COMPUTERS IN MEDICINE

APPLICATIONS AND POSSIBILITIES

JAVITT

COMPUTERS IN MEDICINE

APPLICATIONS AND POSSIBILITIES

JONATHAN JAVITT, M.D., M.P.H.
Resident Surgeon
Wills Eye Hospital
Department of Ophthalmology
Jefferson Medical College of
Thomas Jefferson University
Philadelphia, Pennsylvania

1986
W.B. SAUNDERS COMPANY
Philadelphia London Toronto Mexico City
Rio de Janeiro Sydney Tokyo Hong Kong

W. B. Saunders Company: West Washington Square
Philadelphia, PA 19105

Library of Congress Cataloging-in-Publication Data

Computers in medicine.

1. Medicine—Data processing. I. Javitt, Jonathan. [DNLM: 1. Computers. 2. Practice Management, Medical. W 26.5 C7458]

R858.C656 1986 610'.28'5 86–1777

ISBN 0–7216–1578–3

Illustrated by Dan Reeves

Editor: Dana Dreibelbis
Designer: Terri Siegel
Manuscript Editor: Lee Walters
Production Manager: Laura Tarves and Bob Butler
Illustration Coordinator: Walt Verbitski

Computers in Medicine: Applications and Possibilities ISBN 0–7216–1578–3

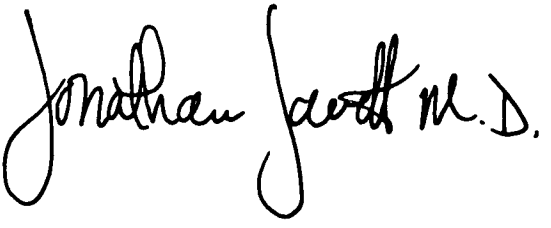
Last digit is the print number: 9 8 7 6 5 4 3 2 1

To my grandmothers,
who continue to wonder
why a doctor should be interested in computers.

PREFACE

My interest in computers began during medical school when I began to combine my interests in epidemiology and ophthalmology. At that time most people identified an Apple as a type of fruit and related computers to engineers and mathematicians. Being neither of these, I sought a basic book that would introduce physicians to computers. That search, which proved fruitless, led me to far more involvement with computers than I ever expected. While the journey has been enjoyable, there is still a need for the introductory book I sought in the first place.

Many individuals have offered the support and asked the questions that caused this book to be written, and I would like to acknowledge their contributions. To the people who pointed me in the right direction: Mr. William Bowen, Dr. B. H. Kean, Dr. Walter Riker, Dr. Michael Bruno, Dr. Robert Ellsworth, Dr. Alfred Sommer, and Sir John and Lady Wilson. To the people who asked the important questions along the way: Dr. Geoffrey Galbraith, Dr. Fernando Flores, Mr. Chauncy Bell, and Mr. and Mrs. Arthur Wellman. Most of all, I thank my colleagues and mentors at Wills Eye Hospital, in particular Dr. William Tasman, Dr. George Spaeth, Dr. William Annesley, Dr. Jerry Shields, and Dr. James Augsburger for their support and teaching.



CONTRIBUTORS

ERNEST BEUTLER, M.D.
Chairman, Department of Basic and Clinical Research, Scripps Clinic and Research Foundation, 10666 N. Torrey Pines Road, La Jolla, CA 92037; Clinical Professor of Medicine, University of California, San Diego School of Medicine, La Jolla, CA 92093

ROBERT S. BLACKLOW, M.D.
Senior Associate Dean, Jefferson Medical College of Thomas Jefferson University, 1025 Walnut Street, Philadelphia, PA 19107

MR. DAVID BROUSSEAU
Medical Student, University of Pennsylvania, 36th and Hamilton Walk, Philadelphia, PA 19104-6015

THOMAS CHALMERS, M.D.
Distinguished Service Professor, Mount Sinai School of Medicine, One Gustave L. Levy Place, New York, NY 10029; Visiting Professor at Harvard School of Public Health, Boston, Massachusetts

JAMES FATTU, M.D., Ph.D.
Clinical Associate Professor of Medicine, Indiana University School of Medicine, 3841 Bellemeade Avenue—Suite 230, Evansville, IN 47710

JONATHAN JAVITT, M.D., M.P.H.
Resident Surgeon, Wills Eye Hospital, Jefferson Medical College of Thomas Jefferson University, 9th and Walnut Streets, Philadelphia, PA 19107

FREDERICK JELOVSEK, M.D.
Associate Professor, Department of Obstetrics and Gynecology, University of Arkansas College of Medicine, 4301 West Markham Street, Little Rock, AR 72207

CHESTER KING
Product Manager for Medical Information Systems Division of Clinical Data, Inc., 1172 Commonwealth Avenue, Boston, MA 02134

PAUL MARINO, M.D.
Clinical Assistant Professor of Medicine, University of Pennsylvania School of Medicine, 36th and Hamilton Walk, Philadelphia, PA 19104-6015; Director, Medical Intensive Care Unit, The Graduate Hospital, 19th and Lombard Streets, Pepper Pavilion, Suite 501, Philadelphia, PA 19146

EDMUND MESSINA, M.D.
Associate Neurologist, Michigan Headache and Neurological Institute, 3120 Professional Drive, Ann Arbor, MI 48104; Clinical Assistant Professor of Medicine (Neurology), Michigan State University, East Lansing, MI 48824

EDWARD A. PATRICK, M.D., Ph.D.
Professor of Engineering and Computer Science, University of Cincinnati College of Medicine, 231 Bethesda Avenue, Cincinnati, OH 45267

WILLIAM STEAD, M.D.
Associate Professor of Medicine, Director of Medical Center Information Systems, Duke University Medical Center, Box 3900, Durham, NC 27710

CHARLES E. STEWART, M.D.
Director, Emergency Services, Saint Mary Corwyn, Pueblo, CO

J. JON VELOSKI, M.S.
Assistant Director, Center for Research in Medical Education and Health Care, Jefferson Medical College of Thomas Jefferson University, 1025 Walnut Street, Philadelphia, PA 19107

CONTENTS

Introduction

This is a book about possibilities—the possibilities that computers open for the practice of medicine today and in the future. There is a plethora of information available today about specific products for use with computers both in medicine and elsewhere. There is an almost total lack of information that enables the thinking person to interpret that information in its proper context and to make intelligent assessments and decisions regarding computer use.

Perhaps the most important distinction that this book can offer is in resolving the question of what you want a computer for in the first place. I assert that it is generally not to assist you in *computing* but rather to assist you in *working*, and thus to enable new possibilities and levels of effectiveness. One does not buy a refrigerator in order to have an electric motor that can power a compressor but rather in order to store food. Similarly, computers for us are information storage machines, information analysis machines, and information retrieval machines. Most important, however, may be their role as machines that can transmit not only information but commitment for action. As a simple example, interns in many hospitals write periodic lists of all medications being administered to a patient in order to keep track of frequent additions and deletions. Anyone reading the chart since the last list was compiled must scan the orders for any further changes. In hospitals in which medication orders are written only via the hospital-wide computer system, a physician's request for a new medication triggers an automatic search for allergies or drug incompatibilities, a request to the pharmacy for the substance, a request back to the physician to order blood levels when appropriate, and an updating of that patient's medication list. This analogy can be extended to any other request for treatment, diagnostic procedure, or consultation. We as physicians have access to up-to-the-minute information on disease and its treatment in unprecedented ways. This book is dedicated to exploring these possibilities for practicing medicine that were unavailable prior to the advent of computers. To a large extent, this book focuses on microcomputers because this is the level at which you are most likely to enter the computer age.

As with any book, you are reading these words at least 2 years after the inception of the project. During the period of time the leading edge of technology has advanced exponentially. Although every effort has been made to assure currency of material at the time of publication, there is no question but that enormous advances will have been made before

this book reaches your hands. For this reason, a book about specific products and programs is not feasible and is of limited value. Fortunately, the advertising needs of the computer industry have spawned a healthy industry in magazines specifically devoted to computers in medicine. This is always where the most current product information will be found.

Part I of this book provides an overview of what computers are, how they can maximize personal productivity, and how they may be incorporated into the mainstream of medical practice and education. Part II focuses on current applications of computers to patient care.

In the opening chapter, *Dr. Thomas Chalmers* draws upon many years of experience as a physician, educator, and dean to point to some of the shifts that computers will bring about in our practice of medicine and even in the qualities that we associate with physician excellence. I have followed this opening with three chapters designed to introduce you to computers, especially microcomputers, and their uses. Chapter 2 is an overview of the basics of computer hardware and software. It presumes no technical understanding of either and serves as a gentle introduction to these topics. Chapter 3 is a comparison of the capabilities of microcomputers and mainframes. Although most of this book is devoted to microcomputers and their capabilities, hospitals are installing large computer systems with which the physician must interact directly. A basic understanding of the "machine in the basement" that lives behind the video screen is thus extremely useful.

Chapter 4 serves as a critical overview of basic software tools for everyday work and introduces the reader to word processors, spreadsheets, and data base programs. In Chapter 5, *Dr. Charles Stewart* offers an overview of the electronic network of medical data that is now available to anyone with a computer and offers an approach to accessing it effectively. *Dr. Ernest Beutler* amplifies that theme in Chapter 6 by discussing the enormously powerful role that computers can play in effective management and updating of personal reference data bases.

In Chapter 7, I have drawn upon my consulting experience in computerizing medical offices in order to offer an approach that saves large amounts of time and money and simultaneously circumvents many of the most dangerous pitfalls in the process. It is interesting to note that, at press time, the only books on computers in medicine to be found focused upon office computerization. The explosion in technology and products since those books were written has made office computerization, billing, and accounting systems an increasingly smaller, although vital, part of the medical computer industry.

Part I concludes with an overview of the integration of computer knowledge into the medical school curriculum. In the past year, the Association of American Medical Colleges has formed a task force to develop effective programs and guidelines to fill this pressing need in the education of physicians for the 1990s. *Mr. John Velosky* and *Dr.*

Joseph Gronella of Thomas Jefferson University discuss the strides that are being made in their institution and elsewhere in the United States.

Part II focuses upon major applications that are available today to assist us in caring for patients. In Chapter 9, *Dr. Edmund Messina* discusses the utility of computerized history-taking in the physician's office and the systems available for that purpose. Although computer-driven history-taking is one of the first areas to which computers have been applied, only in the past year has this technology been easily affordable to the practitioner. In this chapter and its successors, the focus is upon programs that can operate on affordable microcomputer hardware both in the hospital and the office setting.

Chapter 10 provides an overview of some of the products that have recently been introduced for clinical management of patients. In discussing these packages, *Dr. Paul Marino* succeeds in presenting what is possible today. New approaches and products enter the market monthly, but his discussion of existing products can be used as a basis for evaluating new products with which you come into contact.

In Chapter 11 *Dr. James Fattu* and *Dr. Edward Patrick* succeed in making the highly complex field of computer-aided diagnosis intelligible to those of us who do not routinely think in terms of probability theory. The chapter focuses upon experience-based diagnostic systems in which hard clinical data from previous patients feed the decision-making process on an ongoing basis. In contrast, an expert-based system relies upon rules generated by a panel of experts in a field, and those rules are only as good as the collective opinions assembled. Although the data base needed to drive an experience-based system is far more extensive, the system ultimately draws upon a much larger knowledge base and is more rapidly updated than the best expert system.

In Chapter 12, *Dr. William Stead* and *Dr. Frederick Jelovsek* draw upon their experience as pioneers in the area of medical record systems to provide an overview of this field. During the past 10 years, the computerized medical record has evolved from a single electronically stored list to an intelligent system that includes its own checks and counterchecks to ensure optimal patient care. The approach described has been applied in many of the clinical services at Duke University and continues to prove and expand its power and flexibility.

Chapter 13 is a comparative survey of the major products available today for the management of clinical data. An in-depth survey of these products is appropriate in this case for two reasons: They are not adequately discussed either in the medical or nonmedical computer journals, and they are extensive and stable programs that have taken years to develop and are unlikely to change significantly by the time you read this book. *Chester King*, of Clinical Data Incorporated, has done an admirable and impartial job of reviewing this field.

The largest challenge in preparing this book has been in forcing

myself to stop collecting material and send it to press. I am certain that between now and tomorrow morning, when the last page of manuscript hits the publisher's desk, I will discover at least one more topic or application that absolutely must be included. I am equally certain that you will be equally quick to find areas that should be included, covered more extensively, or reported differently. A large part of the satisfaction that I anticipate in having compiled this book is in hearing from you about what I have left out. Only through this form of partnership can I hope to keep this book a current reflection of the possibilities provided by computers in medicine.

JONATHAN JAVITT, M.D.

COMPUTERS AS TOOLS FOR PERSONAL PRODUCTIVITY

PART I