TELEMEDICINE

TELEMEDICINE
Theory and Practice

Edited by

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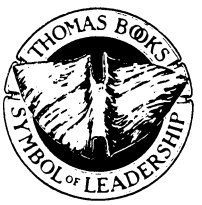

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John R. Searle holds a Ph.D. in biomedical engineering. He joined the faculty of the Medical College of Georgia in 1977 in the department of Biomedical Engineering and has served as its director since 1986. He has developed unique research instrumentation for use in the biomedical sciences, dentistry, and medicine. In 1993 he assumed responsibilities as the Technical Director of the Telemedicine Center. In collaboration with the Georgia Department of Administrative Services, he developed the technical specifications for the telemedicine portion of the Georgia Statewide Academic and Medical System, including a set of optical adaptors to permit coupling a miniature video camera to an ophthalmoscope and an otoscope and other devices. He is currently collaborating with researchers at the Georgia Institute of Technology on the design and development of personal computer-based telemedicine systems suitable for deployment in homes and offices.

Gary W. Shannon, Ph.D., is a professor of medical geography in the Department of Geography at the University of Kentucky. He has been researching and writing extensively on accessibility to medical care over the past 25 years. He has co-authored books such as *Health Care Delivery: Spatial Perspectives, The Geography of AIDS* and *Disease and Medical Care in the United States: A Medical Atlas of the 20th Century.* He is currently involved in the evaluation of several state-wide telemedicine systems.

Ronald S. Weinstein, M.D., is Professor and Head of the Department of Pathology at the University of Arizona College of Medicine. A pioneer in the field of telepathology, he designed and tested the first dynamic-robotic telepathology system while working in Chicago. His clinical research team also carried out the first detailed human

performance studies that validated the use of video microscopy for rendering pathology diagnoses. His concepts of dynamic-robotic microscopy are being implemented in many countries. After moving to Tucson in 1990, Dr. Weinstein co-founded the Arizona-International Telemedicine Network in 1993 and was appointed Director of the Arizona Telemedicine Program and Arizona Rural Telemedicine Network. He has published over 20 articles on various aspects of telepathology and has been granted U.S. patents for telepathology diagnostic networks. He is Past-President of the United States and Canadian Academy of Pathology. He is an experimental pathologist with an interest in cancer biology and urinary bladder cancer.

To
Kenneth T. Bird
True telemedicine pioneer

PREFACE

The first edited volume on telemedicine was published in 1975 when the promise of telemedicine loomed just over the horizon. But the promise dimmed a short time afterwards, and the field nearly faded from memory. Telemedicine was a novel idea then, and few people took notice. Many viewed it with skepticism. Some dismissed it as a mismatch of a high technology solution to simple problems in primary health care. Others were concerned about excessive intrusion of technology into personal relationships, particularly the doctor-patient relationship. Two decades later, we are witnessing the strong revival of telemedicine. Now, the field is widely embraced with high expectations in both public and private sectors. Telemedicine is viewed not simply as a technological augmentation to health care delivery, but more importantly as an innovative system that provides an effective and versatile solution to many of the intransigent problems in health care delivery in this country and elsewhere. Much of this excitement is generated by the enormous expansion of information technology into everyday life, in education, business, commerce, industry, communication, and entertainment. Indeed, health care is a small bit player in the broader development of information technology and its ubiquitous use. Nonetheless, the excitement about telemedicine specifically derives from intuitive assumptions and reasoned speculation about its laudatory effects on access, quality, and cost of health care.

This book was borne out of a desire to present a comprehensive assessment and a scholarly perspective on telemedicine in the 1990s. Like its predecessor, it is intended to represent the state of the art in telemedicine as viewed by clinicians providing telemedicine services, by biomedical and health services researchers engaged in its evaluation, and by visionary scientists charting its future.

As before, we solicited chapters from leading experts whose work should be recognized and whose knowledge should be shared. We hope

we have succeeded in recruiting the leading talent in the U.S. in this particular field.

We undertook the daunting task of producing the book as if it were written by one person. This required homogenizing not only writing styles but also basic approach and content, while respecting the intellectual autonomy of each author and maintaining the integrity of each piece. Our colleagues who wrote the individual chapters were very tolerant of our meddling and changes to their writing style. Without exception, they accepted graciously what seemed to be endless and excessive demands for clarification, editing, and corrections. Our burden as editors was eased considerably by their helpful understanding and cheerful support. When the manuscript was completed, we imposed yet another quality filter by asking our colleague Rudolph Schmerl to help with the copy editing. Dr. Schmerl demonstrated superior skill as a copy editor, and he has earned our endless gratitude for lending his talent, working under pressure, and refining the entire manuscript.

We wish to acknowledge the support and assistance of organizations and individuals who were instrumental in the completion of this book. The BellSouth Foundation served as a catalyst for the project. Their initial funding and ongoing support have been invaluable. Wendy Best, grants manager of the BellSouth Foundation, encouraged the effort as an effective educational tool in telemedicine. The research staff at the National Consortium for Telemedicine Evaluation, University of Michigan, provided valuable assistance throughout the project. Suzanne Worsham worked hard and long preparing numerous drafts of the manuscript, communicating with the authors, and keeping the project on track. Andrzej Kulczycki and Ellen Johnson reviewed and provided valuable editorial changes. Andrew Cameron, Jennifer Schoff, and Rae Reynolds helped with the references. Maryellen Kouba helped with correspondence and clerical chores. While we acknowledge all these people for their valuable assistance and painstaking efforts, together with our colleagues who wrote the individual chapters, we claim full responsibility for any imperfections left in the book.

Finally, we wish to express our heartfelt gratitude to our wives, Naziha, Risa, and Susan, for their tolerance and understanding of our preoccupation with telemedicine, and their helpful support during this labor of love.

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TELEMEDICINE

SECTION I
THE CONTEXT OF TELEMEDICINE

Chapter 1

TELEMEDICINE AND THE HEALTH CARE SYSTEM

RASHID L. BASHSHUR

Introduction

The history of the health care system in the United States over the last four or five decades reveals a preoccupation with three tenacious problems despite various attempts to resolve them:

(1) uneven geographic distribution of health care resources throughout the country, including health care facilities and health manpower;
(2) inadequate access to health care on the part of certain segments of the population, including the under-privileged, isolated, and confined;
(3) unabating rise in the cost of care, including the costs borne by both public and private payers.

All three problems have limited the potential for improving the health status and quality of life for significant segments of American society whether because of their economic status, geographic location, or both. Moreover, and perhaps adding to their significance, these problems are not unique to American society. In varying degrees and intensity, they represent nearly universal phenomena in highly developed as well as lesser developed countries.

Telemedicine has been proposed as a multifaceted response to address all three problems simultaneously through innovative information technologies that expand the productive capability and extend the distributive efficiency of the health care system. The innovations include various combinations of telecommunications, telemetry, and computer technology; integrated organizational structures; health-manpower mixes; as well as a range of diagnostic, clinical, and educational applications.

This chapter assesses the potential role of telemedicine in the health care system once it reaches a reasonable level of maturity and a steady