Essential Evidence-Based Medicine

Evidence-based medicine (EBM) – using the best evidence in the literature for the best care for an individual patient – sounds very simple. Yet most medical students and physicians do not have the mathematical background or training to critically evaluate published research. This "consumer's guide" to EBM helps you become a more discriminating reader of the medical literature. An introduction to scientific methods and study design leads on to a better understanding of measurements and sources of bias. There is a brief introduction to statistics and hypothesis testing (Type I and II errors) and measures of risk and efficacy. The second half of the book teaches medical decision making including discussions of the clinical examination and sources of bias in that examination, likelihood ratios, sensitivity, specificity, and predictive values, and advanced topics in medical decision making. This is an ideal introductory text for medical students and all health-care professionals.

Dan Mayer, M. D. is a professor of emergency medicine at Albany Medical College in New York. A graduate of Albert Einstein College of Medicine, he has been practicing emergency medicine for 24 years. For the last 10 years he has developed and taught a required 4-year course called Evidence Based Health Care at Albany Medical College. He has been a tutor at evidence-based health-care seminars around the world and has spoken frequently about teaching evidence-based medicine to educators, medical school faculty, undergraduate medical students, and residents at conferences internationally and in the USA.

Essential Evidence-Based Medicine

Dan Mayer

Albany Medical College

CAMBRIDGE UNIVERSITY PRESS

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS
The Edinburgh Building, Cambridge CB2 2RU, UK
40 West 20th Street, New York, NY 10011–4211, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia
Ruiz de Alarcón 13, 28014 Madrid, Spain
Dock House, The Waterfront, Cape Town 8001, South Africa

http://www.cambridge.org

First published 2004

Printed in the United Kingdom at the University Press, Cambridge

Typefaces Utopia 9/13 pt. and Dax *System* LaTeX 2$_\varepsilon$ [TB]

A catalog record for this book is available from the British Library

Library of Congress Cataloging in Publication data

Mayer, Dan.
Essential evidence-based medicine/Dan Mayer.
p. cm.
Includes bibliographical references and index.
ISBN 0 521 83261 6 (hardback) – ISBN 0 521 54027 5 (paperback)
1. Evidence-based medicine. I. Title.
[DNLM: 1. Evidence-Based Medicine. WB 102 M468e 2004]
R723.7.M396 2004
616–dc21 2003053202

ISBN 0 521 83261 6 hardback
ISBN 0 521 54027 5 paperback

Contents

Preface

In 1992 during a period of innovative restructuring of the medical school curriculum at Albany Medical College, Dr. Henry Pohl, then Associate Dean for Academic Affairs, asked me to develop a course to teach students how to become lifelong learners and how the health-care system works. This charge became the focus of a new longitudinal required four-year course initially called CCCS or Comprehensive Care Case Study. In 2000, the name was changed to Evidence Based Health Care (EBHC).

During the next ten years a formidable course was developed. It concentrates on teaching evidence-based medicine (EBM) and health-care systems operations to all medical students at Albany Medical College. The first syllabus was based on a course in critical appraisal of the medical literature intended for internal medicine residents at Michigan State University. This core has expanded by incorporating medical decision making and informatics. The basis for the organization of the book lies in the concept of the educational prescription proposed by Scott Richardson, M.D.

The goal of the text is to allow the reader, whether medical student, resident, allied health care provider, or practicing physician, to become a critical consumer of the medical literature. This textbook will teach you to read between the lines in a research study and apply that information to your patients.

For reasons I do not clearly understand many physicians are "allergic" to mathematics. It seems that even the simplest mathematical calculations drive them to distraction. Medicine is mathematics. Although the math content in this book is on a pretty basic level, most daily interaction with patients involves some understanding of mathematical processes. We may want to determine how much better the patient sitting in our office will do with a particular drug, or how to interpret a patient's concern about a new finding on their yearly physical. Far more commonly, we may need to interpret the information from the Internet that our patient brought in. Either way, we are dealing in probability. However, I have endeavored to keep the math as simple as possible.

This book does not require a working knowledge of statistical testing. The math is limited to simple arithmetic and a handheld calculator is the only computing

instrument that is needed. Online calculators are available to do many of the calculations needed in the book and accompanying CD-ROM. They will be referenced and their operations explained.

The need for learning EBM is elucidated in the opening chapters of the book. The layout of the book is an attempt to follow the process outlined in the educational prescription. You will be able to practice your skills with the practice problems on the accompanying CD-ROM. The CD-ROM also contains materials for "journal clubs" (critical appraisal of specific articles from the literature) and PowerPoint slides.

A brief word about the CD-ROM

The attached CD-ROM is designed to help you consolidate your knowledge and apply the material in the book to everyday situations in EBM. There are four types of problems on the CD:

(1) **Multiple choice questions** are also called Self-assessment learning exercises. You will be given information about the answer after pressing "submit" if you get the question wrong. You can then go back and select the correct answer. If you are right, you can proceed to the next question. A record will be kept of your answers.

(2) **Short essay questions** are designed for one- to three-sentence answers. When you press "submit" you will be shown the correct or suggested answer for that question and can proceed to the next question. Your answer will be saved to a specified location in your computer.

(3) **Calculation and graphing questions** require you to perform calculations or draw a graph. These must be done off the program. You will be shown the correct answers after hitting the "submit" button. Your answer will not be saved.

(4) **Journal clubs** require you to analyze a real medical study. You will be asked to fill in a worksheet with your answers in short essay form. After finishing, a sample of correct and acceptable answers will be shown for you to compare with your answers.

Acknowledgements

There are many people who were directly or indirectly responsible for the publication of this book. Foremost, I want to thank my wife, Julia Eddy, without whose insight this book would never have been written. Her encouragement and suggestions at every stage during the development of the course, writing the syllabi, and finally putting them into book form, were the vital link in creating this work. At the University of Vermont she learned how statistics could be used to develop and evaluate research in psychology. She encouraged me to use the "scientific method approach" to teach medicine to my students, evaluating new research using applied statistics to improve the practice of medicine.

Next, I would like to acknowledge the help of all the students and faculty involved in the EBHC Theme Planning Group for the course since the start. This group of committed students and faculty has met monthly since 1993 to make constructive changes in the course. Their suggestions have been incorporated into the book and this invaluable input has helped me develop it from a rudimentary and disconnected series of lectures and workshops to what I hope is a fully integrated educational text.

I am indebted to the staff of the Office of Medical Education of the Department of Internal Medicine at the Michigan State University for the syllabus material that I purchased from them in 1993. This became the skeleton structure of the course on which this book is based. I think they had a great idea on how to introduce the uninitiated to critical appraisal. The structure of their original course can be seen in this work.

I would like to thank Sandi Pirozzo, M.D. and John Kaplan, Ph.D. for their chapters on searching and the ethical conduct of research respectively. I would especially like to thank the following faculty and students at Albany Medical College for their review of the manuscript: John Kaplan, Ph.D., Paul Sorum, M.D., Maude Dull, M.D. (AMC 2000), Kathleen Trapp, B.S., Peter Bernstein, B.S. (AMC 2002), Sue Lahey, M.L.S., Cindy Koman, M.L.S., and Anne Marie L'Hommedieu, M.L.S. Their editorial work over the past several years has helped me refine the ideas in this book. I would also like to thank Chase Echausier, Rachael Levet, and Brian Leneghan for their persistence in putting up with my foibles in the production

of the manuscript, and my secretary, Line Callahan, for her Herculean effort in typing the manuscript. I also thank the creators of the CD-ROM, which was developed and executed by Tao Nyeu and my son, Noah Mayer. I owe a great debt to the staff at the Cambridge University Press for having the faith to publish this book. Specifically, I want to thank Senior Commissioning Editor for Medicine, Peter Silver, for starting the process. Of course, I am very thankful to my copy-editor, Hugh Brazier, whose expertise and talent made the process of editing the book actually pleasant.

Finally, this book is dedicated to my children, Memphis, Gilah, and Noah. Thanks for all of your patience.