the Republic of Argentina," formed the basis for the establishment of the Computer Center for Health at the José de San Martín Hospital.

This paper dealt with the basic aims of the Computer Center for Health, which can be summarized as follows:

1) To train scientific and technical personnel so as to staff health facilities with systems analysts, programmers, and computer operators, and to familiarize the executive personnel of those institutions with the techniques of computer science and data processing.

2) To provide institutions and health services with advice in the field of systems analysis, programming, and computer operations, and to give guidance to the personnel assigned to use these resources, both well in advance and during the installation and operation phases.

3) To undertake research on the development of techniques, systems, and programs which can be applied to the processing of medical and health data.

4) To coordinate the operation of all the equipment employed by health institutions in order to ensure that it is used as efficiently as possible.

III. GENERAL DISCUSSION

The Committee was briefed on the number and the wide use of computers throughout the world. It is estimated that there are over 100,000 computers in use today in the world. Of these, perhaps 60,000-70,000 are in the United States. The actual cost of doing calculations on computers is declining. However, the cost of preparing a finished instruction (programming) is increasing. For example, for three different years the costs of 100,000 calculations were as follows:

Year	*Cost US$*
1951	25.00
1966	0.02
1970	0.009

For the same three years the costs of preparing one instruction were as follows:

Year	*Cost US$*
1951	4.50
1966	6.00
1970	7.00

The Committee was provided with a lengthy list of possible topics for discussion. After considerable debate, eight topics together with specific objectives were selected and these eight are the subjects covered in Sections IV-XI of this report. Of the eight topics, the three that were given priority (Sections IV-VI) were as follows:

1) *The health of a population or nation:* It was agreed that the most important and the first uses of computer resources should be applications to describe the health of a population and to ensure mechanisms for continuously monitoring its health status. In this regard, the collection, preparation, computer processing, and publication of vital and health statistics, including periodic publication of notifiable diseases, was to have the highest priority.

2) *Health manpower and health facilities:* The Committee believed that the next priority in the application of computer resources should be to describe and continuously monitor the health manpower and health facilities of a given population or a nation.

3) *Health planning—A systems approach:* The Committee stated that, following the development of data banks on the health status and on health manpower and facilities, the computer could be made to play an important role in health planning by using a total systems approach involving such methods as operations research and simulation models.

Conceptually, the process as applied to a simplified plan for a health system is diagramatically illustrated in Figure 1.

The other five topics selected for discussion (Sections VII-XI) were:

1) The use of computers in health and medical facilities.

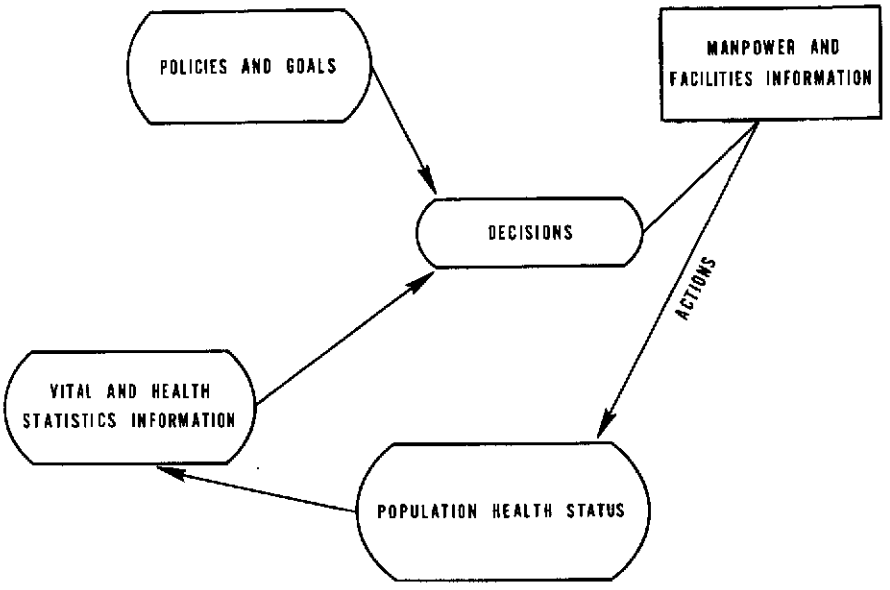
2) The administration, procurement, and funding of computer centers in health facilities and medical schools.

3) Life-science research using computers.

4) Training of health personnel to use and appreciate computer resources.

FIGURE 1

SIMPLIFIED PLAN FOR A HEALTH SYSTEM



A. The objective is to optimize the health status of a population.

1) *Information on the health status* is determined from vital and health statistics.

2) *Information on resources* used to optimize the health status is determined from data on available manpower and health facilities.

3) *Health planning* is accomplished by making decisions based on policies and goals utilizing the information in (1) and (2).

4) These *decisions* are transformed into *actions* which change the status and level of health through channeling of the available resources (a dynamic feedback system).

B. The computer is used to:

1) Process data regarding the *health status* and *health resources* and produce relevant *information* (a data processing problem).

2) Work out *models* and do *simulations* to assist *planners* in making decisions resulting in actions necessary to modify the health status of a population (a scientific computer problem).

C. Conditions that limit the system should be carefully studied (boundary conditions).

5) The use of computers to assist in the administration of health services (i.e., accounting, payroll, stores, etc.).

IV. THE USE OF COMPUTER RESOURCES IN DESCRIBING AND MONITORING THE HEALTH OF A POPULATION OR NATION

Information regarding the health of a population group is derived principally from mortality and morbidity statistics. Mortality statistics, together with statistics on births, marriages, and fetal deaths make up the vital statistics system. In Latin America these statistics are produced by various separate institutions (civil registry, health sector, national office of statistics, etc.). The development of vital statistics has received preferential attention from several international bodies, and in particular from the Pan American Health Organization, not only because of their significance in the health field, but also because they constitute the most important source of information on a country's population dynamics.

The use of electronic data processing in the vital statistics system offers many advantages. It is not claimed, of course, that the use of a computer for vital statistics alone is justified, but if its use on a general basis is justified the production of vital statistics should then almost certainly receive priority.

The advantages lie in the facility with which tabulation and publication can be carried out; better quality control; easier investigation of multiple causes of death; elaboration of birth indices; updating of medical records; incorporation of improved techniques for census and identification records, and so forth.

Information systems on morbidity within a population group are almost totally linked to the health sector. The best known systems are based upon morbidity data on hospital discharges and patients attended in outpatient clinics, cases of notifiable diseases, and special surveys which are carried out to determine the prevalence and incidence of certain diseases.

A large volume of data is usually provided by these information systems, and data processing offers the tremendous advantage of producing data quickly and flexibly enough to permit, within a data bank,

the reconciling of morbidity data with mortality statistics, with data on available medical care and services, and with other information that greatly broadens the horizons of administrative and epidemiological research.

RECOMMENDATIONS

a) The Committee recommends that the Pan American Health Organization provide guidelines regarding the procedures involved in producing vital and health statistics on computers. In this regard it points out that the computer is only one aspect in a long sequence of events involving data acquisition, data preparation, computer program specifications and development, computer processing, and eventual printing and publication.

b) The Committee suggests that the Organization promote more research in the area of vital statistics, especially that dealing with the underlying causes of death.

c) The Committee calls attention to the potential uses of vital statistics in areas other than the health sector—for example, educational resource planning, transportation, and community development.

V. THE USE OF COMPUTER RESOURCES IN DESCRIBING AND MONITORING HEALTH MANPOWER AND HEALTH FACILITIES

The Committee believes that an adequate knowledge of the human, institutional, and financial resources of the health sector is vital to the efficient administration of the services. This knowledge requires special research and the application of highly advanced techniques. It entails a multidisciplinary effort and, because of the complexity and volume of the information collected, the use of the most modern methods of computer science and analyses are essential.

In discussing the feasibility of utilizing computers in the above activities, the Committee pointed out the following major difficulties:

a) The large number of institutions which dispense health care with little or no mutual coordination.

b) The lack of uniformity in the statistical systems in use.
c) The duplication in recording information.
d) The financial problems involved in acquiring, operating, and maintaining computers.

RECOMMENDATIONS

The Committee recommends that the Governments adopt automated systems to handle information on health resources as rapidly as economic and administrative considerations permit. As a first step, all possible efforts should be made to overcome the aforementioned difficulties. The Committee likewise recommends that, prior to the acquisition of the equipment, the Governments provide the technical assistance and personnel training necessary to ensure its efficient utilization.

VI. THE USE OF COMPUTERS IN HEALTH PLANNING—A SYSTEMS APPROACH

A complete, reliable, and effective use of health statistics forms the basis for all national health planning. The Committee recognizes the importance of improving vital and morbidity statistics in order to obtain the required information to be used in planning, and it endorses fully the proposal to give high priority to the use of computers for such statistical purposes.

Because of the importance attached to health planning and to the over-all systems approach to the development of the health care system, the Committee emphasizes the need for applying to the largest possible extent computers for such tasks.

National health planning is at present to a large degree inhibited by the difficulty of correlating complex factors of a medical, social, and administrative nature. It is felt that these difficulties and the time lost in overcoming them could be reduced considerably by the application of modern electronic data processing for the planning and implementation of health programs.

The Committee recognizes that extremely large benefits will derive from applying the systems approach to the development of the health

care sector in the countries of the Americas. This is further accentuated by the necessity of taking into account the numerous factors operating in the health care system and the importance of showing the interaction with the population, the various government agencies, etc.

RECOMMENDATIONS

The Committee therefore recommends that the Organization urge the countries of the Americas to devote efforts and assign special working parties to develop and apply computer technology in the process of health planning.

Special emphasis should be placed on developing a long-term master plan for the health system, although the actual implementation should be made step-wise and the system thus be of modular construction.

The countries should be urged to apply modern management techniques such as operations research, program planning and budgeting, and econometrics, and also to apply cost-benefit and cost-effectiveness procedures. Attention is further called to the need to correlate the vital statistics and morbidity data with the data on health care resources, and to conduct studies on the propensity in a given population for consumption of health care and on the actual and anticipated use of health care facilities.

Recognizing the aforementioned advantages of an over-all systems approach and the utilization of computers, and the possibility that many countries may be able to by-pass certain unimportant basic steps (by leap-frogging), the Committee makes the following specific recommendations:

a) That each country be urged to establish a long-term plan for the development of its health care system.

b) That a detailed systems study encompassing the interests of health administrators, health statisticians, and medical staff be implemented.

c) That every country interested in the further development of the health care system be urged to set up a systems team in its health planning offices and make use of internationally recruited experts to advise on the work of such teams.

d) That any system instituted should be modular and that a phased program should be established, for step-wise implementation.

e) That studies be made of the potential need for organizational changes and of changes in the practice of medicine required by the modern techniques now available.

f) That the Organization encourage the countries to make extensive

use of cost-benefit and cost-effectiveness analyses, econometrics, and operations research in health.

The Committee makes the following additional recommendations to the Pan American Health Organization:

a) That it carry out explorative studies on the value and validity of vital and morbidity statistics to be used in the planning process.

b) That it examine the actual and planned use of computers in health systems planning.

c) That it review the possibilities for application of analytical procedures and modern managerial techniques such as operations research, program planning and budgeting, econometrics, and cost-benefit and cost-effectiveness analyses.

d) That it assist the countries of the Americas in developing the programs for integrated data management in health care applications.

e) That it build up a prototype over-all system for health care and have available experts to assist the Governments of the countries of the Americas in setting up systems teams in the offices for health planning, and that experts also be made available for implementing the over-all systems approach in the respective countries.

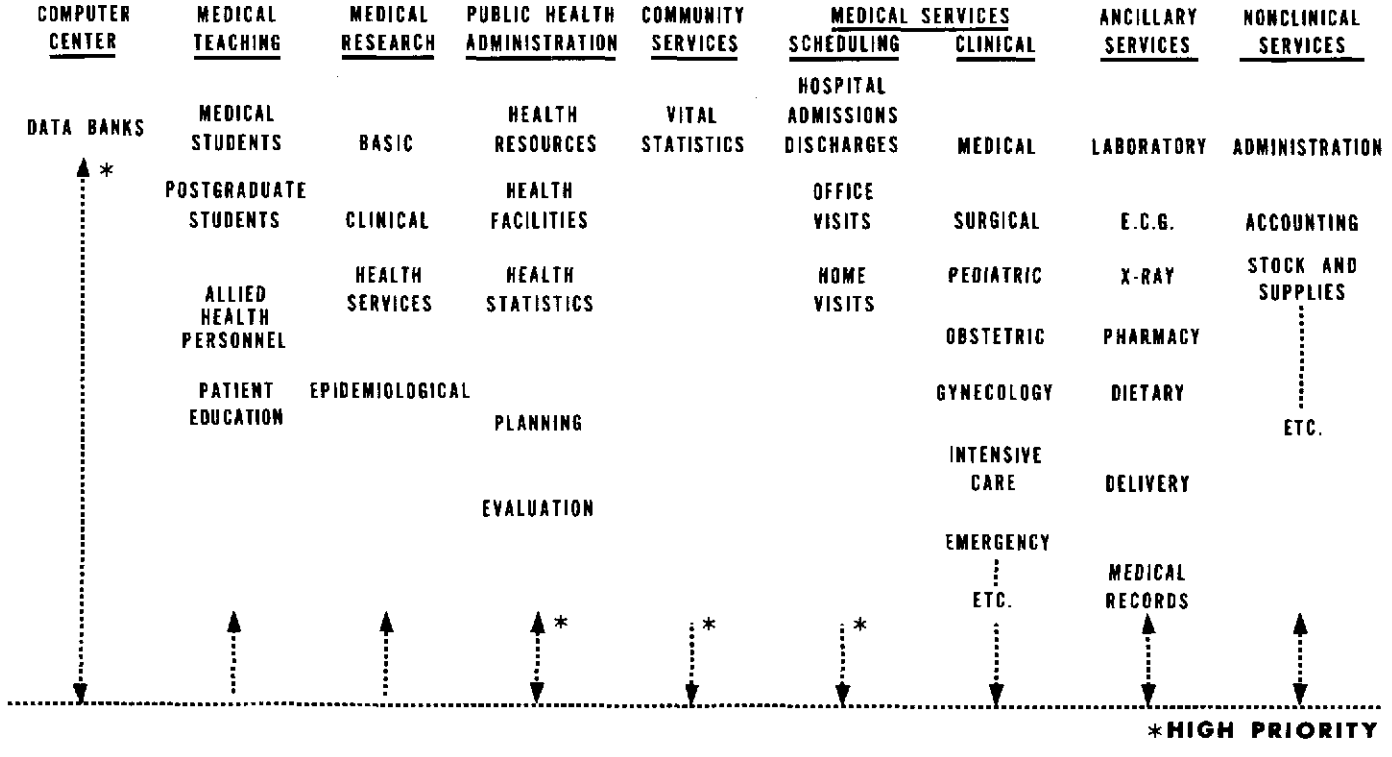
f) That the Computer Science Section of the Pan American Sanitary Bureau act as a coordinating and information exchange office for all applications of computers in health planning.

VII. THE USE OF COMPUTERS IN HEALTH AND MEDICAL FACILITIES

The need for computers in medical facilities has developed because of the increasing volume and cost of medical information, especially in hospitals. For example, the number of laboratory tests performed in hospitals in the United States of America has doubled in the past five years. Furthermore, the cost of handling information in those hospitals has been measured as being one-third of the total operational cost per patient-day. It is obvious that the amount of medical information and its associated costs can only increase in the future, so it is essential to use automated data processing methods to help with this problem.

FIGURE 2

PLAN FOR A TOTAL HEALTH INFORMATION SYSTEM



The objectives of using computers in health facilities should be to acquire essential patient data, including identification and medical diagnoses, by an acceptable prompt method, so as to do the following:

a) Improve the timeliness of data.
b) Improve the quality of data.
c) Provide new data for administration and planning.
d) Hold down the increasing costs of information handling.
e) Help establish standards for hospital services and monitor quality of such services.

RECOMMENDATIONS

The Committee recommends that the methods and procedures for using computers in health facilities be directed first to providing input of data from those medical services components identified as high priority in the "Plan for a Total Health Information System" (Figure 2). The acquisition of discharge diagnoses from all hospital patients should be of the highest priority so as to provide data indicating use of expensive hospital facilities and prevalence of serious diseases in the population. The importance of such data is second only to that of vital statistics.

It would be desirable to obtain from physicians the data giving the reason for outpatient office visits, since most medical care is provided outside hospitals. Simple forms can be developed so that doctors can provide patient identification and morbidity data to be entered into the computer data bank.

The result will be that (1) public health administrators can obtain from the data bank the statistics necessary to monitor the health of the population, and (2) doctors and hospitals can upon request obtain essential medical data on prior medical services rendered to individual patients. To achieve the computerization of health statistics and morbidity data will require at least a five-year commitment of a large amount of money in addition to a well-qualified team of medical and computer personnel. The ancillary services, such as the clinical laboratory, should be of next priority. Clinical services, such as the medical and surgical departments, are most difficult to computerize.

Therefore the Committee recommends that, within medical school hospitals, programs be established to train personnel to begin pilot projects for clinical applications such as X-ray dosage schedules, intensive patient-care monitoring services, etc. It is anticipated that most hospitals will eventually have small dedicated computer processors, some of

relatively low cost, all generating medical data which will eventually be entered into the central patient data bank.

Administrative nonclinical services are not difficult to computerize and this should be done early in order to assist with improving operational efficiency.

In planning for the use of computers for a total health information system, special consideration should be given to the best use of the computers for four types of medical research (Figure 2)—health services, epidemiological, clinical, and basic science research. To ensure the greatest assistance to a country, computer applications for health services and epidemiological research should be supported. The use of computers for clinical research is best conducted within medical school hospitals. Computer applications for basic science research is best conducted within special research institutes.

It is recommended that a central patient data bank be established with the patient files so constructed that not only digital data but also natural language medical information can be entered. This is essential so that health administrators can monitor and become aware of new conditions which appear in a community, even if the condition is not included in standard disease codes. The establishment of a "health information system," in contrast to an administrative or accounting information system, requires that the patient computer record in the data bank be established as a variable-length, variable-format file permitting the storage and retrieval of natural language. This will provide a data bank to eventually satisfy the physicians' requirements for medical information necessary for medical service.

VIII. ADMINISTRATION, PROCUREMENT, AND FUNDING OF COMPUTER CENTERS IN HEALTH FACILITIES AND MEDICAL SCHOOLS

GENERAL CONSIDERATIONS AND RECOMMENDATIONS

It is recommended that, before a computer system is adopted, there should be a plan which has been completely studied both from a financial point of view and from that of the activities to be undertaken to

develop adequate basic information which is properly organized, timely, reliable, and readily available to the users. What is to be done and what is not to be done should be precisely established.

A suitable staff must be available for the operation, maintenance, and administration of the system, and there should be proper coordination and complete understanding between the health administrators and the computer center staff.

Experience has shown that, to avoid failure, the following requirements should be met:

a) A five-year plan, with priority given to the modular components.

b) Commitment of the responsible agency, also for a minimum of five years.

c) Adequate investments, approved for the five years, as an ineluctable commitment.

d) Assurance that the entire staff that directly has any dealings with the computer center has the medical and computer competence to carry out responsible work on a level comparable to that in other scientific and technical disciplines.

The computer center should be placed at a decision-making level, where it can give balanced consideration to the work projects and plans the system must execute. There must be a proper administrative organization which responds to a functional organizational chart in which there is a realistic and good interrelation between the chief and the rest of the staff; in respect to the chain of command, priority decisions will be made by the chief, though not to the exclusion of contributions by the rest of the team.

The chief of the computer center must be a capable person from the technical, computer sciences and administrative point of view, and must not lack the ability to make use of good human relations which will enable him to make the working team a cohesive and well-coordinated unit.

It would be useful to have a group of consultants or advisers who report their views on priorities and resources to the chief of the computer center and aid him in broadening his knowledge of community characteristics so that he will be in a position to make the most appropriate decisions. This advisory group should be made up of computer technicians as well as of users who know something of computer operation. The professional who requires the services of the computer center should collaborate closely with the technicians so as to ensure a complete interpretation of the user's needs.

To achieve maximum efficiency, it is urged that the broadest and most efficient specific training be given to all personnel involved, re-

gardless of their position in the hierarchy. It must be stressed that it is advantageous for the user to know what he can get from the system and, where possible, certain aspects of its special operation with regard to the configuration of a program. Standardization of the work and avoidance of incompatibility of equipment are always to be recommended.

With regard to the financial aspect, the staff's salaries should be competitive with those in the commercial or private sector and the cost of the machinery should be amortized in a maximum of four years, including all maintenance, preservation and other additional expenses, and periodic evaluations should be made with regard to the economic yield the equipment is giving. It is recommended that no payment be made for the purchase of any equipment that is not functioning with proper efficiency.

It is very important to be able to count on assured, continuous service, just as it is to make certain that the system is compatible with other systems, in case two or more are available, and that they are also homogenous. Thought should be given to the possible future need for more powerful equipment which operates without interruptions, and increases in demand and deterioration of the equipment should also be foreseen.

It is recommended that, wherever possible, the equipment be used *exclusively* by the health sector. Nevertheless, the decision to have a central system for the exclusive purposes of health must take into account the use that will be made of the computer, its administration, and the resources available for its operation.

SPECIFIC RECOMMENDATIONS CONCERNING THE MANAGEMENT OF COMPUTER CENTERS IN HEALTH FACILITIES AND MEDICAL SCHOOLS

In initial explorations of the use of computers in health programs, it should be recognized that effective and efficient use can be made of general purpose facilities shared with non-health programs. However, in order to allow maximum flexibility in matching current computer technology to the varied and highly specialized needs of the medical community, computers devoted solely to health programs should be given every consideration. Whenever it proves necessary for health programs to share computer facilities with non-health programs, a special effort should be made to identify the technical and administrative compromises required, the resulting constraints, and their implications.

At the time of inception of a computer center devoted to health programs, the scope of the health activities to be served should be

clearly delimited. Within this defined scope, a set of objectives should be established and a timetable for their fulfillment should be prepared and followed.

Whenever possible, computer facilities for health programs should be located physically near the health personnel whom they are to serve. These computer centers should be associated administratively with the executive office to which all the user groups are responsible.

The chief of a computer center should be assigned the task of assisting users in the preparation and utilization of computer programs and the applications of mathematics, statistics, and physical science concepts in biology and medicine.

A health computer center should establish a continuing formal program to recruit and train computer specialists such as systems programmers, application programmers, digital engineers, electronic technicians, and machine operators. In order to attract high-quality individuals and to reduce as much as possible the staff turnover rate, every effort should be made to provide computer center personnel with salaries and working conditions that are competitive with other job opportunities available to them.

Funds made available for computer centers for health should include those for personnel and supplies and other operating expenses as well as the costs of equipment. In planning for a center it should be stressed that the costs of software development and other aspects of system implementation usually exceed the costs of the hardware involved.

Whenever possible, computer centers for health should be totally financed by the responsible agency in the early years of their operation and provide free services to their user community. Administrative procedures should be established for continuous monitoring of cost-effectiveness in the use of these funds. During the period of free services users should repeatedly be made aware of the actual costs of the services they are receiving; memorandum billing and other administrative measures for accomplishing this purpose should be explored. Once a computer center has reached a stable level of operation, at least a portion of the operating costs should be assumed by the user community in order to diversify and stabilize the bases of financial support for the center.

In selecting a computer system, a computer center for health should, through explicit contractual arrangements, require the vendor to meet specified performance requirements for the entire system, both hardware and software. Issues such as the compatibility of the equipment with other existing and planned systems, and the extent and quality of continuing vendor services, if any, should be carefully considered.

Whenever possible, standard operating systems, programming lan-

guages, and other information-handling techniques should be employed in order to enhance the exportability of the software at the center and to facilitate the implementation of programs and software systems developed by others. Careful attention should be given to the development and use of documentation standards.

The chief of the computer center for health should have available an advisory group which is representative of the user community. This advisory group should assist in the formulation of operating policies and procedures, the definition of priorities, the allocation of resources, and the preparation of long-range plans.

IX. THE USE OF COMPUTERS IN LIFE-SCIENCE RESEARCH

The Committee defined life-science research to include fields of study ranging from molecular biology, genetics, cytology, physiology, and epidemiology to psychology and sociology.

RECOMMENDATIONS

Every effort should be made to encourage the use of computers in health research. Programs and procedures should be established to facilitate the access of life scientists to appropriate instrumentation, to consultation, and to reliable and well-documented programs.

All concerned with computers in health research programs should recognize that exposure of life scientists to expertise in mathematics, engineering, and the physical sciences is as important as exposure to the computers themselves.

Personnel of life-science computer facilities should be encouraged to visit other centers frequently, since papers and reports in journals and other traditional methods of documentation tend to be both incomplete and untimely in the computer field.

Health scientists should be encouraged to formulate their problems for computer applications even if there is uncertainty about the feasibility of the timing of a final implementation; these health-scientist

computer users should be made aware of the over-all benefits which derive from the *mental discipline* associated with computer use.

The Committee identified the following areas as those having the highest priority within the limitations of the funds available for life-science research. It was also recognized that priorities may vary from country to country and no specific order of priorities was recommended.

Priorities for the use of research funds in the life sciences

1) Improved methods of providing medical care services.
2) Epidemiology.
3) Clinical research.
4) Basic sciences.

In view of the importance of life-science research and the limited funds available for such work, the Committee recommends to the Pan American Health Organization that a special advisory group be organized to assist in determining which areas of study should receive the highest priority.

X. TRAINING OF HEALTH PERSONNEL TO USE AND APPRECIATE COMPUTER RESOURCES

The Committee agreed that there has been little actual computer training for health personnel in the Americas. It was suggested that certain courses be provided for the training of physicians, nurses, medical records librarians, and health administrators. These courses should include: (a) basic data handling; (b) operations research; (c) some simulation techniques. It was further suggested that computer scientists be provided training in medical procedures to enable them to serve effectively as members of a medical team. The problem of overloading the medical coursework was discussed. For most physicians a few seminars would be sufficient.

The Committee identified three levels of training for health personnel: (1) systems programming, (2) application programming, and (3)

users' orientation. To train a physician to be an accomplished systems programmer usually takes from four to five years, at least 50% of the training time being spent with the computer resources. To train a physician, a nurse, or a laboratory technician to become an applications programmer usually takes from three to four months of full-time activity. To train users, especially on the input-output devices, usually takes only two or three seminars. The Committee agreed that training should be directed toward the proper use and appreciation of computers, and not toward invention of new hardware. In this regard the Americas can benefit a great deal from the computer applications now existing in the United States.

RECOMMENDATIONS

The Committee specifically recommends that the Pan American Health Organization (1) provide long-term fellowships of one to two years' duration to train physicians in computer hardware and software systems; (2) provide short-term fellowships of three to four months' duration to train various types of health personnel in applications of computers to the solution of health problems; (3) organize a traveling seminar on computer uses to be given by its Headquarters staff and short-term consultants and conducted in various countries of the Americas. It was recognized that the Computer Center in Buenos Aires would be an ideal location for the initiation of such a training program.

XI. THE USE OF COMPUTERS IN THE ADMINISTRATIVE ACTIVITIES OF HEALTH MINISTRIES AND HEALTH SERVICES

The use of computers in administrative activities provides opportunities for research, development, improvement, and evaluation which would be difficult to carry out by other means. In view of the role played by the administrator in planning, programming, and evaluating support activities for health programs, and his responsibility for the direction of many and varied processes, it is obvious that many computer hours will be required for such activities. Gradually, data processing should become an effective administrative tool for planning, recording processes, and evaluation.

RECOMMENDATIONS

The Committee recommends that the following applications be considered:

a) Preparation of payroll lists and issuance of checks in a process closely related to job classification and evaluation.

b) Formulation, implementation, control, and evaluation of budgetary systems as well as accounting system records, movement of funds and patrimony, and cost determination.

c) Preparation of financial statistics and economic analyses of cost structures and sources of financing (linear programming, operations research, etc.).

d) Personnel management and records, and conduct of sociological research on human resources.

e) Planning, implementation, and evaluation of programs for the purchase, storage, and distribution of public health supplies.

f) Planning and evaluation of equipment inventory and installations for equipment maintenance, repair, and replacement.

XII. SUMMARY REMARKS

With the aim of accelerating economic and social development, the countries' efforts are directed toward the planning of their activities and the rational utilization of the resources assigned to each one of the sectors at the national level. In the health sector, often with the collaboration of the Pan American Health Organization, the countries are taking steps to achieve the greatest possible yield from their resources, giving preferential attention to their application for the solution of the most urgent problems.

To support these efforts, it is essential to have systems of information that measure the health problems, the factors conditioning them, the resources available for solving them, the way in which these resources are organized to provide health services, the distribution of these resources, and the effectiveness of the actions taken. In other words, dependable information systems are required which describe the

status and operation of the health system in the country, and contribute to more rational decisions with respect to intermediate and long-range health policies and allow the planning of short-range activities.

There are numerous advantages to be derived from the use of computers in the field of health. The possible benefits include the following:

a) The computer provides a means for the processing of large volumes of data which it is not practical to accomplish by other means.

b) Timeliness of results of data processing can be improved to permit their better utilization in current health planning.

c) More complex analysis of data can be performed which has not been practical heretofore.

d) The opportunity for more extensive analysis of available data actually results in the creation of new data, which can serve to provide new insights into existing problems.

e) The computer can provide a means for monitoring and improving the quality of collected data.

f) There may be cost advantages realized in adopting computer methods of data processing as opposed to more conventional methods, but usually the question is, "Do you wish to spend more in order to get more? "

While there are significant benefits to be derived from the use of computers in the field of health, there are accompanying difficulties which should be recognized. An essential requirement for the effective use of computers is the availability of trained and qualified personnel. The acquisition of a computer before such trained personnel are available would be ill-advised indeed.

In this regard the Committee *strongly recommends* to the Pan American Health Organization that it take immediate steps to establish a training program in computer science and provide this essential service to the Member Countries, utilizing both the facilities at its Washington Headquarters and those of regional computation centers.

An absolute prerequisite for effective planning in the field of health is the knowledge of the actual status of the health of the population of a country. No effective action can be taken without identification of the problems, and the problems may differ from country to country.

As Dr. Horwitz stated in his opening address, "We are convinced that the time has arrived for extending in the Americas the use of electronic computation in the science and art of health," and the members of the Committee concur.

IMPORTANT RECOMMENDATIONS FOR THE ORGANIZATION

1) Annual meetings of the Regional Advisory Committee on Computers in Health should be held in order to promote the introduction of computers in this field in the Region.

2) Fellowships should be provided and traveling seminars organized for the training of health personnel in the use and appreciation of computer systems as a tool for achieving rapid progress in health science.

3) Guidelines should be prepared on the installation of electronic equipment for use in various phases of health sector activities and on the necessary steps in the application of the computer to produce vital and health statistics. Standards for the training of health personnel should be established.

4) The Computer Science Section should provide an information exchange service which will include documentation, software and hardware specifications, and literature on the use of computers in the life sciences and clinical medicine. Furthermore, the Section should be responsible for the coordination of the regional computer science and data processing activities.

REFERENCES

Keydata Corporation. *Computer Characteristics Review.* Watertown, Mass., 1970.

Pan American Health Organization. *Regional Advisory Committee on Health Statistics, Fourth Meeting.* Scientific Publication 139. Washington, 1966.

Pan American Health Organization. *Regional Advisory Committee on Health Statistics, Fifth Meeting.* Scientific Publication 177. Washington, 1968.

University of California. *BMD Biomedical Computer Programs.* W. J. Dixon, Ed. University of California Press. Los Angeles, 1970.

World Health Organization. *The Application of Automatic Data Processing Systems in Health Administration.* Regional Office for Europe, Publication EURO-309. Copenhagen, 1965.

World Health Organization. *Symposium on the Use of Electronic Computers in Health Statistics and Medical Research.* Regional Office for Europe, Publication EURO-341. Copenhagen, 1967.

World Health Organization. *The Public Health Uses of Electronic Computers.* Regional Office for Europe, Publication EURO-3092. Copenhagen, 1969.

United Nations Economic Commission for Europe. "Conference of European Statisticians: Working Group on Electronic Data Processing." Working paper, 1970.

United Nations Food and Agriculture Organization. *Handbook on Data Processing Methods (Parts I and II).* New York, 1962.