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## Synopsis

### *Health and Clinical Management*

When approaching the new millennium, a discussion of health and clinical management in the context of medical informatics naturally looks into the future. However, when formulating a vision, it is always useful to acknowledge the past. 'Health' is derived from the old English word *hal*, meaning whole, healed, sound in mind and limb. Even though these concepts provide a lay meaning, health organizations have used other operational definitions. The preamble to the constitution of the World Health Organization (WHO) described health as a state of complete physical, mental and social well-being, not merely the absence of disease or infirmity. As healthcare came to rely on measurements of phenomena that indicate degrees of absence of health, this first definition became regarded as irrelevant. It also described an ideal state rarely attained in the real world, and few knew exactly what was meant by social well-being. In response to these deficiencies, and with the evolution of successful health promotion programs, the original WHO description has been rewritten. The new definition can be paraphrased as the extent to which an individual or a group is able to realize aspirations, satisfy basic needs and to change or cope with the environment. Health is thus characterized by autonomy and integrity, ability to perform in personally valued family, work and community roles, ability to deal with physical, biological and social stress, a feeling of well-being, and freedom from the risk of disease and untimely death.

During the latter part of the 19th century, the epidemiological observations of John Snow and William Farr, the discoveries of the bacteriologists Louis Pasteur and Robert Koch, and the work of the pathologist-sanitarian Rudolf Virchow in science and politics played a crucial role in improving world health. It has to be remembered that the cities built to host the rapidly growing industrial populations during this period lacked sanitation, but the combination of medical knowledge and social considerations led to both improvement and a critique of these conditions. Edwin Chadwick's study of the sanitary conditions of the laboring class in England followed by Lamuel Shattuck's similar analysis of living conditions in Boston strongly contributed to this development. By the end of the 19th century, many cities in the industrial nations had installed sewer systems and water purification processes. As a result, by the end of that century, some of the worst threats to long life and good health had been controlled by applying infrastructural measures, reinforced by new laws.

Approaching the new millennium, we can observe a similar transformation of social organization that took place a century ago. The difference, however, is that the development does not concern physical structure, such as buildings and roads, but information infrastructures, i.e. ways to collect, communicate and analyze data, information and knowledge. There is therefore a formidable task ahead for the health and medical informatics com-

munity; the development of information infrastructures that promote health and prevent disease may turn out to be as important for world health as the physical interventions a century ago. What we can do at this time is to review some reports of outstanding fin-de-siecle research in an effort to set out a first agenda for future research and implementation.

Many questions about health and clinical management require continuous attention. A health information system is a combination of data from multiple sources, used to arrive at insights about the health needs and outcomes of populations. Ideally, a health information system uses all available sources of health-related information and can expand to encompass other data sets. In the first paper in this section, Brossette et al. illustrate the need for automated pattern discovery and data mining in this type of systems [1]. They define association rules, explain how those rules can be used in surveillance, and present a novel process and system. The new process promises to be efficient in identifying new and unexpected patterns in surveillance data. Even though seemingly simple, this research is important and should lead to future prospective studies. The lack of systems that recognize and promptly report significant trends is today a central reason why it is difficult to control disease outbreaks. Until the present, surveillance strategies have required outcomes of interest to be known in advance before

monitoring activities can begin. Outcomes that are not known to be of interest may therefore go undetected.

Successful data mining in population databases requires a developed information infrastructure. Another aspect of such an infrastructure is the public internet and the use of electronic mail for personal and business purposes. At the end of the century, in many western countries between 25-50% of the adult population has access to internet and approximately half of these individuals use e-mail regularly. E-mail has also become a part of the day-to-day routines of healthcare professionals. The next step would be to use e-mail to communicate between patients and caregivers. Borowitz and Wyatt report experiences from a pioneer 33-month study of an e-mail consultation service [2]. Although the study comprised only a small number of physicians at one institution it suggests that e-mail can provide to patients personalized and disease-specific information in a timely manner. At this site, 87% of the information requests were answered within 48 hours. On average, responding to each e-mail took slightly less than 4 minutes. While showing the possibilities, this study also suggests a number of issues that still have to be considered. There is today no governing body or authority that acts as a gatekeeper of internet publications or consultation. This lack of consistent evaluation and oversight, coupled with easy and low-cost internet publishing can lead to inaccurate and inconsistent health-related information. Spielberg, in the third paper [3], takes up this issue in her review of social, historical, legal and ethical foundations for the patient-physician relationship with relevance for electronic communication. Regarding the personal interaction between a physician and a patient, she points out that it was only a century ago that physicians began to rely on symptoms and corresponding pathological, auscultatory and histo-

logical findings. Previously, a physician drew conclusions regarding diagnoses on the basis of patient narratives, not physical examinations. At that time, face-to-face encounters were therefore neither more nor less reliable than messages relayed from a distance. The introduction of the physical examination led to healthcare becoming organized around personal meetings between physicians and patients. Instead of communicating with patients over distance, the reformed healthcare organization relied on communication between physicians over distance for case consultation.

Even though distance consultations are thus not new for the medical profession, physicians are still reluctant to correspond with or about patients electronically. One reason, suggested in the paper, is simple self-preservation; the physicians are concerned about the volume of the potential e-mail messages they might receive. But more important are the security and secrecy issues, with both ethical and legal aspects. Physicians have from the beginning of their profession been protective of their patients' privacy interest, and this, the author points out, will not change with the introduction of e-mail. A message can be misdirected, printed, intercepted and also by other means read by unintended recipients. Although additional technological safeguards can render e-mail relatively secure, the analysis in the paper concludes that technology alone can not ensure its legal and ethical use in medical practice. A related issue is whether or not e-mail messages should be recorded in the medical record. From the point of view of the author, the e-mail message is itself a medical record; it should be stored electronically or printed in hardcopy. The author finally concludes that e-mail suggests a profound new social dynamic within the patient-physician relationship. E-mail messages, like letters, can not provide caregivers information from vocal intonation and

other physical sources that facilitate interpretation of the patient status. Even so, e-mail messages have the potential to be highly specific and intimate displays of patient narratives and physician compassion. But in a tradition that requires human contact to engender trust and render medical diagnosis, e-mail may seem impersonal and mechanical. E-mail thus presents an opportunity for thoughtful reflection on how physicians do business. The practice needs to be shaped in a legal, efficient and cost-effective form, but then it can change the way basic medical care is delivered.

The fact that the patient-physician relationship is important to consider in the development of health information infrastructures is also displayed in the fourth paper, by Dexter et al. [4]. Advance directives name a surrogate decision-maker or provide written instruction with the intent of extending patient autonomy with respect to end-of-life decisions. Supported by the public, physicians, ethicists, and legislators, advance directives have been promoted as way to control the costs of healthcare at the end of life. The hypothesis tested in this paper is whether reminding primary care physicians to discuss advance directives will stimulate such discussions. Many patients are interested in establishing advance directives, but few actually do complete them. In this study, a randomized control trial was used to determine the effects of computer-generated reminders to physicians. The study covered 1009 patients and 147 primary care physicians and the results showed that physicians who did not receive reminders discussed advance directives with 4% of the patients compared with 24% for physicians who received reminders. The authors suggest that the positive outcome is due to the fact that the computer-based reminders were delivered unobtrusively during regularly scheduled primary-care visits, when patients

are usually not acutely ill and are visiting a physician whom they know and probably trust. However, maybe the most important lesson to be learned from this study is that a highly technical aspect of modern medicine - reminders from an electronic patient record - showed to enhance the oldest and least technical aspect of care: the patient-physician relationship.

Also the fifth paper, by Poller et al. [5], addresses computer support for increasing the quality of care. It reports from a multi-center study on anticoagulant dosage control, where 285 patients were randomly assigned to a computer-generated dose group and a traditional dose group. The computer program calculated doses and times to next visit. The outcome was time spent in the target international normalized ratio range. The mean time within the target range was found to be 63% for the patients in the computer-generated dose group compared with 53% in the traditional dose group. The authors conclude that the computer program provided a better dose control than experienced medical staff. They suggest that computer programs can be made available to community clinics so that nurses, laboratory technicians, and pharmacists can become increasingly involved in the control of anticoagulant dosage. Even though the clinical outcome was not included in the study and the cost-effectiveness of the program was not assessed, the study makes evident that with the computerized dose control, specialized physicians can concentrate more on the few patients who present unusual difficulties for anticoagulant control.

In the sixth and final paper, by Evans et al. [6], the patient and the population perspectives are integrated. It reports from a prospective study on the use of a computerized anti-infective management program for one year in a 12-bed intensive care unit. The authors proceeded from the assumption that the miss-use of anti-infective agents more

often results from insufficient information than from inappropriate behavior. The anti-infective management program was designed to make patient-specific and epidemiological information available at the point of care and at a time when clinical decisions are made. The program used computerized "anti-biograms" (anti-microbial-susceptibility patterns) and heuristic logics for identified pathogens for which antibiotic susceptibility data are not available. For instance, the program relied on recommendations from infectious disease specialists when gram-negative bacteria are first identified in a blood culture. The anti-biograms are used once the pathogen is identified, but before the results of susceptibility tests are available. The use of the program led to a reduction in the orders for drugs to which the patient had reported allergies, reduction in excess drug dosage, and in antibiotic susceptibility mismatches. There were also reductions in the mean number of days of excessive drug dosage and in adverse events caused by anti-infective agents. In a time and motion study performed during the intervention period the authors found that an average of 14 minutes was required for an infectious disease specialist to retrieve the same information that the computerized anti-infective management program retrieved in 3.5 seconds. Following the evaluation, the program met such an acceptance by physicians, that it has been requested and installed in numerous additional inpatient and outpatient facilities.

In conclusion, entering the new millenium, we regard health as a resource for everyday life, emphasizing social and personal resources as well as physical capabilities. Current developments in health partnerships, ethics, and research methods, together with a recognition of what constitutes the expert knowledge needed for both research and implementation, support the active participation of the health

and medical informatics community in the development of an innovative health promoting society. The papers display how recent developments in information infrastructures can support health and clinical management. In particular, we see how use of computers in the daily work of physicians has the potential to improve the quality of care further by freeing up time that physicians can use both to improve the patient-physician relationship and to practice evidence-based medicine.

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