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and Limitations of Artificial Intelligence
Techniques.

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INTERACTIVE PROGRAMS FOR PHYSICIANS: BENEFITS AND LIMITATIONS OF
ARTIFICIAL INTELLIGENCE TECHNIQUES

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ABSTRACT

It has been noted that the clinical computer programs most acceptable to physicians are those which perform tasks that the physician himself is either uninterested in or incapable of doing. Examples of such applications are programs for automating clinical chemistry laboratories and reporting test results, or for monitoring intensive care patients to quantify incidence of atrial arrhythmias or ventricular irritability. On the other hand, significant problems of acceptability are routinely encountered when programs are designed to emulate the performance of clinical experts. Some observers feel that this resistance arises from an inherent reluctance to accept advice from computers when human expertise is available in the same domain. Others argue that specialized clinical expertise is often unavailable and that physicians would accept substitute programs if they were designed with adequate attention to the demands of physician users.

It is the thesis of this discussion that it is premature to assume that physicians will inherently reject interactive consultation programs. We contend, on the other hand, that the demands of physician users require consideration of advanced techniques that remain in the realm of basic computing research, including artificial intelligence (AI). For example, we believe consultation programs must provide both advice and enough supportive explanatory material so that the physician can reach an independent decision regarding patient management, aided but not replaced by the computer-based system. The inability of early consultation programs to provide explanatory information may account in part for the commonly observed physician resistance to computer-based diagnosis. An ability to explain will in turn demand innovative control structures and new methods for knowledge representation, both of which are major research areas in the field of artificial intelligence. Only in the last half decade have we begun to develop programs that "understand" what they are doing in the sense that they can interactively justify decisions that they have made. However, none of these systems has yet to be rigorously tested by physicians other than those who were involved in its development. Thus, an impact of AI on clinical practice has yet to be formally demonstrated, despite our strong intuitions that the research is on the right track.

Other areas of artificial intelligence research that may eventually smooth the interface between physician and computer include natural language processing, scene analysis, and speech understanding. The more "human-like" the consultation system, the more likely that the busy physician will see it as a viable alternative to interaction with a human consultant. He will not tolerate programs that are slow, difficult to access, unforgiving of a beginner's typing, or overly pedantic. The availability of large data bases will heighten the appeal of advice-giving systems, but simple access to statistics will probably not be sufficient to entice physicians to computers if the data are not provided in a rapid, easy-to-use fashion that departs minimally from the format of interaction with another physician who is an expert in the domain.

Despite the potential benefits of artificial intelligence for interactive clinical computing, the youth and experimental nature of the field has thus far tended to limit the development of more than prototype systems. AI programs presently tend to be both large and slow. They are in general doing much more processing than has been attempted before (e.g., searching large knowledge spaces, analyzing complex semantic structures, performing self-correcting or self-modifying functions), and these capabilities will be only partly facilitated by the extensive current research on dedicated hardware devices and more efficient operating systems. In fact, smaller and faster AI programs may no longer be useful if, in their search for efficiency, they sacrifice the very flexibility which makes them appealing in the first place. Thus, although AI may not offer short-term solutions for clinical computing needs, its potential impact on the interface between physician and computer is considerable and warrants heightened research into the use of such techniques in medical domains.

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