

Editorial Comments

JAMIA

Grand Challenges in Medical Informatics?

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"Grand challenges" are fundamental scientific or technologic problems whose solutions require significant increases in our current levels of scientific knowledge and/or technical capabilities. Their solutions should significantly improve both the quality and the delivery of health care while decreasing its costs. Finally, solutions to these problems should be achievable within a decade.

Development of a list of the grand challenges facing the field of medical informatics could serve several purposes. First, it could attract support from funding agencies by identifying and prioritizing projects worthy of economic and political support. Second, it could serve as a method for drawing young people facing difficult career choices into the field by highlighting the key intellectual or technologic challenges within the field and the potential benefits that might accrue to society upon their solution. Third, it could provide an alternative definition of the field.

Several closely related fields have developed such lists. For example, in 1985, the Engineering in Medicine and Biology Society (EMBS) of the Institute of Electrical and Electronics Engineers (IEEE) submitted a report to the National Research Council identifying and outlining eight areas within biomedical engineering as high priority needs for research funding.¹ Of particular interest was that "medical artificial intelligence and information systems" was one of the key areas that they identified. More recently the National Center for Research Resources, a part of the National Institutes of Health, convened a panel of experts to explore the use of information technology and computing systems in biomedical research.² They identified three major areas: 1) modeling and simulation, 2) imaging and scientific visualization, and 3) decision support for biomedical research. Within each

of these areas they described some of the current problems that are under examination. In addition, Board³ published a report describing what he considered to be the grand challenges in biomedical computing. Among them he listed the real-time, noninvasive, three-dimensional imaging of body systems and the real-time generation of three-dimensional, patient-specific models. Finally, the Office of Science and Technology published its "Grand Challenges: High Performance Computing and Communications."⁴ The only biomedical grand challenge they specifically identified was human genome mapping.

Within the field of medical informatics, various panels have been convened to focus upon specific research areas. Examples include the National Library of Medicine's (NLM's) long-range planning panel,⁵ the NLM's outreach planning panel,⁶ and the Institute of Medicine's study of the computer-based patient record.⁷ To move the field to the next stage of development, we need to go beyond these more narrowly focused efforts and develop an overarching statement of the challenges that face medical informatics and the benefits that could result from meeting those challenges.

As a first step toward developing a list of the grand challenges for the field of medical informatics, I posted a draft list of challenges along with a question asking if anyone knew of such a list to the AI in Medicine listserv available on the Internet. I then took the responses to that posting and reposted them to the Fellows of the American College of Medical Informatics' (ACMI) listserv. The responses, edited and combined, are listed below.

1. A unified controlled medical vocabulary
2. A complete computer-based patient record that

could serve as a regional/national/multinational resource and a format to allow exchange of records between systems

3. The automatic coding of free-text reports, patient histories, discharge abstracts, etc.
4. Automated analysis of medical records, yielding (for example)
 - a. the expected (most common) clinical presentation and course and the degree of clinical variability for patients with a given diagnosis
 - b. the resources required in the care of patients compared by diagnosis, treatment protocol, clinical outcome, location, and physician
5. A uniform, intuitive, anticipating user interface
6. The human genome project and the unification of the Brookhaven Protein Database, the Johns Hopkins Genome Database, and the National Center for Biomedical Information Genbank⁸
7. A complete three-dimensional, digital representation of the body, including the brain, with graphic access to anatomic sections, etc.
8. Techniques to ease the incorporation of new information management technologies into the infrastructure of organizations so that they can be used at the bedside or at the research bench
9. A comprehensive, clinical decision support system

In reading this list, one is struck by the fact that it is made up of areas in which active research is already under way. In fact, these areas represent the grand challenges of the past two decades. Which of these projects are truly worthy of the type of concerted effort that would bring them to fruition within the next decade? Are there projects that people are not yet even thinking about that might be more beneficial and achievable within the same time frame? A group of experts should be convened to develop an "official" statement of the grand challenges facing our field. These experts could begin by brainstorming using a listserv (or Usenet newsgroup) devoted to

this project. Once a complete list was ready, a face-to-face session would be necessary to clarify, advocate, and prioritize alternatives. Each item on the list could then be assigned to one or more of the experts and described in detail. The description would have to include a clear picture of the key scientific research questions and the technical barriers to solution of the problem, together with the benefit to society assuming a solution was found. These descriptions could then be combined and published as a monograph entitled "Grand Challenges Facing the Field of Medical Informatics."

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Received for publication: 5/11/94; accepted for publication: 5/19/94.