



## Education and training in health informatics in Europe

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O estudo que se segue foi elaborado pela «Concerted Action on Education and Training in Health Informatics — EDUCTRA», coordenada pelo Prof. Arie Hasman e incluída no programa AIM da União Europeia. O grupo é constituído por dois representantes de cada país. No nosso caso, o Prof. Sobrinho Simões, do Instituto de Patologia Molecular e Imunologia da Universidade do Porto (posteriormente substituído pelo engenheiro Mário Seixas, do mesmo Instituto), e eu própria, da Escola Superior de Enfermagem de Maria Fernanda Resende.

Os dados foram colhidos no final de 1992. O Prof. Sobrinho Simões enviou um questionário e, nalguns casos, cartas aos representantes dos doentes e dos estudantes das faculdades de medicina do país, sindicatos médicos e Ordem dos Médicos, uma escola técnica de paramédicos, um sindicato de técnicos paramédicos, uma associação de utentes de cuidados de saúde, Instituto de Clínica Geral da Zona Norte, Instituto de Patologia Molecular e Imunologia da Universidade do Porto, Serviço de Informática do Ministério da Saúde e ainda algumas personalidades interessadas na matéria. A maioria dos contactados não responderam. Colhi dados através de entrevistas às direcções da Associação Portuguesa de Enfermeiros, da Associação Portuguesa de Fisioterapeutas, da Associação Portuguesa de Terapeutas da Fala e do Sindicato da Função Pública e ainda à enfermeira Lila Melo Anjos, representante portuguesa no subgrupo do «Nursing Minimum Data Set» (Ensino de Informática em Enfermagem), que tinha elaborado o diagnóstico da situação, a nível nacional, do ensino da informática nos cursos superiores de Enfermagem. Não foram concretizadas as entrevistas pedidas ao Sindicato dos Enfermeiros Portugueses e à Associação de Administradores Hospitalares.

O estudo português informava: que não existia um ensino sistemático sobre informática da saúde, embora os *curricula* dos cursos de enfermagem e de fisioterapia incluíssem formação que variava entre 14 e 83 horas; que a iniciação do pessoal de saúde à tecnologia da informação era feita essencialmente através de iniciativas pessoais; que as acções de formação de que os profissionais de saúde dispunham eram minoritariamente realizadas pelas organizações profissionais; que os vendedores tinham um papel importante na difusão da informação nesta matéria; que a formação nem sempre era parte integrante do plano de informatização dos serviços de saúde; que a utilização da informática existia em casos isolados em hospitais e só por excepção em centros de saúde; que o Serviço de Informática da Saúde estava a ter um papel importante na difusão da informática da saúde, não só através da informação, mas



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também através de grupos de trabalho (por exemplo, programa sobre gestão de horários de enfermeiras e estudo de uma base de dados para os registos de enfermagem).

Com base no *survey* que se segue, foi elaborado pelo grupo o documento «Orientações para um *curriculum* sobre informática da saúde», no sentido de sugerir objectivos e conteúdo a incluir em cursos regulares ou acções de formação para profissionais de saúde, tanto das áreas clínicas (técnicos, enfermeiros, médicos) como das áreas da gestão e administrativa. Estão também a ser preparados um livro e um programa informático para ser utilizado individualmente ou em grupo.

MARTA LIMA BASTO

## Introduction

Information technology is a term which has been widely used for some years. It has little relation either to information theory which is concerned with the information content of signals, or to information studies which often describes activities with text based information. Information technology is an all-embracing term which is applied collectively to the use of the modern techniques associated with advanced computing systems and data communication. The goal of information technology therefore is to imagine and create the intellectual tools that can exploit these computing systems and data communication hardware (technology) and to give meaning to the data (information). In order to be able to use these information technology products education and training are necessary. Health informatics as a discipline covers the subject of information technology in health care. Health informatics is used here as a generic term, comprising medical informatics, nursing informatics, etc.

Advances in information technology will have reaching and major effects on education and training in the field of health informatics. While the processes of education and training are complementary, a useful distinction can be made between them. Education is primarily concerned with long term knowledge and skills development with a focus on motivating learning and problem solving. On the other hand training focuses on the immediate

knowledge and skills required in the near future. In other words, whereas training in information technology is aimed at learning to use products, education in health informatics provides the theoretical foundation by linking existing methodologies to information delivery in health care. Health care workers are increasingly confronted with information systems. These information systems can be used for managerial, administrative and financial purpose and also for supporting medical or nursing care. One can question whether the educational level of healthcare workers is sufficient to enable them to use such systems optimally and whether they are prepared to cope with the constantly growing number of new applications.

This paper describes the results of a survey of the present state of education and training in health informatics in Europe. The survey was carried out in 1993 by representatives of 12 countries (Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, The Netherlands, Portugal, Spain, United Kingdom) and was conducted under the umbrella of a Concerted Action on Education and Training in Health Informatics (EDUCTRA) under the auspices of the AIM programme.

The paper will begin by describing the AIM initiative. The survey is then introduced and general observations discussed. The paper then analyses the availability and use of PCs and describes the use of hospital information systems in the various European countries.

The emphasis then shifts to the educational and training aspects. First the situation of education and training in professional schools, polytechnical schools and universities is considered. Although the focus is on the level of education and training in health informatics for professionals, the situation at professional schools and (technical) universities is important because if students are not introduced to health informatics at this stage they will have to be taught later by their peers, which would be a more costly situation.

## The AIM initiative

The AIM initiative (Advanced Informatics in Medicine) is a research and development activity of the European Commission (EC) of the European Union (EU). It was set up in the mid eighties to contribute to the establishment of an appropriate framework for the free exchange of health care information and medical data across Europe. Its objectives are to improve the quality of health care services offered to citizens, regardless of when or where these services are provided. The programme has focused on the possibilities of information and telecommunication technologies, and the necessary requirements in terms of standardization, compatibility, acceptability, confidentiality, etc., in order to obtain the greatest possible benefit. The goals were mainly achieved through R&D projects funded by

the EU science budget and carried out by consortia of organizations such as universities, companies, hospitals and others from member states thus bringing together the potentials of industry, administrations, users and professionals. In addition, a certain number of concerted actions, strategic studies and accompanying measures have been carried out or are in progress.

Although the scope of the AIM programme is limited to the twelve member states of the EU it has also been possible to involve organizations from countries belonging to the European Free Trade Agreement. In broader terms, international cooperation activities directed towards the two main scientific and economic competitors of Europe, the United States and Japan, have also been carried out. Contacts with international organizations such as the World Health Organization, the Council of Europe, standardizations agencies and several groups of professional associations, have been established. Eastern and Central Europe, Latin America and the developing world have also been explored as possible areas for future cooperation.

At present the AIM initiative is part of a larger activity. This includes the research and development programme of telematic systems in areas of general interest, together with equivalent R&D activities in the fields of information and telecommunication technologies applied to distant and flexible learning, academic networks, transport, rural areas, administrations, linguistics and libraries. As a constituent part of the current EU scientific and technological Third Framework Programme, the telematics programme and AIM within it, are preparing for the Fourth Framework Programme (1994-1998). This will bring European research to a mature phase at the beginning of the 21st century.

### The survey

The use of IT varies between European countries, as also does the need for educational and training programmes in IT. It was aimed to study the ways in which health care workers receive education and training in health informatics in the different countries. Even in those countries where information technology is not used extensively healthcare workers must be prepared for the future, as the availability of information technology is certain to increase in all countries.

In the survey the situation is described for different types of healthcare staff, including physicians, nurses, administrators, managers, technicians, etc. For each subgroup different educational and training programmes may be needed because members of each subgroup are confronted with different information needs and may therefore use different applications.

Extensive education and training in health informatics is only useful when what is learned can also be applied in the near future. However, courses concerning the principles of health care information systems are essential to provide health professionals with knowledge of the possibilities and limitations of computer systems. Professionals can only contribute effectively to decisions concerning the purchase of information systems when they possess enough knowledge about these systems.

Ideally plans for training and education should take into account the current level of use of IT. In cases where information systems are available but the level of education and training of healthcare workers is not sufficient one should plan education programmes. An example of such a coupling between plans for implementing information technology and educational programmes can be found in the United Kingdom. Here it was recognized that information should be regarded as a key corporate

resource. Therefore in the National Health Service the way IT is used will be changed considerably in the coming years. An infrastructure for IT will be developed to ensure that information systems are integrated and person based, thus enabling greater sharing and exchange of information about individuals and populations, while maintaining appropriate confidentiality safeguards. Increasingly such data will be derived from operational systems used by health care professionals in their day to day work. Clear target dates for the implementation of the new IT infrastructure have been set. The infrastructure is concerned with both information management and information technology. The National Health Service Training Directorate (NHSTD) is in the process of developing appropriate education and training programmes to support the changes.

### General observations

In almost all of the countries taking part in the survey, healthcare professionals lack knowledge with regards to the possibilities and limitations of computers. Because of this lack of knowledge computer systems are regarded either as a solution for all problems or as a threat. The lack of training may also cause a sensation of «lost time» when healthcare professionals are nevertheless trying to use computer systems, which may eventually result in a refusal to use computers.

The amount of knowledge about IT varies not only by country but even by region within countries, can be different for different professional groups and understandably depends on the age of the professional. The use of health informatics in Spain for example is very diverse depending on geographical factors, professional groups and health sectors. Health informatics is used more extensively for administrative purposes

and the general management of health centers.

When professionals use information systems they usually do not have a total view of the system. Their mental image of the system is confined to the part that they are working with and even then they sometimes do not know to use all the possibilities even of that part. In a number of the countries surveyed IT is mainly used for administrative and financial purposes. There are hardly any medical or nursing applications. Most of the French hospitals for example have systems performing the usual hospital administration tasks: a mission, transfer and discharge of in-patients, billing, accounting, etc.

In Germany two general trends were observed. In the first place new health informatics related professions like medical informaticians, biomedical engineers, medical data technicians, etc., have been created. Computer scientists, programmers, analysts, etc., have received additional medical training and are working in hospitals and health industries, while older professions such as medical documentalists have changed their curricula to include health informatics. In the second place the classical health professions (nurses, physicians, medical technicians) have added some IT or health informatics aspects to their curricula or post graduate education. This second trend is as yet very weak, but the first trend also still shows some insufficiencies.

It was stated several times that although courses in IT — when available — are usually satisfactory for teaching how to use specific programs they are often insufficient to offer a broader overview of IT potentials. In Ireland for example all staff interviewed expressed dissatisfaction with training which focused narrowly and exclusively on the practical skills for a specific system. A similar situation was reported in France.

There is a need for a broader introduction to health information

systems so that staff can appreciate the context of a particular computerized task. Training should be provided about the legal and ethical issues surrounding health informatics such as systems security and protection of confidentiality.

Although not available in all countries, several countries have developed educational programmes to introduce healthcare professionals to IT. Because of language difficulties in some countries it is very difficult to use courseware developed in other countries (this situation exists in Finland for example).

### The use of PCs

In almost every country health care workers use stand-alone PCs. Generally the use of PCs is greatest among physicians and administrators. Courses in the use of database management, graphics and statistical packages are usually offered.

E-mail and other telematic services are not extensively used by health professionals in all countries: in the United Kingdom both e-mail and telematic services are used extensively.

In Greece PCs are predominantly used by physicians. In Portugal PCs are sometimes bought by professionals who then learn to use them through self study or by following one or more courses at their own expense.

In France the use of computer technology in the doctor's office is recent and is growing very quickly. Many physicians use the computer (almost exclusively PCs) for word processing and for their own research.

In Ireland PCs are frequently used for office automation applications (where PCs are often connected to a local area network) and to implement individual management information systems. GPs are increasingly using PCs (over 30 % in Belgium, over 50 % in the Netherlands).

In Germany about 25 % of all ambulatory care practices work with

PCs, mainly for reimbursement purposes, and this figure will rise to 95 % by 1996 because of new laws and regulations. In Italy PCs are used in the clinical laboratory and in pathology and radiology departments.

It can be concluded that in all countries surveyed the use of PCs for dedicated applications (word processing, database management, graphics, etc.), is appreciable. Local area networks are used on a large scale in only some countries.

PCs are used independently of existing hospital information systems by hospital professionals. Usually PCs are not interconnected to other information systems present in the organization.

### Hospital information systems

In most countries hospitals and other health care institutions have installed information systems mainly for administrative purposes. In a number of countries the larger hospitals have also installed computer systems for the provision of medical services. Medical services can be supported by several types of application: patient administration systems, order systems, reporting systems, etc.

In Belgium hospitals have to provide the government with information regarding medical activities. Here information systems are used mainly for administrative and management purposes. Physicians and nurses have almost no access to computing. Laboratory information systems are used everywhere. Radiology information systems and medical imaging management systems are becoming increasingly popular.

In the Netherlands hospital information systems are based on a central development concept (e. g., characterized by a central database used by all the applications). Applications are thereby directly integrated. This is not the case in many of the other countries. Frequently a number of applications that cannot

communicate with one another are installed in hospitals. In Germany hospital information systems are widely used for administrative purposes and for some medical purposes. But in German hospitals many systems are in use in the clinical laboratory, in diagnostic and therapeutic radiology, cardiology, pathology, etc. For department specific patient and documentation management like discharge letter writing, operating theatre scheduling, MBDS (minimum basic data set), etc., computer support is also available. Furthermore there are many computerized medical devices in use in German hospitals like ICU/Operation Theatre vital parameter monitors, EEG, EKG, US, etc. (few are connected to other computers). A minimum of health informatics training is necessary to handle these devices well.

In France also, hospitals use information systems for administrative tasks. Most hospital clinical laboratories run management information systems. Pharmacy applications have been implemented in the large hospitals. The number of nursing applications is limited.

IT is increasingly becoming a crucial resource in the health services in Ireland. Financial systems, patient administration systems, laboratory systems and catering systems are common but not integrated. There is a view that professionals are not receiving adequate training to work effectively with this technology in hospital settings.

It can be concluded that the use of information systems to support medical services is appreciable in only a few countries. In most countries, only administrative and financial applications prevail in hospitals.

#### **Professional schools, polytechnical schools and universities**

In most countries medical schools provide some courses in medical

informatics. This does not mean however that these schools have a department of health informatics. Usually these courses are not compulsory. In nursing schools some courses in health informatics are offered but usually the number of hours is small, equipment for practical work is not available and the number of suitable teaching personal is inadequate.

In Greece all seven medical schools offer mandatory courses. A course is also given in the nursing school. Elective courses are provided in three medical schools and in the nursing school (duration one semester). These courses have to cope with lack of equipment, limited hours per semester and insufficient teaching personal. Moreover, the programmes vary widely in content. In two universities education in health informatics is addressed from a technical viewpoint.

In France medical informatics is a medical speciality. There are 34 professors in medical informatics. Medical informatics is taught to medical students at different levels. In 1993 a new medical curriculum was introduced. The association of teachers of medical informatics (CIMES) has recommended 30 hours of biostatistics during the first year of training and 30 hours of medical informatics during the second year. This suggestion will probably be followed in two thirds of the medical schools. Medical informatics is also part of the curriculum of nursing schools and paramedical schools. These schools often have very limited resources.

In Spain most universities do not offer training in health informatics. An exception is the DOSIS-2000 project developed by the Madrid Complutense University. Here a masters course in Documentation and Health Information Systems and a degree as specialist in computers applied to health is offered. Courses in IT are offered by a number schools of public health. The university cur-

ricula in Spain will be changed and several universities will provide courses in health informatics.

In the United Kingdom nurses during pre-registration training are introduced to IT. There are now many courses including an introduction to basic computing, keyboard skills and the use of applications. The situation for medical students is broadly similar to that of nurses in that there is some teaching in the basics of computing and computer applications. However, the pattern of provision is variable and rather patchy. It is also recognized that there is a lack of core training materials for medical and nursing students and, perhaps even more importantly, a lack of people with the appropriate skills and background to teach these topics in medical schools and nursing schools.

In Germany the education in the health care informatics is well established at professional schools, polytechnical schools and universities. Recommendations for curricula content have been developed and published. A special medical informatics curriculum is offered by the universities of Heidelberg/Heil-bronn, Hildesheim and Lübeck. Almost all universities have a chair in medical informatics usually combined with biometry. Curricula guidelines for nurses do not include medical informatics. However, medical informatics is optional in a number of nursing schools.

In Belgian universities there is usually no formal chair in medical informatics which is not officially included in the medical curriculum. For nursing education there are no recommendations relating to information technology.

In Portugal some teaching in informatics is included in the nursing curriculum. There is no systematic teaching of informatics to medical students, physicians and technicians.

In Ireland medical informatics was not included in the curriculum of the medical schools until re-

cently. Since 1991 in Dublin a one year course as well as a practicum on computers is given in the largest universities. It is not a course in medical informatics, however.

In the Netherlands almost all universities have a chair in medical informatics. In addition an outline for a curriculum in medical informatics has been developed. The number of hours devoted to medical informatics in medical schools is still rather low. By contrast, more hours are offered to health science students. In the case of institutes of higher professional education a special curriculum on health informatics has been developed since 1990 (Amsterdam).

In Finland health care schools provide a compulsory course in the basic principles of using a computer (use of word processing, spreadsheets, etc.). There is no education in the area of health informatics in 30 % of these schools, or are there medical informatics departments in universities though some universities give a 80 hour computer literacy course. There are also a few courses in IT applications in health care and computer assisted learning.

In Italy there are no departments of medical informatics either.

From the survey it can be concluded that the situation concerning health informatics in universities is far from ideal. In a large number of countries there are no departments of health informatics. Courses are offered but are frequently devoted to technical use of computers. Graduate students enter professional life without having had an introduction to the possibilities and the limitations of information systems. This situation is rather alarming. In order to educate professionals more teachers require to be available. These teachers need appropriate training. From the survey it is clear that there is less of a need for computer specialists than for teachers in health informatics. Apparently in a considerable number of European countries there is no possibility of ob-

taining the necessary knowledge and skills in health informatics in schools of medicine and health science. Since education and training of professional in health informatics will be more costly than educating students, professional organizations should stress strongly the need for this type of education. However, as some of the rapporteurs noted, the critical mass of motivated professional is not always reached.

### Post-graduate training

Post graduate courses are organized by some universities. These courses are usually given in the context of research methods courses. Sometimes doctors can obtain an officially recognized specialist qualification in medical informatics (Germany, France, Belgium and the Netherlands). In Great Britain the NHSTD now offers six open learning packages in health informatics. Healthcare staff who successfully complete the modules can gain points which can be used towards a masters degree.

In France a medical informatics department was created in most hospitals four years ago. The need for education in IT was obvious. A degree in information management can be obtained in the universities of Montpellier and Nancy which cater for forty students each year. Two modules of 30 hours each are more closely related to medical informatics.

In Greece a seven month international post graduate course in health informatics is organized by Athens University School of Nursing (subsidized by the Erasmus programme).

Joint agreements between universities, large hospitals and other institutions resulted in the creation in Spain of medium length (one to two years) programmes covering subjects ranging from health information systems to expert systems.

In France many courses are available for the users of hospital infor-

mation systems applications. The courses are organized by professional associations, computer companies, universities, etc. The methodological aspects are usually poor and technical aspects are emphasized.

In the United Kingdom courses are available for nurses, and to a lesser extent for doctors. There is however an extensive range of educational and training possibilities for managers.

Since the introduction of the minimum clinical data set in Belgium, educational programmes have been introduced to teach staff from university hospitals to collect and codify information. University hospitals in turn train staff from regional and local hospitals. University medical schools also train staff from other hospitals in the use of the minimum nursing data set. There are some post-graduate teaching initiatives by the professional nursing organization. University post-graduate programmes in hospital management or public health for nurses include courses in IT.

In Denmark a few post-graduate courses are offered and the technical universities offer the possibility of specializing in biomedical engineering. Nursing schools do not provide general introductions to computers though in-service training programmes for nurses have some basic introductory courses covering the use of PCs. Aalborg University, the Danish Hospital Institute and the Danish Institute for Health and Nursing Research are developing the framework for a study programme in health care informatics. The study programme is to be offered as an «open university» course using computer networks for distance learning.

In Portugal training programmes for health care professionals are organized by professional bodies or private organizations and deal with subjects like: introduction to MS-DOS, word processing, database management, etc.

In Ireland in the Health Service Manager's Development one mod-

ule is devoted to IT. This course is conducted by distance learning and the participants are generally administrators and clinicians. This programme focuses on understanding the potential of IT. A number of IT courses are also available for various other personal including clerical, technical and management staff. Nurses are introduced to nursing informatics in the school of nursing in Dublin. This training focuses narrowly and exclusively on the practical skills for a specific system, which is not entirely satisfactory.

In Germany satisfactory health informatics training is offered to doctors and medical informaticians by universities, private teaching institutes and a newly founded Medical Informatics Academy. However, only a few doctors (about a hundred per year out of a possible 100.000) attend these courses. Post-graduate training for medical documentalists and related professions is also well established but for nurses, medical technicians few post-graduate health informatics courses.

In the Netherlands a certain number of courses for managers, nurses and GPs are offered by universities and institutes of higher professional education and training. Information planning is one of the subjects emphasized.

In Finland the extent of education in the use of information systems is generally inadequate. However, if a doctor is prepared to make the effort, provided he is ready to pay for it, education and training is available to meet his need. Gaps remain in knowledge about the more advanced use of hospital information systems. Nurses are very conscious of the fact that they do not have requisite knowledge and skills in using information systems and that IT is not integrated in their curriculum. Like doctors they have to pay themselves for training if they wish to fill these gaps.

In Italy practical skills are acquired on the job. Some limited

education is provided by the professional training programmes which exist at some of the large hospitals usually aimed at providing basic knowledge about computers and their applications. The approach consists of lessons and seminars rather than providing practical experience.

In Greece, increasingly, short IT courses are organized by professional societies.

It can be concluded that, at post-graduate level courses in IT and health informatics are of variable content and quality. This may be a consequence of the limited number of health informatics teachers. An important task for the Concerted Action is to produce guidelines for a curriculum for various groups of professionals. By having such guidelines courses that have been developed in one country can also be used (after translation) by other countries. In this way the current lack of educational programmes can be countered more quickly.

#### **The role of the vendor**

The role of vendors in education and training is small. Training in the practical use of particular systems is often supplied by vendors as part of the purchase arrangements. Usually a number of employees is trained in the use of their systems. These employees become the trainers of the remaining employees. The courses are usually meant for computer technicians and future system operators.

Vendors are supporting the idea of the development of vendor independent programmes in IT. In Greece, for example, vendors sponsor courses organized by professional societies. In some countries the vendors play an important role in providing or subsidizing courses in IT.

In Ireland selected staff members have been chosen to work, on secondment, on training their peers

on the new systems. This approach has proved to be successful.

In Finland most of the main vendors do not offer training programmes. Only one Finnish company has an extensive training programme.

#### **Training staff**

For education in IT an adequate number of teachers with appropriate skills should be available. In a number of countries the supply of teachers is inadequate. In some countries (e. g., Spain) computer technicians support healthcare workers. Because of their background they cannot be considered as «health informatics trainers». In several countries the need for teachers with a background in health informatics was expressed.

#### **Government policy**

In most of the countries the recommendations of the Council of Europe [Recommendation No. R (90) 21] with respect to health informatics are not taken into account. Either the relevant ministries cannot impose a strategy or they are not aware of the recommendations. In Portugal the Ministry of Health Informatics Department is playing an important role in the diffusion of health informatics.

In Ireland the Department of Health (DOH) has given hospitals the autonomy to select their own systems using the guidelines supplied by DOH. The DOH operates an IT development fund in order to assist the funding of worthwhile developments.

In the United Kingdom a lot of effort is put in raising awareness in the field of information management and technology in order to cope with the increasing use of IT in the healthcare system.

In Belgium, by implementing a nationwide minimum basic data set collection for all hospital admissions, the government has suc-

cessfully initiated a programme of continuing education and training in clinical and nursing MBDS for hospital doctors, nurses and clerical staff.

### Delivery methods

In a number of countries computer aided instruction is advocated as means of introducing health care personal to IT and health informatics (Germany and Great Britain). An exchange of teachware on an European scale would seem to be a good idea.

In Ireland half day briefing sessions are provided for all staff supplemented by information packs. This structured in-house programme is considered highly adequate. The development of experienced tutors from amongst the peer group is considered an important long-term strategy to ensure both the acceptability of the training and its cost effectiveness, given the large numbers of staff involved.

In some countries post-graduate courses are available on the basis of distance learning. In Greece a number of telemedicine programmes have been developed. A pilot project in telemedicine has been developed by the Department of Medical Physics of the University of Athens. This department and the Sismanogleion Hospital are linked to fifteen medical centres in remote areas of the country. Voice and image transfer has been carried out successfully using this network. During the pilot project a number of education and training programmes in telemedicine have been completed. Doctors were trained using the existing telemedicine network at their own place of work. In the UK the NHSTD provides a range of distance learning courses in health informatics and IT. The same is true of the Open University in Denmark with regard to IT.

Some of the rapporteurs mentioned the lack of textbooks written with the European situation in mind.

### Conclusions

From the above it will be clear that most healthcare professionals have an inadequate knowledge of the principles of health informatics. Health professionals use PCs for word processing, database management and graphics but their knowledge of the function of health information systems in particular and of the possibilities and limitations of computer information systems in general is inadequate.

Although in a number of countries information systems are not used extensively one can safely predict that information systems will be introduced increasingly in health care. Decisions about which systems are appropriate are made by professionals who lack the necessary knowledge. In this way past errors are likely to be repeated.

From what has been said above, it may be concluded that the deplorable situation which exists is unlikely to change in the near future. Although younger professionals have more experience in the use of PCs, they still lack the relevant background knowledge of health informatics. The principles of health informatics are often neglected in universities, so that also the new generations of graduates are no better informed than existing professionals. Moreover there is an enormous shortage of professionals who are well trained in health informatics, a situation which seems unlikely to change in the coming years.

The challenge facing us is to stimulate health professionals to adopt informatics as a tool in their working environment. This goal can be approached by improving the training opportunities in the field of health care informatics, by employing trainers with the relevant background and by the provision of adequate course material.