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Series Preface

This series is directed to healthcare professionals who are leading the transformation of health care by using information and knowledge to advance the quality of patient care. Launched in 1988 as Computers in Health Care, the series offers a broad range of titles: some are addressed to specific professions such as nursing, medicine, and health administration; others to special areas of practice such as trauma and radiology. Still other books in the series focus on interdisciplinary issues, such as the computer-based patient record, electronic health records, and networked healthcare systems.

Renamed Health Informatics in 1998 to reflect the rapid evolution in the discipline now known as health informatics, the series continues to add titles that contribute to the evolution of the field. In the series, eminent experts, serving as editors or authors, offer their accounts of innovation in health informatics. Increasingly, these accounts go beyond hardware and software to address the role of information in influencing the transformation of healthcare delivery systems around the world. The series also increasingly focuses on “peopleware” and the organizational, behavioral, and societal changes that accompany the diffusion of information technology in health services environments.

These changes will shape health services in the new millennium. By making full and creative use of the technology to tame data and to transform information, health informatics will foster the development of the knowledge age in health care. As coeditors, we pledge to support our professional colleagues and the series readers as they share the advances in the emerging and exciting field of health informatics.

Kathryn J. Hannah
Marion J. Ball
Preface

The 1998 UK Foresight Report described the field of Health Informatics thus: “Health Informatics examines the organisational, professional and technical issues involved in the use of information systems to support patient-centred healthcare delivery. It includes activities like clinical decision making, efficient information management, knowledge acquisition and dissemination, and informed patient participation.”

Health informatics is evolving quickly, driven by:

- rapid pace of innovation in information and communications technologies and their increasingly pervasive deployment in biomedicine and healthcare,
- exponential growth of knowledge in the biomedical and clinical sciences, and associated need to structure and organise this knowledge as an accessible, up-to-date and coherent electronic resource,
- rapid change in social, professional, legal and organisational contexts of healthcare, associated with greater focus on cost-effectiveness, safety and governance of treatments and services.

Though by no means yet a mature discipline, innovation in the field, over several decades, has proven most successful where pursued locally, under the leadership of successful healthcare professionals, engineers and scientists. As with much investment in IT, the specification and effective delivery of large-scale national projects has been hazardous, reflecting lack of knowledge about generic clinical service requirements and clinical, technical and management discipline needed to support innovation at this level.

To meet national and international healthcare needs, an information infrastructure must join up clinical process and meaning across the many services, professions, organisations and locations of healthcare that provide services and support for individual patients and the communities in which they live. To do this reliably and confidentially, in timely fashion, is the nature of the complex, 2020 challenge we now face. The scale and precision of operational performance of systems that is needed, the necessary clinical and technical standardisation of data, systems and services and the educational and
organisational development required to manage the implied change and enable effective deployment and use of the new infrastructure, by patients and professionals alike, are key aspects. Innovation, driven by diversity and local requirement, from the bottom up, must now grow upwards and find accommodation with standardisation and nationally coordinated procurement and implementation of new systems and services, driven from the top down.

Health informatics has now reached a crucial stage of collision between these, hitherto rather damagingly disconnected, bottom-up and top-down evolutionary strategies. The requirement for a comprehensive, coherent and patient focused health information infrastructure has risen to the highest level in the scale of priorities of health services internationally. Investment on a national scale is now forthcoming in some countries and from it can come benefits from:

- Evidence-based underpinning of health information standards and services and their evolution, over time,
- New professionalism in the management of information, across the whole healthcare enterprise,
- New industrial capacity for relevant supporting products and services,
- Enhanced international collaboration on global health issues.

Research is vital in health informatics because we must learn, practically and by careful experiment, about the necessary underpinning discipline of health informatics. There are no available and proven blueprints of design for such a comprehensive infrastructure and, moreover, the target is shifting all the time.

Science moves on:

- E.g. advances in genomics are leading to potentially huge new personal health data collections, correlating genotype and phenotype of disease with treatment and outcome.

Healthcare services move on:

- E.g. there are increasing concerns for improved patient safety, for achievement of best possible clinical outcomes and for security and confidentiality of personal health data.

Society and the law move on:

- E.g. the cost–effectiveness of chronic illness services for ageing populations, the need to respond globally to new epidemics of infectious diseases, the requirement to show due diligence within a markedly sharper legal framework for management of personal health data.
Introduction

The main concept behind this book is to present the transformation of healthcare services in the Information Society age. These changes are catalysed by conducting professional and social activities with the use of the Internet and mobile tools. The synergy of computer technologies and medical services opens up new, fascinating possibilities in the areas of continuing care, chronic disease treatment, home monitoring of elderly people, etc. The understanding of the nature of this IT-accelerated healthcare transformation is a key factor in improving medical standards and reducing costs. The book addresses this issue as a priority of the Information Society and presents a complete survey of many promising e-health technologies, implemented as real-life applications. Our focus is on providing an integrated overview of the medical, social and technical aspects of e-health. Applying information technologies to healthcare promises fundamental changes in existing models of care delivery and system performance. Hence, an in-depth presentation of how healthcare services are enhanced by the Internet and mobile tools is one of the essential objectives of the book. This unique analysis of the evolution of healthcare services is illustrated by numerous examples; the book also contains a description of available telecare solutions.

The scope of our work is both complex and innovative. The editors have decided to invite leading experts in the field to author individual chapters, related to the deployment of IT tools for solving important problems in 21st century healthcare systems. This approach guarantees high scientific and professional value of the book.

The idea of publishing a book on the use of information technology solutions for improving healthcare delivery systems originates from the PRO-ACCESS initiative (ImPROving ACCESS of Associated States to Advanced Concepts in Medical Telematics, IST-2001-38626) focused on providing better access for new EU Associated States (now full EU members) to modern e-health technologies developed at leading European centres.

Chapter 1, *Evolution of IT-Enhanced Healthcare: From Telemedicine to e-Health*, introduces the concept of telemedicine, including definitions and requirements
of telemedical systems. The evolution of contemporary telemedical systems and challenges faced by future technologies are also shown. Additionally, this chapter reviews speciality-specific applications, including formal and legal aspects of telemedicine as well as its acceptance among users. An important item is the cost/benefit analysis of telemedical services.

Chapter 2, *Access Technologies in Telecare*, overviews access telecommunication technologies. Basic requirements for such communications are considered, both in the hospital-to-patient scenario and in the hospital-to-hospital scenario. The available and emerging solutions are also briefly presented.

Chapter 3, *Internet Technologies in Medical Systems*, presents the requirements and architectures of Internet-based medical systems, with focus on Internet telemedical services, Web services and portal technologies. The next-generation point-of-care information systems are also described and the shift in the methodology associated with medical systems to suit new software architectures is analyzed. As a case study, the TELEDICOM system for collaborative teleradiology is presented.

Chapter 4, *Security and Safety of Telemedical Systems*, describes the requirements related to this important area, analyzing them in the context of legal acts affecting the security of e-medical systems. Subsequently, security system architecture modelling and techniques for securing e-medical systems are described.

Chapter 5, *Wireless Systems in e-Health*, focuses on modern wireless technologies. Security aspects and wireless interference issues are discussed. Wireless hospital and telecare applications are also described and the requirements for mobile access from PDA devices to medical databases are considered in more detail. As a case study, a wireless emergency system is presented.

Chapter 6, *Relevance of Terminological Standards and Services in Telemedicine*, describes medical terminology standardization on several levels of granularity and overviews existing classifications and nomenclatures. As a case study, this chapter presents the TOSCA Project dedicated to establishing a common terminology.

Chapter 7, *Electronic Health Records*, describes the progress in constructing a common set of data structures contained in medical records and reports on the main standardisation efforts in this area. The Electronic Patient Record has fundamental significance for the implementation of medical information systems and telemedical applications.
Chapter 8, *Decision Support Systems in Medicine*, covers knowledge-based and expert systems which support physicians in making medical decisions by providing interactive tools. A classification of such systems is presented and their internal structures and architectures are evaluated. Several classes of expert systems are described and compared.

Chapter 9, *Health Telematics Networks*, briefly describes the requirements and architecture of telematics networks and the organisational models for such networks. It also overviews e-health network services available over the Internet.

Chapter 10, *IT Applications for the Remote Testing of Hearing*, presents innovative telemedical systems for sensory self-diagnostics over the Internet. The preconditions and structures of successful nationwide programs based on these systems are also described.

Chapter 11, *Model of Chronic Care Enabled with Information Technology*, defines the scope of the problem, describing Web-based and telemonitoring solutions as the most commonly used technologies in the area. Subsequently, issues relating to patient empowerment and formal aspects of electronic patient-physician communications are described. The chapter is summarized by an overview of benefits and real-life applications.

Chapter 12, *Computer-Aided Interventions*, presents image-guided surgery as an evolving technology used to carry out minimally-invasive procedures. Such procedures enable access to difficult-to-reach organs and minimise trauma to the patient. This area combines high-speed computer systems with specialised software and tracking technology.

Chapter 13, *Biosignal Monitoring and Recording*, concerns monitoring and recording biosignal data as an extension of medical investigations which takes into consideration their changes over time. This information is used to develop a diagnosis or if it is not sufficient to request more investigations. By this approach a better understanding of physiological control systems can be achieved.

Chapter 14, *Enhancing Medical Education through Telelearning*, specifies telelearning standards and requirements for medical telelearning platforms. The chapter contains an overview of existing telelearning platforms and multimedia material. The process of preparing educational materials for medical e-learning is described, as are the technical aspects of handling multimedia in e-learning medical systems. As a case study, the Medical Digital Video Library and the Virtual Video File System are presented.
 Acknowledgments

All books are collaborative efforts, and this one is no exception. Numerous people have contributed ideas, comments and inspiration, helping turn our concept into reality.

Many chapters of this book have been inspired by discussions during the three “E-health in Common Europe” conferences organized as part of the PRO-ACCESS IST Project in June 2003, March 2004 and December 2004 respectively. The chapters are not selected papers from these conferences, nor do they duplicate the contents of invited lectures - they are intentionally written by leading experts, using materials which detail the most relevant emerging problems in modern telemedicine.
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