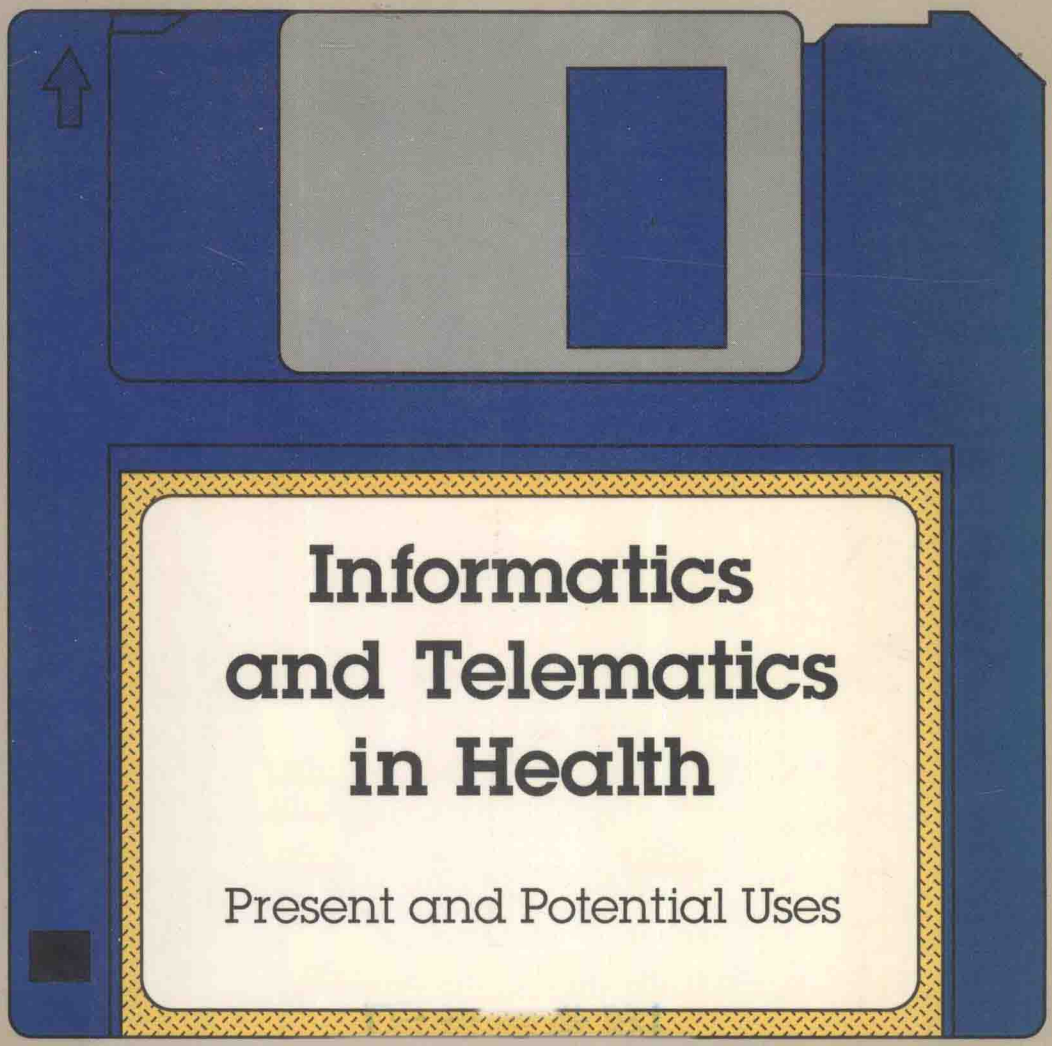

Informatics and Telematics in Health

Present and Potential Uses

World Health Organization
Geneva

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1988

In order to ensure prompt distribution, this book has not received such detailed editorial revision as most other WHO publications

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FOREWORD

The recent developments in computer and telecommunications technologies have given significant impetus to the provision of, and demands for, more information support in many different fields. These developments have been used to support good cost-effective management and technical work. But the potential of informatics and the opportunities it creates are of far-reaching significance - so much so that some have referred to the "informatics revolution". Informatics has already changed the life-styles of individuals and societies, and indeed the economic growth patterns of whole nations. Its influence on every aspect of life promises to be as profound as that of the industrial revolution.

The use of informatics in the health sector has expanded enormously over the past five years. Most applications have been in the medical field, with less change in other fields, such as community and public health. Considerable interest in the potential of informatics has been expressed by the staff of national health authorities. Indeed, there is an increasing awareness of the potential of informatics for improving the quality and cost-effectiveness of health services and support activities.

Recognizing these developments, in January 1985 the Executive Board of the World Health Organization requested that a report be produced to assist national health authorities in answering the following questions: for what purposes, where, and how can informatics be used in the health sector? and how should informatics systems be introduced and managed in order to maximize the benefits to health services? A draft report was issued in November 1986, mostly based on consultations with senior health administrators and informatics experts from national institutions, including WHO collaborating centres in health informatics. The present version has been updated to reflect the rapid evolution of informatics technology and its increasing and evolving uses in the health sector.

Informatics, if properly used, can increase the efficiency and cost-effectiveness of health services. It is hoped that this book will help the staff of health services to appreciate the way in which informatics technology has developed and the ways in which it may evolve in the future, as well as providing an overview of the many existing and anticipated uses of informatics in the health sector.

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Chapter 1

Introduction

The purpose of this report is discussed together with basic assumptions about health care systems as related to informatics and telematics. The chapter also highlights key computer applications in health and identifies the current trends in these rapidly evolving technologies as they apply to health.

1.1 BACKGROUND

Health informatics is a relatively recent technology which is rapidly being introduced into health systems around the world, especially since the advent of microcomputers. Recognizing these developments and the potential benefits they hold out for countries, the WHO Executive Board in January 1985 called for a report to be produced that would assist national health administrators in making efficient and appropriate use of informatics in health, especially for information systems supporting the monitoring and evaluation of health services.

In response to this request, the present report was produced by the Consultation on the Applications of Informatics in Health. Convened in December 1985, the Consultation was attended by national informatics experts, senior health administrators responsible for health informatics services, representatives of the WHO Collaborating Centres in Health Informatics, and members of the WHO Secretariat as shown in Annex 1. The aim of the report is to help public health administrators and health managers to decide: (i) for what purposes, where, when and how informatics may be used in health services, and (ii) how to manage these services in order to benefit most from informatics. The main target group for this report is therefore the top managerial levels of the permanent professional staff of health ministries, secretariats, or equivalent. Other health professionals to whom the report is directed include :

(a) the main providers of information;
(b) health informatics specialists;
(c) the principal users of information; and
(d) technical staff responsible for significant applications.

The report can also be useful as an introductory text in health informatics.

Annex 3 gives a glossary of the main terms used in the report. Readers not familiar with computer terminology will find it useful to brief themselves on the key terms (shown in capital letters) before reading on.

1.2 ASSUMPTIONS

1.2.1 Health Care Systems

In deliberating on the subject of informatics in health, the Consultation was acutely aware of the differing status of development and organization of health care systems in different countries. Most countries have some form of managerial process for national health development and many have plans with definite objectives and strategies for implementation, according to established time frames, but they differ in their targets and priorities, the scope and structure of

their health care systems, their methods and levels of funding, as well as in the sophistication and detail of their planning processes.

It is assumed that some form of health care management structure, with defined focal points of accountability and decision-making, exists in all countries. In the health sector as elsewhere, managerial decision-making requires reliable, relevant and timely information. Informatics, which may already be in use in other sectors of the national economy, can serve as a useful tool for providing this information. It should be recognized, of course, that the introduction of informatics will itself cause major changes in the organization of the health care system. Better information may lead to pressure for different decisions from previously uninformed individuals and groups.

The belief that only developed countries can afford computer technologies is a misconception. Informatics is not free, of course, but at today's prices, with a complete microcomputer configuration (computer, printer, etc.) costing under US$5000, its use can be considered by all. The investment required in human resources to develop and use informatics is usually more costly.

By choosing appropriate entry points and the right mix of technologies and resources, even developing countries can afford and benefit from the current explosion in informatics technologies. To obtain maximum benefit from these recent advances, however, it is necessary to establish a national health informatics policy and strategy, and to prepare the health system for the appropriate use of the new technologies.

Since the adoption of the Global Strategy for Health for All by the Year 2000 by the World Health Assembly in 1979, WHO's Member States have agreed on global, regional and national strategies and on very specific targets. Health-for-all strategies, especially in developing countries, place great emphasis on the development and strengthening of primary health care services and on efficient management systems at the district level. In each country, informatics policies and applications must be tuned to these strategies and be compatible with the prevailing conditions and resources available.

AT-A-GLANCE

* Decision-making in health care management depends on reliable, relevant and timely information.
* Informatics is a useful tool for the management of the health care system.
* All countries, including developing ones, can benefit from informatics
* Effective implementation of health informatics in any country or organization requires the establishment of policies and strategies.

1.2.2 Computers and Informatics

Information can be stored, manipulated, and retrieved quickly and efficiently with computers. In large computer systems, a single magnetic disk can easily store more than 100 000 pages of text. This is roughly equivalent to four rather large encyclopaedias or over 300 books of more than 300 pages each. A huge storge capacity is now available for microcomputers also, thanks to optical disks or Compact Disks/Read Only Memories (CD/ROMs), using laser technology. One CD/ROM can store the equivalent of more than 730 books of some 300 pages each.

Besides occupying significantly less physical space, information on disks can be retrieved at a speed several orders of magnitude faster than with methods which use other devices for bulk storage of information, such as paper and microfiche. Also, computers permit virtually direct access to the precise set of information desired, provided the information is appropriately indexed. It used to take hours, days, and even weeks

to retrieve and consolidate information. The same function can now be completed in a few minutes by a computer.

Today, a microcomputer can put at the disposal of an individual about the same basic computing power as a mainframe computer did in the 1960s and a minicomputer did in the 1970s. Mainframe computers are now used principally to handle very large data volumes, such as a national health information data base. The minicomputers introduced in the 1970s are nowadays most appropriate for a department or division or even a working group within a large organization. Microcomputers are ideally suited as work stations for individuals. However, by interconnecting a series of microcomputers through a local area network, it is feasible to generate enough computational power to meet the needs of an entire organization.

A computer receives, stores, processes and communicates information by breaking a task down into logical operations that can be carried out with binary numbers - strings of 0's and 1's - and by doing up to a thousand million operations per second. At the core of the computer is the central processing unit (CPU), consisting of scores of interconnected electronic components. In a microcomputer, the CPU consists of a single electronic element - a "chip" - that is typically about a centimeter square. This is the true "brain" of the computer, carrying out the computations and comparisons, supervising everything that is being done by sudsidiary chips, and controlling the traffic or information between the various parts of the system. Other electronic elements constitute the computer's primary memory, where both instructions and data can be stored.

Information can be entered into the computer usually by means of a keyboard or by means of transfer from storage devices(magnetic tapes or disks). The computer's output is displayed on a screen, called a monitor or video display unit. The output can also be printed on paper by a printer unit. A modem (**mod**ulator-**dem**dulator) can be attached to convert the computer's digital signals into signals for transmission over telephone lines.

These various electronic elements and the many other peripheral devices which can be attached to them constitute the computer's hardware. The hardware can do nothing by itself: to work, it requires an array of programs, or instructions, collectively called software. The core of the software is an "operating system" that controls the computer's operations and manages the flow of information. The operating system mediates between the machine and the human operator and between the machine and an "application" program that enables the computer to perform a specific task: calculate a payroll, edit a letter, or draw a picture.

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1.3 TRENDS IN INFORMATICS

Informatics may be defined as the combination of technology and methodology which makes possible the computer-assisted collection, storage, processing, retrieval, distribution and management of information. In this report the

term "informatics" is used to refer to both informatics and telematics, i.e., the use of informatics in telecommunications.

The spectrum of computer-based applications is becoming ever wider thanks to the rapid growth in the power of computers and the sharp decline in their prices. If the aircraft industry had evolved as spectacularly as the computer industry over the past 25 years, a Boeing 767 today would cost US$500 and could circle the globe in 20 minutes on twenty litres of fuel. This popular analogy illustrates the reduction in cost, the increase in speed of operation, and the decrease in energy consumption of computers. The cost of computer logic devices has been falling by 25 % a year and the cost of memory devices by 40 % a year. Computational speed, on the other hand, has increased by a factor of 200 in 25 years.

Informatics and telematics have been with us for a comparatively long time, but it is only in the past few years that the information revolution has become really visible. The industrialized countries have made substantial progress in the use of informatics. Consequently, they have benefited in many areas of endeavour, not least in the provision and management of health services. In most developing countries informatics is grossly neglected. There is considerable disparity between developed and developing countries in terms of the extent and the nature of their use of informatics. It has been estimated that Third World countries, which represent about 80% of the world population, account for only 2% of the total global expenditure on informatics and electronic information handling. A study carried out in 1986 revealed that 5.7% of the world's computers are installed in Asia, Africa and Latin America, and half of these are in Latin America. However, several developing countries are proceeding rapidly in this field and within 20 years some of them may overtake many currently industrialized countries in this technology.

Furthermore, there has been a recent acceleration in the development of informatics technology and informatics systems. Their utilization 10 years from now will certainly be quite different from what it is today. Therefore, considering the time it takes to train personnel to design and operate health systems, especially in the professional categories, there is an urgent need to orient the teaching of health informatics to future applications, equipment and methods. This could be achieved by closely integrating research and education.

During the last 25 years, uses of informatics in health have changed considerably. The operation of health care systems has benefited from versatile informatics tools supporting both the multiple demands of patient care and the needs of clinical and administrative decision-making. This report presents and projects these trends by describing forthcoming technologies and the changing needs of health services and systems for informatics support - for instance, for improved communication, for more intersectoral cooperation, and for well informed decision-making at all levels of the health services. The report further stresses the necessity for associating research with education, especially in developing countries. Also in planning new applications, it is necessary to ensure that they will both satisfy health services requirements of the future and take advantage of forthcoming technologies.

1.4 APPLICATIONS OF INFORMATICS IN HEALTH CARE

The transfer of computer-based health care applications from developed to developing countries is a delicate issue which is not always given due consideration, especially by enthusiastic vendors or consulting firms. The transposition of a system from one country to another, without a thorough analysis of the situation and requirements often results in an inefficient system and consequently in wasted resources and frustrated users.

Most countries - developed and developing - suffer from an abundance of unanalysed data with limited relevance to strategic planning and to the management of health services and programmes. It has repeatedly been said that informatics in health, especially in developing countries, can-

not be regarded as an isolated discipline and technology but must be viewed as an integral and essential element of the managerial process for national health development. In this connection, it should be noted that the rationalization of managerial procedures that is a prerequisite for computer use will often yield important benefits irrespective of the eventual automation of the process. Recognition of the importance of the management sciences in the rationalization of operational and administrative activities is indispensable. Many health care delivery problems can be directly related to the appropriate, effective and efficient use of resources.

An important area for the development of informatics in health is the management of health services and programmes at the district level. Computer networks connected through adequate telecommunication services can be important tools to this end, and great progress has been made in recent years in installing reliable telecommunication networks in several developing countries. In addition, work is going on in several places to develop appropriate information systems giving measures of the efficiency and outcome of the health care delivery process.

The health worker of the year 2000 is likely to be a person with immediate, transparent access to a large amount of data along with analytical decision support routines to assist him/her in decision-making. This fact has far reaching consequences not only for the training of health personnel but also for the organization and management of health programmes.

It cannot be overemphasized that **national policies and strategies** for the development of informatics in health and for the solution of the related standardization and organizational problems are fundamental for sound, cost-effective development. Numerous and often dramatic examples could be quoted of failure of informatics applications because of disregard of these policy and strategy issues. There is a need to tune health informatics policies and strategies to national informatics policies and strategies.

AT-A-GLANCE

* Computers can store, manipulate and retrieve large amounts of information quickly and efficiently.

* Information stored in computers may be transmitted through telecommunication links (cables, telephone lines, satellites, etc.).

* Informatics is becoming increasingly inexpensive, but there is still a large disparity in information processing expenditures among countries.

* Successful transfer of computer-based applications in health from one environment or country to another requires care.

* Enlightened policies for informatics personnel are of paramount importance.

Informatics also has a definite role in the **training and education** of health workers. In many countries health workers will have to use informatics in their daily work and will thus need to be taught how to handle informatics tools and use them to maximum advantage. Experience has also demonstrated the effectiveness of computer-assisted education and refresher training in teaching a variety of subjects, particularly in educational programmes with inflated curricula.

The development of applications should focus on those areas of greatest relevance to health-for-all strategies. Later chapters will consider the formulation and implementation of national policies and strategies for informatics in health and their integration with both health and overall informatics policies and strategies. In-

creased informatics support will be needed especially for primary health care programmes, including direct assistance to community health workers and leaders. Informatics support for the management of local health services at the district level is also of major importance, and suitable examples are cited in Chapters 3 and 4.

1.5 ORGANIZATION OF THE REPORT

The report contains a general overview of informatics in health, citing specific applications. It also deals with general policy and strategy issues, and reviews present technology choices and future prospects. It comprises seven chapters and three annexes.

Chapter 1 sketches the background of the report and gives an overview of trends in informatics and its applications.

Chapter 2 deals with national health policy and strategy. It emphasizes the importance of formulating such policies and strategies.

Chapter 3 deals with informatics support for health programmes. It outlines the specific support required at various levels of management. It gives some examples of major applications of informatics in health, chosen because of their importance in the management of the health care system.

Chapter 4 discusses the informatics support used in the care of the individual both in the organized health care system and in self-care and community care. It deals also with computer assistance to decision-making in health care on subjects such as statistics, epidemiology and literature retrieval.

Chapter 5 analyses the issue of human resources for health informatics. It emphasizes the importance of appropriately trained personnel in the development and operation of informatics. It shows, in addition, how computers can be used as tools to increase the efficiency of training and education in other subjects.

Chapter 6 addresses itself to some basic elements in the selection of adequate informatics technology, although it does not provide all the detailed considerations needed to make actual choices.

The ***Epilogue*** highlights some issues not considered elsewhere in the report. Annexed to the report are a list of contributors, sample curricula in health informatics, and a glossary of terms.

Chapter 2

National Health Informatics Policy and Strategy

The situations which lead to the need for a national health informatics policy and strategy are discussed. The essentials of a policy are reviewed, including both standards and financial, material and human resources. Likewise, the need for and contents of an implementation strategy are discussed, together with essential and recommended applications, and the development of personnel and standards.

2.1 INTRODUCTION

"Informatics is expensive."
"Informatics is disruptive of administration."
"Informatics lets me do my real job."

These and other statements are sometimes heard, and there is some truth in each of them. Certainly, countries that have developed computerized information systems within their health services have had to apply significant resources and managerial energy to the task. The evidence indicates that this investment has been well worth while. This does not automatically mean, however, that all nations should follow suit to the same extent. Each should consider for itself whether informatics systems are appropriate to it and, if so, what kinds of systems it should examine and on what timetable it should proceed.

"The Export Trading Company is upgrading its equipment and will give us its old computer free."

"We have US$40 000 left in the budget. Let's buy a computer with it."

"Dr Part learned how to use a System 88 on his training fellowship and wants one for his department."

"The planning committee needs guidance on whether a computerized system for hospital statistics or an accounting system should receive priority."

"The MCH department has completed a requirements analysis and feasibility study and is seeking approval for a complete hardware/software system."

All of these options and more may well be under consideration simultaneously in any health organization. How can we decide on them collectively and individually? How do we avoid wasting scarce financial and human resources? How do we avoid duplication of effort and the incompatibility of systems? How do we ensure that training is directly relevant to our future systems? In the face of such situations and questions, it should be clear that every complex organization needs an information policy and strategy.

The overall objective of health informatics is to meet information requirements at all levels of the health services for purposes of:

- policy formulation and programming;

- implementation, i.e. supporting the provision of health care and disease prevention;
- monitoring and control.

Until recently, there were differing underlying technologies for the various information services. For example, the technologies for typing and editing text, for producing the text as a document or publication, for preparing graphs and pictures to be added to the document, and for disseminating the document to its various destinations were totally different. Such differences in the underlying technologies of information services were used to explain the operational inconveniences and relatively high costs of the traditional means of providing the services. The inconveniences and costs of the fragmentation and incompatibilities of office support have had to be met because they appeared to be unavoidable.

Today, they are avoidable. Modern information services, such as word processing, information processing and retrieval, graphics, document production, data transmission, facsimile, telex, telephone, etc., are based on one underlying technology - digital computer technology. Economies in the costs and improvements in the efficiency and quality of these services depend on a high level of compatibility and integration of the computing support to these services.

Health informatics makes appropriate use of technology to provide information in a cost-effective manner. The policy and strategy for health informatics must reflect the environment in which they will operate. They must be appropriate to the technological status of the country, reflect the financial and human resources available, and meet the timing constraints often imposed from elsewhere.

2.2 THE NEED FOR A NATIONAL HEALTH INFORMATICS POLICY

A policy establishes the rules an organization must follow in carrying out its work. Establishing a health informatics policy helps to ensure that development and use of systems will proceed in a coordinated manner. The health informatics policy must be in consonance with any overall informatics policies in force in a country as well as with its overall health policies. The national health informatics policy, in turn, sets limits to any policies that may be established lower in the hierarchy, at regional or local levels.

Once formulated, a policy must be implemented in a coordinated manner. It may be necessary or convenient to establish a formal organizational entity to coordinate implementation. Such a group may be charged with formal coordinating functions, such as:

(a) Conducting surveys and research on the implementation of health informatics activities in programme areas suitable for computer utilization;

(b) Taking measures to solve problems that stand in the way of computer utilization and establishing systems and procedures for assistance to national, regional and local agencies active in health informatics;

(c) Promoting training of computer personnel and coordinating system-wide training programmes;

(d) Conducting research into computer-sharing and promoting the joint use of computers, computer files and software in order to diminish costs and establish an interorganizational network of information systems;

(e) Preparing and disseminating policies and guidelines on the requisition and use of information resources.

The coordinating group must strike a balance between indiscriminate or unregulated use of computer resources and overly rigid procedures that may hinder effective development.

A health informatics policy may require legislation, operational regulations, and guidelines. As part of a national informatics policy, it should establish linkages, common standards, procedures, etc., for sharing of information with other sectors. It should support established priorities, both general and in health.

AT-A-GLANCE

* Health informatics offers appropriate technology to meet information requirements at all levels of the health services in an effective and efficient manner.
* Health care managers require a policy and strategy to guide their day-to- day decisions on the use of informatics in their organizations.
* The health informatics policy chosen must be in consonance with any overall informatics policies as well as with health policies at the national level.
* Coordination of the implementation of the health informatics policy may be assigned to a formal organizational entity.
* The policy must establish common rules, such as standards, priorities and guidelines, and prepare the way for compatible legislation and regulation.

2.3 ELEMENTS OF A NATIONAL HEALTH INFORMATICS POLICY

A policy must first of all support national goals and objectives in informatics and in the health sector. Within these objectives, particular attention should be given to the sharing and exchange of information, the relative priority of different projects, the education and training of health professionals in informatics, the impact of informatics on the health services, the issue of centralization and decentralization of information systems, the problems of data security and privacy, the definition of the rights and levels of access, and the methods for choosing appropriate supportive technology.

National policies will play a key role in the development of informatics. Established policies control managerial mechanisms, allowable technological solutions, and resource levels.

Managerially, health informatics must reflect the policies and practices in use. Informatics is not, however, simply subservient to established methods as a new health programme might be. Information is a unique commodity and the provision of information requires special attention. All organizations have difficulty in assigning responsibilities for informatics within established managerial structures. In addition, the use of informatics itself permits, and sometimes imposes, new approaches to the management of organizations.

At the policy level the technological considerations are concentrated on the need for standards. The most obvious rationale for standards is that they facilitate the exchange of data. Almost as important as the exchange of data is the transfer of programs from one computer to another, made possible by language standards. Communication between computers, which is becoming increasingly important, requires standards for hardware, software and communication protocols.

Standards are needed to ensure the reliability and security of data.

Standards are also necessary in such areas as