

A BASIC PROGRAM FOR TEACHING MEDICAL INFORMATICS TO STUDENTS OF MEDICINE

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ABSTRACT

A basic program for teaching medical informatics to students of medicine is presented. It comprises two main modules. The purpose of the first module, "introduction to informatics", is to give the students basic knowledge in the field of implementation and use of computers and computer systems (basic computer skills). The aim of the second module, "introduction to medical informatics", is to introduce to the students the basic principles and methodology of medical informatics as a discipline dealing with the application of data, information and knowledge in health care and medicine. The program complies with the European requirements in the field of education in information systems in medicine and health care and can be adapted for different levels and forms of education in medical informatics.

Key words: medical informatics, education, standards, information systems, electronic medical record, decision support

INTRODUCTION

Medical informatics is a relatively recent technology that is rapidly being introduced into the health systems around the world, especially since the advent of microcomputers. It deals with the application of information sciences and technologies for acquisition, processing, interpretation, storage and communication of medical data in medicine, medical education and research and development in medicine and health care. In the USA, medical informatics is acknowledged as a basic formal discipline (1). A number of European medical schools have introduced medical informatics as an obligatory subject in the curriculum of medical education (2).

The necessity of teaching medical informatics to students of medicine

Modern medicine is complex, often driven by technologies and it is impossible for the individual to learn and retain all necessary knowledge. It is universally acknowledged that in order to practice modern medicine, physicians should have enough knowledge of the new information technologies. Since medical professionals will always be responsible for the consequences of use of the results of medical information processing, regardless the way they were received and processed, it is of tremendous importance that they should have basic knowledge of the computer process-

ing of the medical information, as well as knowledge of the different applications in this area.

The question is when should medical specialist gain this knowledge? In medical education the most important skill for medical students to acquire is the ability to identify gaps in their knowledge and go about finding for themselves the answers to the problems they face. This means that they should have thorough working knowledge of the use and the management of data, information and knowledge that they constantly encounter.

So, it is obvious that students of medicine or other health care professions should study medical informatics. This basic knowledge of information management physicians should gain as early as possible in their career. They should have this from the moment they decide to study medicine. So, the place of medical informatics in the undergraduate curriculum of students of medicine is of great importance.

Aims of the education in medical informatics for students of medicine

The analysis of the existing teaching materials in informatics in Bulgaria shows that there are no handbooks or other teaching materials available especially tailored for use by medical students, physicians or other medical specialists. The existing teaching materials are intended for education in general informatics and information technologies and do not discuss problems from the field of medical informatics. They are not directed to medicine and do not consider its uniqueness. On the other hand, the majority of these materials are absolutely illegible for the average physician or medical student. Hence, the necessity of organising a specialised education in medical informatics for medical specialists.

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The aims of such an education can be formulated as follows:

- To give the students basic theoretical, methodological and practical knowledge in the field of medical informatics;
- To acquaint the students with the opportunities and the restrictions of the application of information technologies in health care;
- To prepare the students to participate in the development and the implementation of health care information systems;
- To facilitate the education process by acquainting both students and teachers with the means and methods of computer aided learning;
- To teach the students how to analyze and use health information on the basis of theories and methods from other areas such as biomedical engineering, computer sciences, communications etc.;
- To assist the students in developing the skill of reasoning which should help them for the continuous education during their life-long professional career.

Basic program for medical informatics

Analyzing the necessity of education in medical informatics and considering the European requirements (3) in this area, a basic program for medical informatics was developed

(Fig. 1). According to this program, the education in medical informatics comprises of two modules:

Module 1 - Introduction to informatics

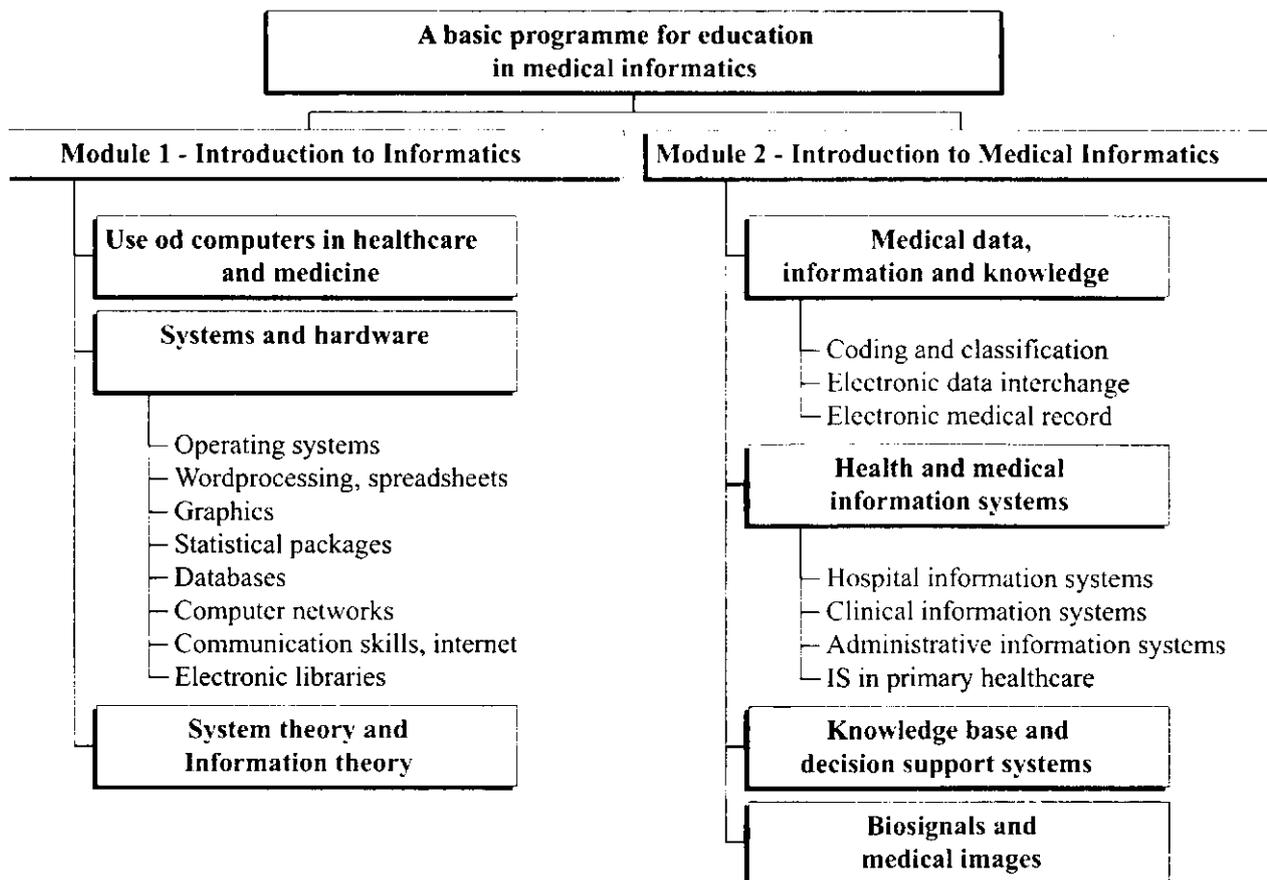
The aim of this module is to give the students basic knowledge of computers and computer applications in medicine and health care, so that they could readily use them. The module covers the following topics:

- Use of computers in medicine and health care.

A classification of the different applications of computers, computer technology and information systems in medicine and health care is discussed. In this context the roles of man and computer in information management in the field of medicine and health care are explained. Also the concordance with applications elsewhere in society is discussed.

- Systems and hardware

The logical and physical design of computer systems is discussed. The various types of computer systems and peripherals are presented. Also an overview of the different operating systems and computer languages are discussed. Attention is paid to basic computer skills: (1) operating systems, (2) word-processing, (3) spreadsheets, (4) representative graphics, (5) statistical packages, (6) databases, (7) networks, (8) communication skills including e-mail and Internet, (9) bibliography and (10) different commercially available software packages.



1. A basic programme for education in medical informatics

Module 2 - Introduction to medical informatics

This module covers the basics or general knowledge of medical informatics. As it is aimed to non-computer specialist it conforms to their capacity and abilities. The aim of this module is to increase the sophistication of the future health professionals, so that they know, understand and use in the best possible way the available resources.

Students will gain general knowledge on medical information and medical data, how to organise this data so that it will be available and helpful when needed, how to assess the quality of clinical knowledge they are acquiring. The study of medical informatics will improve their skills in information management and problem solving, in their decision making in formulating diagnosis, treatment and curing of patients. This module covers the following topics:

- System theory

A formal approach to the general system theory is presented including system design and life cycle of a system. The role of the user in a software development process is discussed.

- Information theory

A formal approach to the general information theory is presented. The basic characteristics of medical data and information are discussed.

- Data documentation and data and information

Medical data and medical information are discussed in terms of types, utilisation, quality and communication. The processes of data acquisition, documentation, communication and methods of storage of medical data in databases are described. Various types of data organisation are discussed. Aspects of structured data entry and natural language processing, recording of temporal patient data, electronic interchange of patient data, interaction between users and computers are presented. Various topics such as ownership, protection, security, confidentiality, accuracy, integrity, reliability and availability of data are discussed. Special attention is paid to databases and electronic medical records in medicine and health care:

Databases

- Databases in health care are presented. The complexity of the application of the medical databases arising from the semantic interconnection of these data and the wide variety of different goals that are to be served is explained. Attention is paid to data storage and retrieval, query languages, dictionaries and thesauri, and knowledge bases. The students get acquainted with the different types of medical data, the different systems for data presentation and classification (ICD, ICPC, Read codes, SNOMED, etc.).

- Electronic medical record

The advantages and disadvantages of paper based medical record and electronic medical record are discussed. The need of transition from paper base to electronic medical record is revealed. The basic principles, structures and models of electronic medical records are presented.

- Signal and image processing

A description of signals and images in medicine is given. The process of analogue to digital conversion is discussed. The process of signal and image analysis, pattern recognition, classification and interpretation of bio-signals and medical images is explained. Some methods of signal and image archiving are presented.

- Decision support

Different medical decision support systems are presented (QMR, Dxplain etc.). Questions concerning the formalisation of medical knowledge, reference standards and the integration of electronic medical record with decision support systems are discussed. The students are acquainted with some means and techniques used in decision support as clinical protocols, statistical methods, knowledge base analyses, mathematical methods, models, medical decision making.

- Information systems

The basic functions, aims and architecture of information systems in medicine and health care are discussed. Attention is paid to the problem of defining the requirements and the choice of an appropriate information system. Some basic problems concerning access and security of medical data are explained. General legal issues are interpreted. The students get acquainted with information systems in primary health care, laboratories, pharmacies, clinical and epidemiological information systems.

CONCLUSION

The presented basic program in medical informatics is aimed mainly at teaching the students how to obtain the information they need via the information systems available and thus at improving their knowledge and not just wait for this information to be readily given to them.

It can easily be adapted for different levels and forms of education: for medical students, for master's degree education in medical informatics, for medical and/or computer specialists, or as a separate academic discipline. The program can be used as a basis for the preparation of courses in medical informatics for physicians in hospital or primary health care, too.

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