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(Editors)

The Behavioral Sciences and Health Care

4th edition

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About the Editors

Olle Jane Z. Sahler, MD, is the George Washington Goler Professor in Pediatrics, and Professor of Psychiatry, Medical Humanities and Bioethics, and Oncology at the University of Rochester School of Medicine and Dentistry, Rochester, New York. She is a behavioral pediatrician with a special interest in the care of chronically and terminally ill children and their families, and in the treatment of children and adolescents with chronic pain syndromes, using an integrative medicine approach. She has written widely on medical student, resident, and practitioner education in the areas of child development, management of behavioral problems at home and in school, and on palliative care, end-of-life care, and bereavement counseling. The W. T Grant Foundation and the National Cancer Institute have funded her multi-institutional research focused on siblings and mothers of children with cancer for over 30 years. She has also been funded by the National Center for Complementary and Alternative Medicine (now the National Center for Complementary and Integrative Health) of the National Institutes of Health to study the effects of using music therapy on symptom control and immune reconstitution in patients undergoing stem cell transplantation. Lastly, she has been the principal investigator and project manager of the Rochester Area Collaborative Center of Excellence in Pain Education since 2012. The goal of this project, which is funded by the Pain Consortium of the National Institutes of Health, is to develop online educational materials appropriate for interprofessional education about responsible pharmacological as well as nonpharmacological management of both acute pain and chronic pain syndromes.

As an educator, she was Director of the Pediatric Clerkship at the University of Rochester School of Medicine for 17 years and Director of the Department of Education of the American Academy of Pediatrics in 1995–1996. She was the founding chairperson of the Medical Student Education Special Interest Group of the Academic Pediatric Association, in McLean, Virginia (formerly the Ambulatory Pediatric Association), the founding president of the Council on Medical Student Education in Pediatrics (COMSEP), also in McLean, Virginia, and the founding chairperson of the Alliance for Clinical Education (ACE) of the Association of American Medical Colleges, in Washington, DC.

As President of the Association for the Behavioral Sciences and Medical Education (ABSAME) in 1992–1993, she began a project to develop a comprehensive curriculum guide for medical student and resident education in the behavioral sciences, which was published in 1995. An updated version of this curriculum guide, reflecting the many advances in our understanding of the importance of the integration of the behavioral and social sciences into medical education that occurred around the turn of the 21st century, forms the foundation for this present book, now in its fourth edition. The authors and editors who contributed to this text represent the diverse experience and expertise of ABSAME's former membership, working in conjunction with other expert professionals dedicated to excellence in education.

A graduate of Radcliffe College/Harvard University, Dr. Sahler received her MD degree with Distinction in Research at the University of Rochester, was a resident in pediatrics at the Duke University Medical Center, and completed a fellowship in Behavioral and Developmental Pediatrics and Child and Adolescent Psychiatry at the University of Rochester. She served as a Captain in the US Army Medical Corps and received a Special Commendation Award for her work in identifying and managing cases of child abuse in the military.

John E. Carr, PhD, is Professor Emeritus of Psychiatry and Behavioral Sciences and Psychology at the University of Washington where he served a 4-year term as the acting chair of the Department of Psychiatry and Behavioral Sciences, was Director of Undergraduate Medical Education, and played a principal role in developing behavioral science curricula for the School of Medicine. He has written extensively about the need for an *integrated sciences model* for the

behavioral and biological sciences in medical education and clinical psychology graduate training. He has served as a consultant to the World Health Organization (WHO) on behavioral sciences in health care training, and co-coordinated a cooperative venture between ABSAME, the Association of Medical School Psychologists, and the International Union of Psychological Societies in developing behavioral science training modules for WHO.

Dr. Carr received an MA in industrial psychology and a PhD in clinical psychology from Syracuse University. He is a diplomate in health psychology of the American Board of Professional Psychology. He is a fellow of the American Psychological Association, Association of Psychological Science, Society of Behavioral Medicine, and the Academy of Behavioral Medicine Research. He has served on the National Board of Medical Examiners Behavioral Sciences Test Committee, and is a founding member and was twice elected to the presidency of the Association of Psychologists in Academic Health Centers. His promotion of an integrated sciences model in medical education and graduate psychology training reflects his bio-behavioral orientation and a research career focused on identifying the mechanisms of bio-behavioral interaction in stress, anxiety, and depression.

Dr. Carr is the recipient of a Distinguished Educator Award from the Association of Psychologists in Academic Health Centers, the Gary Tucker Award for Lifetime Achievement in Teaching and Dedication to Education from the Department of Psychiatry of the University of Washington, and Distinguished Psychologist Awards for Contributions in Scholarship and for Contributions to the Field of Psychology from the Washington State Psychological Association. He is the 2016 recipient of the American Psychological Association Award for Distinguished Professional Contributions to Institutional Practice.

Julia B. Frank, MD, LDFAPA, is a member of the voluntary faculty of the Department of Psychiatry at the George Washington University School of Medicine and Health Sciences (GWU). While serving at GWU as Director of Medical Student Education in Psychiatry (2003–2015), she organized the preclinical behavioral sciences curriculum and integrated it with the psychiatry clerkship. A graduate of the Master Teachers program of the GWU School of Education and Human Development, she has cultivated an interest in multiple modes of learning, including team-based learning, problem-based learning, medical readers theater, medical humanities, and self-directed learning. She became a coeditor of the third edition specifically to help align it with current thinking about the principles of psychopathology.

Dr. Frank is a member of the Society of Distinguished Teachers, a former board member of ABSAME, a diplomate of the American Board of Psychiatry and Neurology, and a Lifetime Distinguished Fellow of the American Psychiatric Association. She was named Psychiatrist of the Year by the Washington Psychiatric Society in 2005, based on organizing colleagues to work with survivors of Hurricane Katrina. Her other scholarly writing includes coauthorship with her father, Jerome D. Frank, MD, PhD, of *Persuasion and Healing: A Comparative Study of Psychotherapy* (1991), a classic work explaining the universal processes and effects of psychotherapy, written especially for medical students and trainees in other mental health disciplines. More recently, she coedited, with Renato D. Alarcón, *The Psychotherapy of Hope: The Legacy of Persuasion and Healing* (Baltimore, MD: Johns Hopkins University Press; 2012). Other scholarly interests include research into the pharmacological treatment of posttraumatic stress disorder and writing about women's mental health, victims of violence, and various topics in the history of medicine. She has also published medical comic poetry in the *New England Journal of Medicine*.

A graduate of Harvard University and the Yale University School of Medicine, Dr. Frank completed an internal medicine internship at Michael Reese Hospital in Chicago. She pursued psychiatry residency at the Yale Department of Psychiatry. Dr. Frank has provided clinical psychiatric care to chronically mentally ill veterans, medically ill patients, university students, and refugees seeking asylum. Her current practice serves outpatients with anxiety, mood disorders, perinatal psychiatric syndromes, and a wide range of other adaptive disorders.

João V. Nunes, MD, is Associate Medical Professor at the City University of New York (CUNY) School of Medicine in New York City.

Through the years, he has been instrumental in developing behavioral science, neuropsychiatry, and doctoring curricula at the school. A Harvard-Macy Scholar in the Harvard-Macy Institute for Physician Educators (a joint Harvard Medical/Education Schools/Joaiah Macy Foundation program), he developed his interest in the principles and methods of active, self-directed learning, especially problem-based learning, team-based learning, and service learning. He is a diplomate of the American Board of Psychiatry and Neurology, a psychiatrist, and child and adolescent psychiatrist with a special interest in brain and behavior, clinical neuroscience, childhood development, psychopathology, psychotherapy, health disparities related to sleep disorders and chronobiology, and exploring personal narratives to understand behavior, including food-related behavior. He has written and presented on medical student education, on sleep and chronobiology, and on health disparities. He has dedicated much of his career to providing leadership, directorship of ambulatory services, and direct clinical psychiatry care in underserved areas of Harlem and The Bronx in New York City (where he still practices), to undergraduate and graduate medical education, and to the cause of facilitating access of underrepresented minorities to medical education. He currently helps develop the undergraduate medical education curriculum, which he teaches extensively. He has founded and directed required courses, and has directed a psychiatry clerkship and a psychiatry residency training program.

Dr. Nunes played an important role in the development of the *Behavioral Science Curriculum Guide,* published in 1995 by ABSAME, one of the first ever efforts to provide an educational template in the behavioral sciences for medical students and residents, allied health students, and teachers. These efforts were followed by participating extensively in all editions of the present book.

Beyond the medical field, he composes and performs music and writes poetry, having published a bilingual (English/Portuguese) anthology titled *True Word*, with two other poets.

A graduate of the Faculty of Medicine of Espírito Santo Federal University, Brazil, he completed residencies in pediatrics, psychiatry, and child psychiatry at the Rio de Janeiro Federal University. After moving to New York, he completed residency and fellowship training in psychiatry and child and adolescent psychiatry at the Albert Einstein College of Medicine. He holds a certificate in psychotherapy and psychoanalysis from the Post Graduate Center for Mental Health (University of the State of New York). He is a full fellow of the American Academy of Psychoanalysis and Dynamic Psychiatry.

Preface to the Fourth Edition

In prior editions, we stressed the critical importance of combining the principles of the behavioral and social sciences with those of the biological sciences to develop a comprehensive understanding of health and illness. This concept of an integrated sciences model of research, clinical training, and health care delivery anticipated the explosion of interdisciplinary studies focused on the mechanisms by which biological and behavioral and social factors interact to influence health outcomes, which has occurred since the beginning of the 21st century. Simultaneously, there has been increasing recognition that interprofessional education leading to interdisciplinary collaboration among health care professionals is essential if we are to create unified, efficacious, and cost-effective delivery systems.

Our objectives in this new edition are twofold: (1) to amplify our understanding of the mechanisms and processes contributing to bio-behavioral interactions, by reviewing recent research advances from behavioral genomics, the cognitive and social neurosciences, psychoneuroendocrinology, and other interdisciplinary research fields relevant to health care and (2) to examine how interdisciplinary practice can promote the broader application of knowledge gained from integrating the biological and behavioral and social sciences in the training of all health care professionals.

The Association for the Behavioral Sciences and Medical Education (ABSAME) gave rise to this textbook through the development of a set of educational guidelines for the behavioral sciences, and has supported its evolution over the past decade. In 2013–2014, ABSAME changed its focus and broadened its membership to reflect a growing understanding that it is only through interdisciplinary efforts that we can keep the world's population as free of disease as possible and maximize the sense of self-efficacy and well-being that is essential to living a full and productive life. Regrettably, ABSAME is no longer active as an organization, but members have joined with other organizations (e.g., Association of Psychologists in Academic Health Centers) that foster behavioral and social sciences education within the traditions of the disciplines of medicine, psychology, nursing, and social work, among others.

There are limits to the resources that professionals can rely on to improve and maintain the health of society. It is clear that the expertise of many different disciplines and the accountability of all members of the team are crucial elements of an efficient, effective health care system. Thus, it is incumbent on all of us to integrate scientific knowledge and apply our respective skills cooperatively toward achieving our mutual goals.

In keeping with these objectives, this work is designed to provide an understanding of how the behavioral, social, and biological sciences interact to influence health care. It is also designed to provide information and insight from the behavioral and social sciences that can be applied to the clinical practice of any health care provider regardless of discipline. In Section IX, we use the provider–patient relationship as an example of the broader clinician–client relationship that is the backbone of health care. Clearly, the professional responsibility to provide information, teach, advise, guide decision making, and advocate for the best interest of the person seeking our counsel – all with the utmost integrity – is inherent in the standards of all provider groups. We trust that the universal role the behavioral and social sciences play in optimizing well-being will be self-evident and that you will find these principles applicable in every health care encounter you have, in what we hope will be a rich and fulfilling career.

Resources for teachers, including an instructor's manual, are available via the publisher's website at https://www.hogrefe.com

The Editors

Contents

Introduction and How to Use This Book

In the course of human experience, people are born, mature, feel emotion, develop relationships, produce and reproduce, and struggle to cope with a myriad of challenges to their survival and well-being. This book is about the diverse ways in which health can be compromised; the many factors that contribute to an individual's predisposition, vulnerability, and resilience; the wide range of precipitating events that can trigger a disease, injury, or malfunction; and the complex array of individual differences that determine each patient's unique response to a disease as well as its treatment.

When health and well-being are challenged, humans have, for millennia, sought the aid of healers, individuals who are purported to possess special knowledge about the etiology and treatment of various disorders. History has witnessed the evolution of health care from a spiritually based healing art to a scientifically based technical profession, reflecting advances in our knowledge of the biological functioning of the human body. After World War II, there was a gradual shift away from medicine's exclusive focus on linear causal relationships between a disease and its biological etiology. Physicians began to refer to a "biopsychosocial model," which proposed that psychosocial variables were as important as biological variables in determining health status.

Although a major step forward in understanding that complex interactions exist, the biopsychosocial model failed to explain *how* psychosocial variables actually interact with biological variables. That is, what are the specific connections that exist among the biological (e.g., neurotransmitter systems), psychological (e.g., emotional reactions to stress or memory), and social (cultural prescriptions and proscriptions about appropriate physical and interpersonal responses) factors that define health and illness, and by what mechanisms are they established and maintained? In the final decades of the 20th century, medical researchers began to explore the knowledge and methodology of psychology, sociology, anthropology, and other behavioral and social sciences as they apply specifically to medicine. Focusing on bio-behavioral connections, their studies have given rise to new fields such as behavioral genetics, behavioral neuroscience, psychoneuroendocrinology, behavioral pharmacology, social biology, and behavioral medicine.

The growing integration among the behavioral and biomedical sciences, coupled with the development of interprofessional education, has revolutionized training, so that behavioral and social science concepts are typically taught within other curricular domains (e.g., organ systems-based courses in medical schools, provider–patient relations in many different professions) without being connected to a particular academic tradition or research domain. We expect that educators responsible for different courses and curricular themes will use different sections of this book separately. The more clinical chapters include case vignettes to facilitate integration with current educational strategies that emphasize case-based or problem-based rather than discipline-based approaches.

The model presented in this book calls attention to the clinical significance of the *interaction* among biopsychosocial variables, and focuses on identifying the mechanisms that interconnect these variables. We call this extension of the biopsychosocial model the *integrated sciences model* (ISM) because it emphasizes the interdependence of the contributions made by *all of the sciences* basic to medicine.

In Section I, we briefly trace the evolution of health care practices and models, the development of contemporary health care provider practice, and the integrated sciences model. In Section II, we present a brief review of the human nervous system and how its evolution has contributed to the unique survival capabilities of *homo sapiens*. In

Section III, we discuss the basic homeostatic systems and the critically important role that the stress response plays in human adaptation. In Section IV, we review basic psychological principles and the higher order bio-behavioral mechanisms involved in sensation, learning, cognition, emotion, and social interaction and cooperation. In Section V, we review human development through the life cycle and important aspects of major developmental theories as they apply to the individual and to the family. In Section VI, we examine social behavior and groups, and the influence of culture, ethnicity, and other social factors on health and health care. In Section VII, we explore several contemporary social issues that contribute to, complicate, or are major problems in health care.

In Section VIII, we examine the organization and functioning of the health care system, in particular the US health care system, the role that certain areas of special focus such as palliative care play, the rise of integrative medicine (the inclusion of complementary therapies in conventional health care plans), and some of the ethical and legal issues faced by health care providers. In Section IX, we discuss the clinical encounter and examine the relevance of basic, clinical, and social science to understanding the patient's complaints, eliciting and interpreting findings, making a diagnosis, negotiating a treatment plan, and motivating patient behavior. We also explore the importance of patients' health literacy and provider impairment in effecting health outcomes. In Section X, we summarize the field of psychopathology, present brief descriptions of the more common psychiatric disorders, and show how basic behavioral science principles help us to understand this complex area of health care.

Each chapter in this volume begins with a set of bulleted questions designed to focus attention on key learning points. Each chapter also concludes with a short set of review questions based on information in the text. We have chosen to emphasize ideas, principles, and established research findings, and to minimize references in favor of providing selected recommended readings. Finally, significant scientific observations from the behavioral and social sciences as well as clinical applications and examples have been included to make the theoretical practical.

In the Appendix, we have presented several of the psychological tests commonly used in the assessment of cognition, emotion, and behavior in both normal and clinical populations. Lastly, we have included 335 multiple-choice questions with explanations of the correct answer and why the incorrect choices are, in fact, incorrect. Some of the questions in this section provide additional review of material in the text. However, many questions are focused on new material to make the contents of the book even more comprehensive through the use of brief, directed discussions. The construction of these questions is designed to give you a sense of the kind of material and question format you may encounter later in training.

Good medicine is science artfully applied. The laws of probability should be interpreted in the light of experience and intuition, and common sense appreciated as a useful guide to decision making. Respect for the autonomy and self-efficacy of the patient will usually lead to the best outcome – although not everyone may agree with what the patient wants as the outcome.

We have tried to be explicit in defining the mechanisms of bio-behavioral interaction where they are known and to incorporate typical patient experiences where relevant. Some of the material will seem self-evident, some will seem counter-intuitive, but all derives from the amalgam of research findings from the biological, behavioral, cognitive, sociocultural, and environmental sciences that contribute to our knowledge of the determinants of health and illness important for you as well as your patients.

Olle Jane Z. Sahler, MD
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Section I
The Behavioral Sciences and Health

1 Evolving Models of Health Care

John E. Carr, PhD, Olle Jane Z. Sahler, MD, Julia B. Frank, MD, and João V. Nunes, MD

- How does the World Health Organization define health?
- How do disease, sickness, and illness differ?
- What is the difference between direct and indirect health risks?
- What shared concepts underlie traditional and modern health care systems?
- Why is the biomedical model discipline specific?
- What is the biopsychosocial model?
- What is an integrated sciences model?

Health, Disease, Sickness, and Illness

How does the World Health Organization define health?

The **World Health Organization** (WHO) defines **health** as a *state of physical, social, and mental well-being*, measured by the patient's ability to cope with everyday activities, and fully function physically, socially, and emotionally. At its optimal level, good health provides for a life marked by spiritual serenity, zestful activity, a sense of competence, and psychological well-being.

How do disease, sickness, and illness differ?

Disease is the manifestation of impaired bodily functions. Disease is recognized and classified by the type of organ damage (e.g., cirrhosis of the liver, myocardial infarction), by functional impairment (e.g., diabetes), or by homeostatic system failures (e.g., infectious disease, autoimmune disorder). **Sickness** refers to those behaviors manifested by an individual who believes that they are suffering from a disease or functional impairment. An individual can feel sick, yet have no identifiable disease. Conversely, someone may have a disease but not feel or act sick. Being perceived as sick or feeling sick leads to adopting the **sick role** relative to the rest of the community. This frees a person from the obligation to perform the tasks of everyday living without blame (i.e., to take sick leave). However, the sick person has obligations to (1) pursue and accept help and (2) adhere to culturally or professionally prescribed regimens that facilitate a return to health.

Illness represents the totality of a patient's experience: how a patient feels, how a patient behaves and perceives their condition, and how others respond. Responses vary according to the person's place within the family or community, as shaped by cultural beliefs and expectations. Beliefs about how or why the illness occurred (**explanatory models**) and the course the illness takes determine how the patient behaves and how the larger community responds.

Risk and Prevention

What is the difference between direct and indirect health risks?

Direct risks to health include dangerous practices (e.g., reckless driving, smoking) and various

environmental pathogenic conditions (e.g., environmental toxins, contaminated water). *Indirect risks* to health are lower risk practices or prevention failures (e.g., high fat diet, not exercising). While some risk factors (e.g., age, race, genetic makeup) are not modifiable, many risk factors are related to a person's **lifestyle** (e.g., diet) and are, therefore, modifiable. Other risk factors, such as occupation, social class, religious practices, and cultural traditions, affect health status in complex ways that may or may not be modifiable.

The concept of health care extends from the *treatment* of disease; to the *prevention* of disease**,** injury, sickness, and illness; to the *promotion* of health. To achieve these goals, health care professionals not only apply medical treatments, but also seek to change patient behaviors, beliefs, social and cultural practices, and environmental conditions. *Such work requires knowledge of the ways these factors interact, how they affect patient health, and the methods by which they can be effectively modified.*

Primary prevention involves practices to protect, promote, and maintain health. These include the concerns of specialized public health professionals, whose role is to promote sanitation and occupational safety and to monitor environmental conditions. Primary prevention in medical settings involves advising patients about personal habits such as exercising regularly, maintaining normal weight, eating nutritional foods, and avoiding smoking, substance use, or other activities that jeopardize health. **Secondary prevention**, for which many types of health professionals may assume responsibility, involves practices such as immunization, medical surveillance, **harm reduction**, and health screening to enhance resistance to, or buffer the impact of, risk factors.

Evolving Approaches to Health Care

Archeological evidence suggests that humans have practiced some form of health care for at least the past 30,000 years. Early human beliefs about sickness encompassed observable *natural causes* such as climatic events, personal behaviors, and unobservable, incomprehensible, or *supernatural causes* such as sorcery. Naturalistic treatments presumably involved simply accepting fate, or using herbs, tonics, and oils whose healing or curative properties would have been discerned empirically over time. Since healing and religion have been so intertwined in human history, treatment of supernaturally caused conditions involved rituals that were interpreted and administered by priests or Shamans knowledgeable about the relations between the mystical and natural realms.

Recorded information about the human body and theories of health care appeared roughly 6,000 years ago in the time of the Babylonians. The **Code of Hammurabi** defined the different surgical operations to be performed, a scale of fees, and penalties for malpractice. Five thousand-year-old Egyptian records describe symptoms of abdominal, eye, and heart disorders; treatment of wounds, fractures, and dislocations; and an understanding that brain lesions may be associated with paralysis of the opposite side of the body.

> What shared concepts underlie traditional and modern health care systems?

Major systems of traditional Chinese, Ayurvedic, and Greek medicine began to evolve between 1,500 and 500 BC and constitute the basis for many current health care practices. Despite cultural and geographic differences, knowledge moved freely throughout the ancient world, likely through trade and conquest, resulting in common doctrines fundamental to all of these systems:

1. The universe is an integrated whole that is subject to laws governing all phenomena including human behavior and health.
2. The individual is an integrated system of physical, mental, cultural, and spiritual qualities.
3. Health is a state of balance (homeostasis) between the individual and the outside world, and among the elements, humors, and forces within the individual.
4. All living things are endowed with a life force composed of vital energies that must be kept in balance (e.g., male/female, yin/yang) to maintain optimal health.
5. Disease results from disruption or imbalance within the life force, an imbalance between the life force and external events (stress), or an imbalance among humors and bodily functions.

6. Symptoms represent the body's efforts to restore balance and health.
7. Healers supplement or strengthen the body's efforts to restore balance by applying treatments based on universal principles.

These conceptualizations of disease and health, rooted in indigenous cultural beliefs, constitute the subject matter of **ethnomedicine** (see Chapter 17: Culture and Cultural Competence in Health Care) and reflect an awareness of certain concepts found in both traditional and modern health care systems. Common or universal principles include the interaction and interdependence of *etiological factors*, the principle of "balance" or **homeostasis**, the influence of **stress**, and an appreciation of the *role of the healer*.

Modern concepts of health care have their roots in the writings of **Hippocrates** (b. 460 BC), who is credited with establishing the first school dedicated to the scientific study of medicine. Hippocratic medicine was the definitive standard for medical knowledge and professional ethics until the work of **Galen**, a Roman practitioner in the 2nd century AD who compiled the medical knowledge of his time and began anatomical and physiological investigations. Because of religious constraints, Galen could carry out dissections only on animals. As a result, many of his anatomical findings proved to be in error, although he made significant contributions to understanding the functioning of the respiratory, circulatory, digestive, and neural systems.

Galen laid the scientific foundations for **allopathic medicine** by asserting that lesions in specific body organs led to dysfunctions, establishing the principle that persons schooled in the study of pathology (physicians) should be the definitive healers in society. Galenic *treatments*, only loosely grounded in his scientific work, were based on the **law of opposites** – that is, diseases were treated with medicines or interventions that created an effect opposite to the symptom.

Despite its limitations, Galenic medicine dominated medical dogma for 1,400 years. Galen's work was rediscovered in Europe through the preservation and translation of Roman, Greek, and Arabic texts, and its worldwide dispersal influenced most major medical systems but, paradoxically, stifled scientific advancement. While the applied law of opposites presumably benefited some cases (e.g., applying cooling remedies in cases of fever), it often justified inappropriate and dangerous "treatments" such as the indiscriminate use of enemas, bloodletting, purging, and other toxic and invasive procedures.

The resurgence of rationality, critical discourse, and experimental investigation that marked the **Renaissance** and the later **Age of Enlightenment** led to important advances in the development of medicine. Seventeenth-century developments in the natural sciences led to important discoveries of the physical, mechanical, and chemical functions of the human body, but these scientific advances had limited impact on the development of health care practices for some time. Subsequent challenges to Galenism reaffirmed the **physician's role** in mobilizing and assisting the body's own healing efforts. This led to the development of **homeopathic**, **osteopathic**, **naturopathic**, and **chiropractic** approaches to medicine (see Chapter 32: Complementary and Integrative Medicine).

Biomedical Model – Discipline Specific

Why is the biomedical model discipline specific?

By the end of the 19th century, the scientific foundation of medicine included **systematic observation**, **objective measurement**, and **experimental tests of theories**. These activities were developed and taught within specific disciplines such as pathology, microbiology, physiology, and pharmacology. Corresponding clinical techniques gradually became more sophisticated and disease specific. Advances in *microbiology*, for example, showed that microorganisms contributed to disease and could be controlled by sterilization, antiseptics, and immunization.

Despite these advances, medicine and medical training were still primitive, reflecting vestiges of Galenism and a lack of scrutiny into the efficacy of various practices. However, at the beginning of the 20th century, medicine's increased scientific sophistication finally led to intense examination of the quality of North American medical training. The ***Flexner Report***, issued by the Carnegie Foundation in 1910, critically evaluated the scientific curricula of all the medical schools in the US

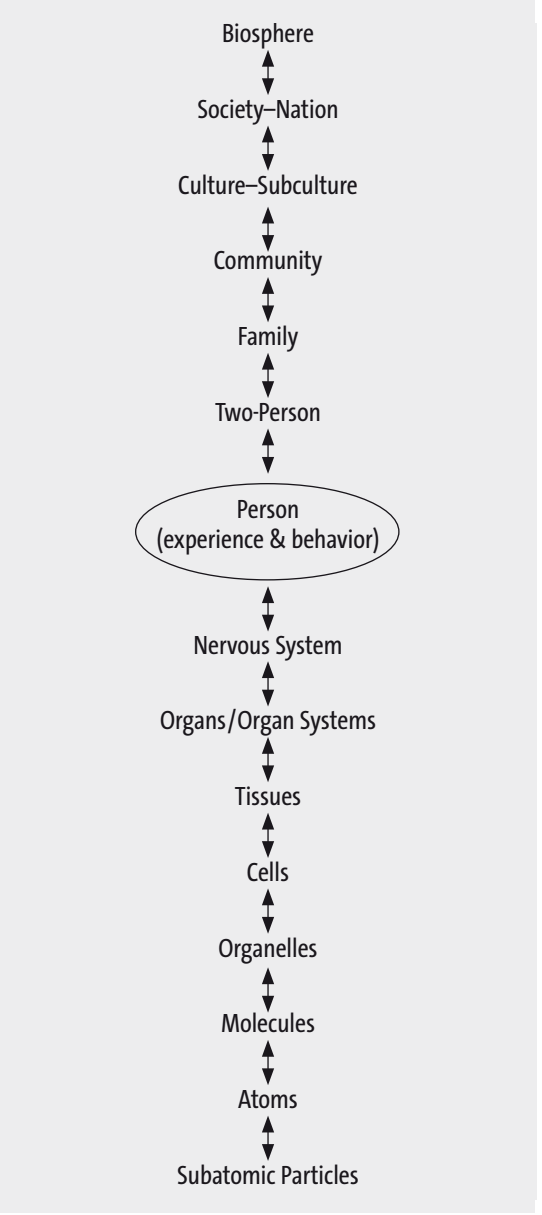
and Canada. The report called for the establishment of higher standards for medical education, grounded in the *biological sciences* and *scientific methodology*. These recommendations became the defining criteria for the **biomedical model**, making medicine **discipline specific**. Flexner downplayed, even discounted, the contributions of the behavioral and social sciences to medicine. As a consequence, post-Flexnerian medical education and practice became heavily biomedical and partly lost sight of the broader behavioral and social context of disease and health care.

Although the domain of biomedicine expanded rapidly in the beginning of the 20th century, critical academic disciplines, especially public health, and the behavioral sciences of anthropology, psychology, and sociology fostered continued awareness of the limitations of a strictly biological approach. Experience with the effects of severe stress on the health of soldiers in two world wars underscored the influence of psychosocial factors on illness and treatment outcome (see Chapter 47: Stress Disorders, Bereavement, and Dissociative Disorders). Despite their value, rigorous social science studies of the contextual determinants of health and processes of health care were too often constrained by their unique methodologies. Researchers lacked the tools to explore how psychosocial variables *interact* with biological processes in the etiology or causality of both illness and disease. Beginning in the mid-1970s, the intellectual pendulum had swung back to a midpoint that seeks to *integrate* a wide variety of methods and insights into the multidisciplinary study of health and disease.

Biopsychosocial Model – Multidisciplinary

What is the biopsychosocial model?

In 1977, **George Engel** published an article in *Science* titled "The Need for a New Medical Model: A Challenge for Biomedicine." He further explored the model in a 1980 article entitled "The Clinical Application of the Biopsychosocial Model" in the *American Journal of Psychiatry* (pp. 535–544). Engel asserted that, in contrast to the biomedical model, the **biopsychosocial model** recognized (1) *multiple determinants* of disease and the resultant illness process and (2) a *hierarchical organization* of biological and social systems that contribute to the disease and illness experience. The systems hierarchy and levels of organization were as follows:



Each system was seen as a component of a higher, more abstract system. Therefore, change in one system would effect change in other systems, especially those most closely linked to it. In the biopsychosocial model, the behavioral and social sciences were as important as the biological sci-

ences in understanding the determinants of illness, and researchers began to focus on identifying specific psychosocial factors associated with specific diseases or illnesses.

Clinical Application of the Biopsychosocial Model

Since people can function normally physiologically with only one kidney, a kidney donor will continue to have normal renal functioning. In the biomedical model, once recovered from surgery, a donor returns to full health. By contrast, the biopsychosocial model directs attention to the psychosocial parameters of the donor's and recipient's conditions. For example, this model recognizes that a donor's recovery and sense of self-worth may be facilitated, even enhanced, if they know the recipient was helped by the donation, the community applauds the donor for the gift, and the donor believes the recipient will make a full recovery. However, the model also recognizes that the knowledge of having only one kidney may leave the donor feeling damaged or otherwise impaired; the donor also may feel diminished if insufficient gratitude was expressed. These latter perceptions may impair full functional recovery.

While no *biomedical* intervention beyond appropriate postoperative care for a donor is required, care provided according to the principles of the ***biopsychosocial*** model posits that education is essential to reassure a donor of their biological integrity, that information about the benefits to the recipient will reinforce a donor's sense of self-worth, and that the support of family and community are essential to recovery and return to a state of full health.

Integrated Sciences Model – Interdisciplinary

What is an integrated sciences model?

Determinants of health are not simply a collection of individual psychosocial and biologic variables, each linearly related to some specific health outcome, nor are they discipline-specific systems only hierarchically related to one another. Rather, health is determined by *multiple etiological variables*, continuously interacting via complex mechanisms and interdependent processes (see Figure 1.1). Identifying the determinants of disease and illness requires identifying not only the biological processes involved in the etiology of the condition and the psychosocial factors that influence these processes, but also the mechanisms by which psychosocial and biological factors *interact* to determine health outcomes. Efforts to identify these mechanisms of bio-behavioral interaction have prompted the growth of a number of interdisciplinary fields (see Box 1.1), in which behavioral and biological scientists collaborate by combining theoretical and methodological efforts.

These research collaborations reflect the evolution of the biopsychosocial model from a multidisciplinary view of behavioral and biological sciences as distinct from, although equal in importance to, a more complex **interdisciplinary** view that focuses on (1) the interdependence of biological and behavioral processes; (2) the mechanisms of their interaction; and (3) the integration of biological and behavioral scientific principles, concepts, and theories into a more integrated sciences model.

The survival of the human species is largely attributable to the evolution of the human brain. Over many eons, in response to genetic anomalies and epigenetic events, the brain and the associated neuroendocrine subsystem developed an array of remarkable abilities that enable *Homo sapiens* to survive in an inhospitable environment. These abilities allowed the organism to respond to threat reflexively and through experience by adapting, avoiding, anticipating, and planning as it coped with challenges from multiple domains. Eventually, humans became able to relate to, cooperate with, care for, and communicate with other humans. Such functions provide our species with extraordinary tools for mastering the environment and insuring survival.

In an **integrated sciences model** (ISM), all psychosocial and biological phenomena are viewed as *interdependent* and functionally *interactive*. The principles of interaction involve common universal scientific principles and processes, such as homeostasis, stress, adaptation, learning, development, and genetic modification. The individual can be viewed as a complex adaptive organism with homeostatic capabilities that enable adaptation not only to biological challenges, but also to environmental, cognitive, sociocultural, and behavioral challenges (see Figure 1.1). Homeostatic challenges from within each domain contribute to the individual's condition, trigger-

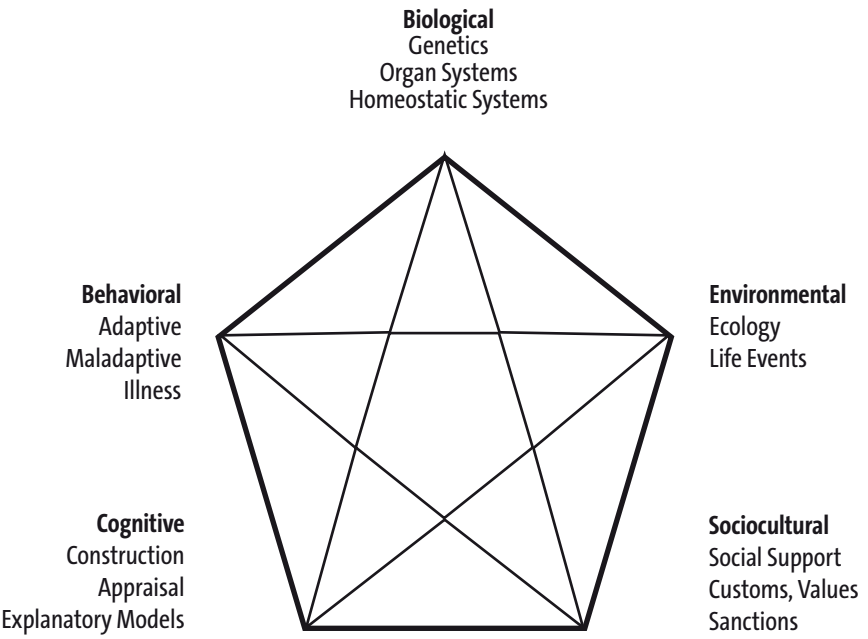


Figure 1.1. The integrated sciences model.

ing adaptive responses in all other domains. As in the original biopsychosocial model, change in any domain effects a change in all others, as the organism constantly strives to maintain *optimal balance* or homeostasis within and among domains.

Box 1.1. Interdisciplinary research fields in health care

Genomic sciences	Seek to identify the genetic processes associated with normal and abnormal development and functioning, and the mechanisms by which these processes influence, and are influenced by, human behaviors, social and biological functioning, and environmental interaction.
Cognitive neurosciences	Seek to determine the brain structures and neuroendocrine mechanisms that contribute to, and are influenced by, specific cognitive processes (perception, learning, memory, problem solving).
Social neurosciences	Seek to determine the specific biological systems and mechanisms that implement social processes and behaviors, and the mechanisms by which those social processes modify and influence organ-based, neural, neuroendocrine, and immunological functions.
Psychoneuroimmunology	Seeks to define the mechanisms by which stressful events and emotional responses influence neurological and immune system functioning.

Integrated Sciences Model

1. The human organism possesses an integrated network of homeostatic systems enabling it to adapt to any challenge to homeostasis from biological, behavioral, cognitive, sociocultural, and environmental domains. This homeostatic network is regulated by the brain and associated neuroendocrine systems.
2. Any challenge to homeostasis constitutes "stress" and initiates a multivariate stress response.
3. Variables within each domain interact with those in other domains via diverse bio-behavioral mechanisms. Hence, stress in one domain initiates responses in all domains.
4. Challenges to the organism are ongoing, and this interactive system is constantly evolving as it is continuously adapting.
5. Diseases and disorders are byproducts of the failure of the homeostatic stress response system. Therefore, accurately addressing the differential role of stress conditions and other risk factors in each domain is essential to determining the best intervention strategy.
6. Treatment of the disease may alleviate or, in turn, initiate new stress responses within any of the domains of variables.

Stress – The Engine of Adaptation

Any challenge to homeostasis is defined as **stress**. This term is derived from physics and refers to the interdisciplinary principle of a **system under strain** (i.e., the systemic effects of any challenge within any domain). Stress or biological, developmental, environmental, behavioral, cognitive, or sociocultural challenges to homeostasis initiate *adaptive responses* in other domains, whereby the organism attempts to resolve, cope with, and learn from the stressful condition. Thus, stress is the engine that drives adaptation, the raison d'être for the evolution of the brain's remarkable capabilities and, therefore, is not necessarily destructive. Instead, the nature, intensity, and outcome (adaptive or maladaptive) of the stress response are determined, in part, by the **degree of stress**. Every college student is familiar with the *inverted U*-shaped curve describing the relationship between stress and productivity. Too little challenge (stress) undermines motivation and may result in poor performance. Too much challenge (stress) may discourage effort and impair performance. Optimal challenge (stress) motivates and inspires, but does not overwhelm.

The adaptive success of the **stress response** in this highly complex network of homeostatic systems defines individual health; its maladaptive breakdown or dysfunction contributes to disease or disorder. Ironically, an overfunctioning stress response may also contribute to disease and disorder, as in *autoimmune diseases* where the immune system that normally protects against external pathogens attacks the host body. The bio-behavioral mechanisms of the stress response involved in adaptation and illness are discussed in greater detail in Chapter 7: Stress, Adaptation, and Stress Disorders.

Integrated Assessment

Assessment should involve a detailed exploration of the differential and *interactive* contributions of biological, behavioral, cognitive, sociocultural, and environmental risk factors. This information informs the health care professional about the bio-behavioral mechanisms and processes that contribute to a particular disorder and which, therefore, may be appropriate targets for treatment.

Clinical Application of an Integrated Sciences Model

Frank Howard has been diagnosed with chronic obstructive pulmonary disease (COPD) and advised by his physician, Dr. Elizabeth Knight, to give up smoking. Working collaboratively, Dr. Knight and Mr. Howard carefully review Mr. Howard's lifestyle to identify variables or situations that influence his smoking. Reviewing each of the domains shown in Figure 1.1, they come up with the following information:

- Biological: While he recognizes the implication of a diagnosis of COPD, Mr. Howard's nicotine dependence is making it difficult for him to quit smoking.
- Behavioral: The stress relief he experiences is a strong incentive for smoking.
- Cognitive: He previously believed he could quit anytime he chose. The knowledge that smoking contributes to his COPD is powerful, but not enough

by itself to deter his behavior, although he is now willing to consider a change in smoking behavior.
- Sociocultural: Previous role models and cultural sanctions had strong reinforcing value, but Mr. Howard is now getting increasing social and familial support for not smoking.
- Environmental: Tobacco had been readily accessible and smoking opportunities available and reinforcing. However, as the cost of tobacco has increased and places and opportunities for smoking have decreased, Mr. Howard is becoming more open to change.

An integrated sciences model illustrates the complexity and interdependence of factors contributing to smoking addiction and why treatments that focus only on one domain (e.g., changing a smoker's cognitions) or one variable (e.g., stopping cigarette advertisements) are likely to fail. The probability of changing complexly determined health behaviors is maximized only if treatments address as many of the contributing factors as possible. Mr. Howard and Dr. Knight, as described in the example, decided on a multimodal approach and agreed to implement the following strategies:

Biological: nicotine patches to counter nicotine dependence;

Behavioral: alternative work break and stress relief activities such as taking a walk, social gatherings in nonsmoking venues, stress management training, and meditation;

Cognitive: explaining to others (e.g., young people) how smoking is harmful; exposure to high-profile, high-status nonsmokers;

Sociocultural: encouraging family to praise, reward, reinforce nonsmoking; encouraging membership in a "smoke-enders" group; pursuing cultural and sports activities that preclude smoking behavior;

Environmental: make smoking materials and opportunities less accessible (e.g., restrict access to tobacco and limit smoking to inconvenient and uncomfortable places).

As can be seen, a multimodal treatment plan is likely to have a better outcome than a treatment plan that focuses on only a single domain. Since certain interventions may not always be practical or worthwhile, multimodal perspectives allow for greater flexibility in treatment strategizing. Also, even though a specific factor may be important in the etiology of a condition, it may not be an effective target in treatment (e.g., while new drugs improve survival rates in HIV/AIDS patients, behavioral management of the social and psychological aspects of the disease is still a major focus of disease management).

In the chapters that follow, we explore the biological, behavioral, cognitive, sociocultural, and environmental domains that influence human adaptive functioning, and the bio-behavioral mechanisms and processes by which factors in these domains interact and, thereby, contribute to human health and illness.

Recommended Readings

Berntson, G. G., & Cacioppo, J. T. (2009). *Handbook of neurosciences for the behavioral sciences*. Hoboken, NJ: Wiley. http://doi.org/10.1002/9780470478509

Carr, J. E. (1999). Proposal for an integrated sciences curriculum in medical education. *Teaching and Learning in Medicine, 10*, 3–7. http://doi.org/10.1207/S15328015TLM1001_1

Cuff, P. A., & Vanselow, N. A. (Eds.). (2004). *Improving medical education: Enhancing the behavioral and social science content of medical school curricula*. Washington, DC: National Academies Press.

Engel, G. L. (1977). The need for a new medical model: A challenge for biomedicine. *Science*, *196*, 129–136. http://doi.org/10.1126/science.847460

Gazzaniga, M. S. (Ed.). (2010). *The cognitive neurosciences* (4th ed.). Cambridge, MA: MIT Press.

Review Questions

1. A manifestation of impaired bodily functions that is caused by environmental trauma, biologic malfunction, or an identifiable agent or substance is defined by which of the following concepts?
   A. Disease
   B. Illness
   C. Injury
   D. Sick Role
   E. Sickness

2. The *Flexner Report* promoted scientific and educational standards consistent with which of the following models?
   A. Biomedical
   B. Biopsychosocial
   C. Explanatory
   D. Integrated sciences
   E. Interdisciplinary

3. Defining all the variables and processes that contribute to health, disease, sickness, and illness and the complexity of bio-behavioral mechanisms by which they interact and are interdependent, defines which of the following models?
   A. Behavioral
   B. Biomedical
   C. Biopsychosocial
   D. Integrated sciences
   E. Sociocultural

Answer Key on p. 465

Section II
Regulatory Systems

2 Predisposition

João V. Nunes, MD, Ian M. Kodish, MD, PhD, and John E. Carr, PhD

- What distinguishes genotype from phenotype?
- What do genes do, and how does the environment influence genetic functioning?
- What information is provided by a pedigree study?
- How does gene–environment interaction differ from gene–environment correlation?
- What does diathesis–stress interaction mean?
- How does personality contribute to illness vulnerability?

Genetic Predisposition

What distinguishes genotype from phenotype?

Eons of evolutionary development have provided the central nervous system (CNS) with the mechanisms that enable humans to interact with the environment, learn from experience, and adapt to ever-changing environmental demands. Because the CNS of the newborn has not yet accumulated experience, it must rely on preprogrammed expressions shaped by the collective evolutionary experience through genetic adaptations. Each cell's genetic code (genotype) functions to help scaffold the anatomical, biochemical, physiological, behavioral, and personal characteristics (phenotype) of the individual.

The **genotype** is the genetic constitution (genome) of a cell. The **phenotype** is the developmental result of the interaction of the genotype with the environment, and refers to the composite of biological and behavioral characteristics manifested by the individual under certain environmental circumstances**.** Each personal characteristic is called a **trait**, and virtually all traits are expressions of gene–environment interaction. Indeed, the activation of an individual's genes (**gene expression**) is dependent upon the influence of environmental events, occurring even before birth, that prompt selective activation of genes, thus shaping expression across development and setting the stage for subsequent behaviors, traits, resiliencies, and vulnerabilities.

What do genes do, and how does the environment influence genetic functioning?

Each gene carries the **DNA code** for the production of a protein. Genes are expressed through an initial copy of **messenger RNA** (mRNA), which serves as a template for the subsequent assembling of amino acids to match the coded string and form a protein (translation). To transcribe the genetic code to a particular protein, DNA uses RNA as an intermediary molecule: A nocleotide sequence in the DNA molecule is initially copied into an RNA sequence in a process called transcription. The modified RNA molecules become templates to assemble amino acids into the synthesis of a protein. That is, each RNA molecule is translating an amino acid into a protein. These molecules are essential modulators of cellular functions, and some even serve to further regulate gene expression by stimulating **promoter regions** to initiate more copies.

The expression of our genetic code is also regulated by **epigenetic processes** that modify the ability of genetic material to be transcribed without changing the DNA sequence. DNA is stored as heterochromatin, a form of chromatin