医療情報処理 22－1
（1978. 10. 11）

Present Status of Education in Medical Informatics in the Federal Republic of Germany

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Paper presented during the Workshop "Education in Medical Informatics" during MEDIS'78, Oct. 2-6, 1978, Osaka/Japan

In the Federal Republic of Germany the discussion about educational programs in medical informatics has started in 1970 in meetings between the German Association for Medical Documentation, Informatics and Statistics (GMDS: Gesellschaft fuer Medizinische Dokumentation, Informatik und Statistik) and the German Association for Informatics (GI: Gesellschaft fuer Informatik). Out of these discussions resulted definitions for the discipline of medical informatics.

The conceptual definition (3) is:

- given that an algorithm is a generally applicable procedure to solve a given problem in a finite number of steps,
  = medical informatics is the science of the qualities, construction and presentation of algorithms in medicine.

The operational definition which was used (2) describes medical informatics as dealing with the

- documentation
- analysis
- steering
- control and
- synthesis

of information processes in medicine.

The methods to be used were described to be those of

- data acquisition

- data validation
- data management
- data analysis and
- model building and simulation.

Out of the discussions between the two scientific organizations educational efforts were planned and implemented.

This paper reflects the following educational aspects in the Federal Republic of Germany:

- teaching for medical students (and allied personnel)
- teaching for students of informatics (and allied personnel)
- post-graduate training.

1.0 Teaching for medical students

In regard to the teaching in medical schools, it has to be explained that already since many years courses in biomathematics and biostatistics have become mandatory. With a new revision of the educational system in medicine, all examinations are centrally conceived and evaluated. The mandatory subjects require written examinations in multiple-choice form. These examinations are conducted in two stages during the clinical studies (second half of the overall six years).

Consequently, all medical schools in Germany have departments or chairs for medical documentation and statistics. Most of these

chairs carry also the name of medical

- information processing
- informatics or
- data processing.

There is a convergence now to the name of medical informatics.

Furthermore, in addition to the 26 departments or chairs there are 6 departments or chairs for medical

- informatics
- data processing and
- information processing

in addition to the chairs for biostatistics, in most places combined to centers or departments, such as in Hannover, Goettingen or Frankfurt.

In addition to the mandatory courses in biostatistics, which are given during the first clinical part and consisting of approximately 30-40 contact hours, mandatory courses in clinical applications or statistics and medical informatics will become mandatory this fall with 20-30 contact hours leaving approximately 6-16 hours for medical informatics. The teaching for medical students therefore encompasses now:

- during the first clinical year:

  Biomathematics, Biostatistics,

- during the second part of the clinical studies (5th year):

Clinical Applications of Biostatistical Procedures, Medical Informatics.

The syllabus for teaching is defined by a central commission which also elaborates the questions for the multiple-choice examinations.

Whereas the subject matters described for the first biomathematical course contain basic statistical procedures and their interpretation, the course in clinical application of biostatistics includes the following topics:

- controlled clinical trials
- retrospective studies
- prospective studies and
- aids to diagnosis (analysis, methods, procedures, mathematical approaches, problems and applications).

The subject matter for medical informatics during this course contains the following topics:

- Principles of informatics
  definition of signals, data, information and algorithms,
  principles of computers and peripherals,
  principles of information systems.

- Medical documentation
  data acquisition in medicine, clinical documentation,
  problems of coding and coding procedures, nomenclatures,

computer assisted medical records,
special registers.

- Application systems
  medical record systems,
  medical (hospital) information systems,
  biosignal processing.

- Data protection
  respective laws,
  medical implications.

- Systems analysis
  principles of system analysis,
  analysis of health care and health care systems, project management.

Courses in medical informatics are not mandatory for schools of nursing and schools for medical technicians. However, in the latter here and there courses in programming as a simple introducation are given.

2.0 Teaching for students in informatics

Medical informatics has been adopted as a subsidiary or minor subject for students of informatics (computer science). As a general rule, the curricula for informatics should contain 25% of credit

hours to be taught in the application subject, such as medical informatics. In the practical implementations, this results to 20 - 40 credit hours out of a total of 160 credit hours. The subjects for students of informatics have been defined to be

- structures and functions of human body
- principles of pathophysiolcgy
- principles of therapy
- medical terminology
- medical methodology
- hospital administration
- organizational forms in public health
- biostatistics (if no other statistics have been taken)
- biomathematical models
- special problems of data prccessing in medicine
- medical documentation.

Not necessarily all these subjects will require separate courses but several of them might be combined to comprehensive courses in medical informatics.

A recent survey yielded that there are presently at least courses in medical informatics at five universities leading to a graduation as 'Diplom-Informatiker' which is equivalent to a master of science. Four of these schools fcllow the principles that after graduation the student should have the full capabilities of a general informatician who is also capable of working in another field though he is specifically oriented tcwards medicine. Only one school

(Heidelberg/Heilbronn) dedicates a larger amount of teaching to medical informatics being their major subject in this school.

The universities in question are:

University	first graduation	students/year
Braunschweig Hannover	1977	15
Hamburg	1976	22
Munich	1977	20
Erlangen	1981	10
Heilbronn/ Heidelberg	1977	70

In addition to these efforts there are schools for medical documentation assistants in

- Ulm and
- Giessen.

The major part of their teaching is dedicated to what might be called the work of a medical librarian, but to an increasing amount basic aspects are taught of informatics including also courses in programming and handling information systems.

3.0 Post-graduate training

The national board of physicians accepted in principal medical informatics as subspecialty, requesting three years of practical

work in the field. After this subspecialty has been adopted in principle, it is now up to the regional boards of physicians to define the requirements and set up accreditation procedures.

In discussions between the GMDS and GI it was decided to create a certificate (or fellowship) defining the qualification for a 'medical informatician' in order to give guidelines for quality of training and experience in the field. A joint commission has worked out the details for such a certificate. The basic principles of the procedure are (1):

- the qualifying background is requested either in medicine or informatics. However, if another academic study has proceeded the operational qualification and if requested subjects are taken after graduation, any other scientific or related qualification may be accepted,

- an operational qualification is requested, i.e. the applicant must have worked in the field and have shown his ability to work successfully either in a scientific or application project,

- post-graduate education has to be undergone selecting subjects out of a list of prescribed topics and elective subtopics.

The applicant may already apply after graduation giving a plan of his educational intentions and the commission may accept such a plan or make recommendations for changes. When this plan is completed,

the certificate is awarded. The commission may invite the candidate for an oral presentation in order to explain his scientific work or the subjects in which he has worked, if there is doubt about the acceptability of an item in his educational plan.

The operational qualifications requested are, generally speaking, work in

- information management
  such as information systems inside and outside the hospital

- computer aided management of health care delivery systems or subsystems
  as for example in hospital or regional administration

- technical information
  such as work in process control applications, biosignal processing, interfacing and networking.

The list of subject matters from which the complementary training has to be taken includes the following subjects:

- medicine
  structures and functions of the human body
  general pathology
  medical methodology
  systems of medical care
  organizational aspects

- informatics

  algorithmic formulation

  program languages and syntax analysis

  non-sequential processing

  functional concepts of computers

  peripheral equipment

  systems programming

  electives:

    data structures - information systems

    high-level language

    process control

- medical informatics

  definition and application areas

  medicine and its environment

  problems of data processing in medicine

  system analysis and project management in medicine

  user reaction and sociological structures in the health care environment

  medical documentation

  general systems in medicine

  special systems in medicine

- biomathematics

  basic principles

  methodology

applications

interpretation

- economics/ public and business administration

  principles

  public and business administration

  financing

  budgeting

  organization and management aspects

  operations research

  laws

  hospital administration.

The exemple of a possible personal curricula for applicants shall be demonstrated in three exemples:

Student of general informatics:

After graduation he has to take additional courses (either during his work in the field or a post-graduate course) to acquire knowledge in general medicine and the principles of medical informatics. After having completed the necessary experience in inplementation or scientific projects, he may be awarded the certificate of 'medical informatician'.

Student of informatics with the subsidiary subject medical informatics

In this case, the post-graduate teaching needs only to expand in the medical areas. The additional on the job experience remains the

same.

Student of medicine

After graduation he has to acquire the knowledge in informatics as prescribed. Furthermore, it is also recommended that he takes courses in the principles of medical informatics. The on the job training is required as in the other cases.

If the requirements are met, the medical informatician may also acquire a Ph.D. in informatics as such, whereby a topic in the area of applications in medicine is naturally possible. Furthermore, some schools have already implemented degrees of a scientific medical doctor (mostly called Dr. hum. biol.) which might be a logical degree for the people working in the medical field.

Certainly, this certificate is a non-official document, not equivalent to a state diploma. Nonetheless, it is hoped that it will obtain normative influence upon the training and career aspects within medical informatics. It furthermore is supposed to point out those individuals to possible employers in the health care delivery system, who qualify for a leading position in a project, a hospital, within a regional organization or in industry.

The joint commission has been set up and started its work. The first 12 applications have been received.

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