AUTOMATISATION AND RESPONSIBILITY

A commentary on the paper by U. Kliegis, A. C. M. Renirie and J. Schaefer

This is a commentary on a previous version of the paper 'Medicus Technologicus' by Ulrich Kliegis, Alexis C. M. Renirie and Jochen Schaefer in this issue of Theoretical Medicine. According to my criticisms, the authors now have dropped their initial thesis that programmable cardiac pacemaker-systems represent expert systems and have adopted my view that rather they represent automated diagnostic and treatment programs. However, the relation between Artificial Intelligence in general, expert systems, and cardiac pacemaker-systems remains a problem and a challenge to medical ethics; therefore, I think that the following considerations might not have become completely superfluous.

In the aforementioned paper, interesting questions are raised which result from the advancing automatisation of cardiac pace-maker therapy. The authors, in my view, are correct in writing that quite profoundly this development not only affects technical but also terminological and epistemological problems and decisions. This culminates in their thesis that the usual relationship between diagnosis and the decision for therapy tends to be cancelled when the technologically most advanced pacemaker-systems are used. In addition, the authors point out that a special problem thereby arises regarding the responsibility of the physician who is recommending such treatment. I want to offer additional considerations in my commentary to the following two questions: (1) Are the pacemaker-systems in question so-called expert systems in the sense in which the computer science and Artificial Intelligence research use these terms? (2) Under what circumstances is there a new kind of problem formation in the physician's responsibility?

A related question is whether the technologically most advanced or even projected pacemaker-systems, which react according to certain diagnostically relevant and measured parameters (bio-signals) with a well-defined program of electrical stimuli, can already be called expert systems. This question cannot be answered at present in a theoretically compelling way, because at least in part mere nominal definitions enter into this question. If, however, the present linguistic usage of the terminology of artificial intelligence is taken as representative measure, one would have to answer in the negative, for the following reasons:

At the present time, expert systems consist of those computer-programs...
which have at least the following four properties: (a) They are able to perform tasks which, if done by a human being, would require the knowledge and the application of expert-knowledge (e.g. the ability to make diagnoses, to interpret the mass-spectrum of molecules, proof of mathematical theorems). (b) The system works in a 'user-dialogue', that is, a given statement of a problem is put in by the human user and the result of this knowledge application is issued to him again; in particular, any application of the knowledge will not be further processed without such an intermediate step of issuing it to the user. (c) The results can be justified by the system, that is, it can explain which knowledge and which steps in the argument this result is based upon. (d) In general, the knowledge base of the system can be enlarged and modified, without necessitating additional programming, that is, the system is able to 'learn'.

Of these four conditions, only the first is valid for cardiac pacemaker-systems, and only for technologically very advanced systems. The development of a pacemaker-program demands expert knowledge in the field of cardiology and cardiac disturbances of rhythm, and in a well constructed program, the reaction of the pacemaker should be similar in a given situation or even identical to the reaction of the cardiologist. The programmable pacemaker, however, is used only to circumvent the necessity to consult a human expert, and thereby someone who will take the responsibility in a given medically relevant cardiac situation, before a therapeutic decision can be made. This circumvention is thought to be helpful, and is based on good medical reasoning in the case of life-threatening disturbances of cardiac rhythm. For the same reason, it should not be required that the system has to account for its decision to take these or other measures. The conditions of (b) and (c) are, therefore, non-existent in programmable pacemakers, and likewise the fourth point (d), the capability to learn, can at present only be realized in a very limited manner. Because of these reasons, in the case of programmable pacemakers, one should not speak of an expert system but of an automated cardiological diagnostic and treatment program, which is realized in such pacemaker systems.

As to the problem of the physician's responsibility in indicating the implantation of such pacemaker systems, I would like to argue that, with one exception, no fundamentally new problem is at issue, because well tested models of solutions and views can be used by analogy. In this connection, essentially the following four cases, which can be present and which might lead to inherent problems, must be distinguished respectively:

1. The pacemaker system in question is programmed according to the justifiable opinion of experts in the case concerned, but the treating