

# Geriatric Anesthesiology

---

Second Edition

# Geriatric Anesthesiology

---

Second Edition

Jeffrey H. Silverstein  
G. Alec Rooke  
J.G. Reves  
Charles H. McLeskey

Editors

 Springer

Jeffrey H. Silverstein, MD  
Professor  
Department of Anesthesiology, Surgery,  
and Geriatrics and Adult Development  
Vice Chairman for Research  
Associate Dean for Research  
Mount Sinai School of Medicine  
New York, NY, USA

G. Alec Rooke, MD, PhD  
Professor  
Department of Anesthesiology  
University of Washington and the Veterans  
Affairs Puget Sound Health Care System  
Seattle, WA  
*and*  
Visiting Professor of Anesthesia, Critical  
Care, and Pain Medicine  
Harvard Medical School  
Beth Israel Deaconess Medical Center  
Boston, MA, USA

J.G. Reves, MD  
Vice President for Medical Affairs  
Dean, College of Medicine  
Department of Anesthesiology/College  
of Medicine  
Medical University of South Carolina  
Charleston, SC, USA

Charles H. McLeskey, MD  
Salt Lake City, UT, USA

Library of Congress Control Number: 2007926756

ISBN: 978-0-387-72526-0 e-ISBN: 978-0-387-72527-7

Printed on acid-free paper.

© 2008 Springer Science+Business Media, LLC.

All rights reserved. This work may not be translated or copied in whole or in part without the written permission of the publisher (Springer Science+Business Media, LLC, 233 Spring Street, New York, NY 10013, USA), except for brief excerpts in connection with reviews or scholarly analysis. Use in connection with any form of information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed is forbidden.

The use in this publication of trade names, trademarks, service marks, and similar terms, even if they are not identified as such, is not to be taken as an expression of opinion as to whether or not they are subject to proprietary rights.

While the advice and information in this book are believed to be true and accurate at the date of going to press, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

9 8 7 6 5 4 3 2 1

springer.com

*To my Grandparents, Regina and David Silverstein and Blanche and Daniel Klein, MD. Their love and their sufferings provided endless opportunities and insights. I hope, and believe, they would have liked this result.*

—JHS

*To my Children, Douglas and Linnea.*

—GAR

*To Margaret Cathcart and her late Husband, Dr. John W. Cathcart.*

—JGR

*To my Parents, Marion and Hamilton McLeskey, who encouraged care and consideration for our elderly.*

—CHM

# Preface to the Second Edition

*Do not go gentle into that good night,  
Old age should burn and rave at close of day;  
Rage, rage against the dying of the light.*  
Dylan Thomas

The goal of getting older is to age successfully. Unfortunately, the majority of our older patients will have acquired one or more chronic medical conditions as they age, and, even if a perfectly healthy older patient presents for surgery, that patient's ability to handle physiologic stress will be diminished, including the stress of surgery. Nearly half of all surgical procedures involve patients older than age 65, and that percentage is likely to increase as the U.S. population ages. Thus, the perioperative care of the older patient represents one of the primary future frontiers of anesthetic practice. Even though perioperative mortality has diminished for the elderly, as well as for the population in general, the growing number of cases spotlights perioperative morbidity and mortality as an important issue for patients and health care systems alike. The vision set forward by the first edition (i.e., to apply the growing body of knowledge in this subspecialty area to the everyday practice of anesthesiology) remains the mission and vision of this second edition. The editors believe that the updated contents of this edition represent an important opportunity to consolidate and organize the information that has been acquired since 1997 and to apply that knowledge to the current practice of anesthesiology.

Part I contains several new chapters on topics that may not always seem to be directly involved with anesthetic care, but are important to the future of medical and anesthesia care. An understanding of the aging process may lead to methods of slowing its progression, or at least of ameliorating some of its consequences, including the development of chronic disease. Most anesthesiology residency programs provide limited formal teaching of geriatric anesthesia. The editors believe the incorporation of relevant subspecialty material in the anesthesiology curriculum is needed to improve care for this patient population. The realities of reimbursement for services rendered to the older patient, either by Medicare or other payers, warrant the attention of all anesthesiologists who provide care for older patients. Ethics as applied to treatment of the older patient is also addressed. The medical management of this population is often complicated by issues such as patient goals that differ from physician expectations, physician "ageism," patient cognitive impairment, and the physician's failure to recognize the true risk of surgery and attendant recovery time. The last chapter of Part I reviews current knowledge and suggests research areas where the greatest impact on patient outcomes might be realized.

Parts II and III review the physiology of aging and the basic anesthetic management of the geriatric patient, and Part IV examines selected surgical procedures

frequently performed in older patients. Not all of these chapters are specific to anesthetic management. Geriatric medicine is a broad field with many relevant topics. Wound healing is a perfect example. The reality is that anesthesiologists can likely have a positive impact on patient care by being better able to recognize conditions that may compromise skin when other medical professionals may fail to and, as a result, can improve protection of the skin, especially during long operating room cases. In contrast, polypharmacy and drug interactions, major topics in geriatric medicine, have direct relevance to anesthetic management. The cardiac surgery chapter is an example of how age affects outcomes after a specific type of surgical procedure. The unusual aspects of anesthetic management for cardiac surgery revolve mostly around the patient's underlying disease status rather than there being anything specific to cardiac anesthesia in the older patient beyond the principles delineated in Parts II and III.

For chapters similar to those in the first edition, an effort has been made to update content and incorporate studies that examine outcome. Such work helps us challenge conventional wisdom and sometimes test novel ideas that prove beneficial. Even the most casual reader of this textbook will recognize huge gaps in our present knowledge. It is not sufficient, for example, to take an understanding of the physiology of aging and draw conclusions regarding anesthetic management from that information. Oftentimes, however, we are forced to do just that when making anesthetic management decisions. The editors hope the future will provide better research and answers that advance the field of geriatric anesthesiology.

The editors thank the many authors of this text. In addition to their hard work, they responded to entreaties for revisions and updates with admirable patience and promptness. Their contributions expand our knowledge and will improve the care of elderly patients.

Lastly, the editors thank Stacy Hague and Elizabeth Corra from Springer. Without their vision and determination, this book would not exist.

*Jeffrey H. Silverstein, MD*  
*G. Alec Rooke, MD, PhD*  
*J.G. Reves, MD*  
*Charles H. McLeskey, MD*

# Preface to the First Edition

Approximately 14% of the current U.S. population is 65 years of age or older. By the year 2020, it is predicted that 20% or 60,000,000 Americans will reach this milestone. Further, if today's statistics continue unchanged, at least half of these individuals will undergo anesthesia and surgery, likely of increasing complexity, prior to their eventual demise. The geriatric patient population represents a huge and growing challenge for anesthesia providers the world over.

My interest in the anesthetic management of geriatric patients was kindled 15 years ago while on the faculty at Bowman Gray. One of our surgeons asked me to anesthetize his healthy 72-year-old father. All went well in the intraoperative and postoperative periods and he was discharged home in the customary time frame. However, my colleague later reported that he had observed subtle psychomotor changes in his father which persisted postoperatively for 7 weeks. It dawned on me that perhaps the geriatric patient is not simply an older adult, but rather, a truly different physiologic entity. What could explain the relatively commonly observed delayed postoperative return of normal mentation in the geriatric surgical patient? It is this and other unanswered questions regarding the anesthetic management of the elderly that stimulated the development of this text.

*Geriatric Anesthesiology* is designed to be a comprehensive text that methodically addresses the aging process while emphasizing important clinical anesthetic considerations. The first two sections of the text define the demographics of our aging population and describe age-related physiologic changes that occur in each major organ system. The third section addresses the multitude of factors that contribute to a safe and successful anesthetic with suggested adjustments in technique that may improve anesthetic management of the elderly. Topics range from preoperative evaluation and risk assessment to the altered effects of various classes of drugs with further discussion regarding positioning, thermoregulation, perioperative monitoring, and postoperative recovery. In addition, issues such as management of pain syndromes, outpatient anesthesia, medicolegal implications, and even special CPR techniques in this age group are considered. The fourth section identifies the ten most commonly performed surgical procedures in the elderly, and for each, offers recommended anesthetic techniques. The text ends with an intriguing exploration into future research opportunities in the field, including molecular mechanisms of aging.

Considerable energy has gone into the creation of this text. I am grateful for the significant efforts made by all the contributing authors and especially appreciate contributions made by the editors from Williams & Wilkins. The text would have been impossible to complete without the encouragement, dogged determination, and professionalism of Ms. Tanya Lazar and Mr. Carroll Cann. Tim Grayson was innovative and supportive during the original design and formulation of this project.

I am optimistic that this text will heighten the awareness of the very real clinical differences presented by the geriatric patient population. Perhaps by referring to appropriate sections in this text, anesthesia providers will be armed with a better understanding of the physiologic changes of aging and the recommended considerations and modifications of anesthetic technique, which we hope will contribute to an ever-improving outcome for the geriatric surgical patient population.

*Charles H. McLeskey, MD*



# Contents

Preface to the Second Edition .....	vii
Preface to the First Edition .....	ix
Contributors .....	xiii
<b>Part I Introduction to Clinical Geriatrics</b>	
1 The Practice of Geriatric Anesthesia .....	3
<i>Jeffrey H. Silverstein</i>	
2 Demographics and Economics of Geriatric Patient Care .....	15
<i>Maria F. Galati and Roger D. London</i>	
3 Theories of Aging .....	29
<i>Stanley Muravchick</i>	
4 Ethical Management of the Elderly Patient .....	38
<i>Paul J. Hoehner</i>	
5 Teaching Geriatric Anesthesiology to Practitioners, Residents, and Medical Students .....	58
<i>Sheila J. Ellis</i>	
6 Research Priorities in Geriatric Anesthesiology .....	66
<i>Christopher J. Jankowski and David J. Cook</i>	
<b>Part II Cardinal Manifestations of Aging and Disease in the Elderly</b>	
7 Alterations in Metabolic Functions and Electrolytes .....	97
<i>Michael C. Lewis</i>	
8 Perioperative Thermoregulation .....	107
<i>Daniel I. Sessler</i>	
9 Postoperative Central Nervous System Dysfunction .....	123
<i>Deborah J. Culley, Terri G. Monk, and Gregory Crosby</i>	
10 Alterations in Circulatory Function .....	137
<i>Thomas J. Ebert and G. Alec Rooke</i>	
11 The Aging Respiratory System: Anesthetic Strategies to Minimize Perioperative Pulmonary Complications .....	149
<i>Rodrigo Cartin-Ceba, Juraj Sprung, Ognjen Gajic, and David O. Warner</i>	

12	Operative Debridements of Chronic Wounds . . . . .	165
	<i>Andrew M. Hanflik, Michael S. Golinko, Melissa Doft, Charles Cain, Anna Flattau, and Harold Brem</i>	
<b>Part III Anesthetic Management of the Aged Surgical Candidate</b>		
13	Preoperative Risk Stratification and Methods to Reduce Risk . . . . .	181
	<i>Linda L. Liu and Jacqueline M. Leung</i>	
14	Anesthetic Implications of Chronic Medications . . . . .	197
	<i>Tamas A. Szabo and R. David Warters</i>	
15	The Pharmacology of Opioids . . . . .	209
	<i>Steven L. Shafer and Pamela Flood</i>	
16	Intravenous Hypnotic Anesthetics . . . . .	229
	<i>Matthew D. McEvoy and J.G. Reves</i>	
17	Inhalational Anesthetics . . . . .	246
	<i>Gary R. Haynes</i>	
18	Relaxants and Their Reversal Agents . . . . .	266
	<i>Cynthia A. Lien and Takahiro Suzuki</i>	
19	Management of Regional Anesthesia . . . . .	278
	<i>Bernadette Veering</i>	
20	Fluid Management . . . . .	293
	<i>Jessica Miller, Lee A. Fleisher, and Jeffrey L. Carson</i>	
21	Pain Management . . . . .	308
	<i>Jack M. Berger</i>	
22	Anesthesia Considerations for Geriatric Outpatients . . . . .	322
	<i>Kathryn E. McGoldrick</i>	
<b>Part IV Anesthesia for Common Surgical Procedures in the Aged</b>		
23	Sedation and Monitoring . . . . .	341
	<i>Sheila R. Barnett</i>	
24	Total Hip Replacement, Joint Replacement, and Hip Fracture . . . . .	355
	<i>Idit Matot and Shaul Beyth</i>	
25	Transurethral Prostatectomy Syndrome and Other Complications of Urologic Procedures . . . . .	368
	<i>Daniel M. Gainsburg</i>	
26	Thoracic Procedures . . . . .	378
	<i>Steven M. Neustein and James B. Eisenkraft</i>	
27	Cardiac Procedures . . . . .	390
	<i>James H. Abernathy III</i>	
28	Vascular Procedures . . . . .	398
	<i>Leanne Groban and Sylvia Y. Dolinski</i>	
29	Abdominal Procedures . . . . .	416
	<i>Jeffrey H. Silverstein</i>	
	Index . . . . .	429

# Contributors

*James H. Abernathy, III, MD, MPH*  
Assistant Professor  
Department of Anesthesia and  
Perioperative Medicine  
Medical University of South Carolina  
Charleston, SC, USA

*Sheila R. Barnett, MD*  
Associate Professor  
Department of Anesthesiology  
Harvard Medical School  
Beth Israel Deaconess Medical Center  
Boston, MA, USA

*Jack M. Berger, MD, PhD*  
Clinical Professor  
Department of Anesthesiology  
Keck School of Medicine  
University of Southern California  
Los Angeles, CA, USA

*Shaul Beyth, MD, MSc*  
Department of Orthopedic Surgery  
Hadassah Hebrew University Medical Center  
Jerusalem, Israel

*Harold Brem, MD*  
Associate Professor  
Director, Wound Healing  
Department of Surgery—Wound Healing Program  
Columbia University Medical Center  
New York, NY, USA

*Charles Cain, MD, MBA*  
Clinical Professor  
Department of Anesthesiology  
Columbia University Medical Center  
New York, NY, USA

*Jeffrey L. Carson, MD*  
Richard C. Reynolds Professor of Medicine  
Chief  
Division of General Internal Medicine  
Department of Medicine  
UMDNJ—Robert Wood Johnson Medical School  
New Brunswick, NJ, USA

*Rodrigo Cartin-Ceba, MD*  
Critical Care Medicine Fellow  
Department of Critical Care Service  
Mayo Clinic  
Rochester, MN, USA

*David J. Cook, MD*  
Professor  
Department of Anesthesiology  
Mayo Clinic College of Medicine  
Rochester, MN, USA

*Gregory Crosby, MD*  
Associate Professor  
Department of Anesthesiology  
Brigham and Women's Hospital  
Harvard Medical School  
Boston, MA, USA

*Deborah J. Culley, MD*  
Assistant Professor  
Department of Anesthesiology  
Brigham and Women's Hospital  
Harvard Medical School  
Boston, MA, USA

*Melissa Doft, MD*  
Surgical Resident  
Department of Surgery  
Columbia University Medical Center  
New York, NY, USA

*Sylvia Y. Dolinski, MD, FCCP*  
Associate Professor  
Department of Anesthesiology and Critical Care  
Medical College of Wisconsin  
Milwaukee, WI, USA

*Thomas J. Ebert, MD, PhD*  
Professor and Vice-Chair for Education  
Department of Anesthesiology  
Medical College of Wisconsin  
Milwaukee, WI, USA

*James B. Eisenkraft, MD*  
Professor  
Department of Anesthesiology  
Mount Sinai School of Medicine  
New York, NY, USA

*Sheila J. Ellis, MD*  
Associate Professor  
Department of Anesthesiology  
University of Nebraska Medical Center  
Omaha, NE, USA

*Anna Flattau, MD*  
Assistant Professor  
Department of Surgery and Family  
Medicine—Wound Healing Program  
Columbia University Medical Center  
New York, NY, USA

*Lee A. Fleisher, MD*  
Robert D. Dripps Professor  
Department of Anesthesiology and Critical Care  
Chair of Anesthesiology and Critical Care  
Hospital of the University of Pennsylvania  
Philadelphia, PA, USA

*Pamela Flood, MD*  
Associate Professor  
Department of Anesthesiology  
Columbia University  
New York, NY, USA

*Daniel M. Gainsburg, MD*  
Assistant Professor  
Department of Anesthesiology  
Mount Sinai School of Medicine  
New York, NY, USA

*Ognjen Gajic, MD, MSc, FCCP*  
Assistant Professor  
Department of Internal Medicine  
Mayo Clinic College of Medicine  
Rochester, MN, USA

*Maria F. Galati, MBA*  
Vice Chair, Administration  
Department of Anesthesiology  
Mount Sinai School of Medicine  
New York, NY, USA

*Michael S. Golinko, MD*  
Post-Doctoral Research Scientist  
Department of Surgery—Wound Healing Program  
Columbia University Medical Center  
New York, NY, USA

*Leanne Groban, MD*  
Associate Professor  
Department of Anesthesiology  
Wake Forest University School of Medicine  
Winston-Salem, NC, USA

*Andrew M. Hanflik, BS*  
Medical Student  
Keck School of Medicine  
University of Southern California  
Los Angeles, CA, USA

*Gary R. Haynes, MD, PhD*  
Professor  
Department of Anesthesia and Perioperative Medicine  
Medical University of South Carolina  
Charleston, SC, USA

*Paul J. Hoehner, MD, MA, FAHA*  
Director  
Department of Cardiovascular and Thoracic  
Anesthesiology  
Central Maine Heart Associates  
Central Maine Heart and Vascular Institute  
Lewiston, ME  
Harvey Fellow in Theology  
Ethics and Culture  
Department of Religious Studies  
University of Virginia Graduate School of Arts  
and Sciences  
Charlottesville, VA, USA

*Christopher J. Jankowski, MD*  
Assistant Professor and Consultant  
Department of Anesthesiology  
Mayo Clinic College of Medicine  
Rochester, MN, USA

*Jacqueline M. Leung, MD, MPH*  
Professor  
Department of Anesthesia and Perioperative Care  
University of California San Francisco  
San Francisco, CA, USA

*Michael C. Lewis, MD*  
Associate Professor  
Department of Anesthesiology  
Miller School of Medicine  
University of Miami  
Miami, FL, USA

*Cynthia A. Lien, MD*  
Professor  
Department of Anesthesiology  
Weill Medical College of Cornell University  
New York, NY, USA

*Linda L. Liu, MD*  
Associate Professor  
Department of Anesthesia and Perioperative Care  
University of California San Francisco  
San Francisco, CA, USA

*Roger D. London, MD, MBA*  
Vice President and Medical Director  
Flagship Patient Advocates  
New York, NY, USA

*Idit Matot, MD*  
Associate Professor  
Department of Anesthesiology and Critical  
Care Medicine  
Hadassah Hebrew University Medical Center  
Jerusalem, Israel

*Matthew D. McEvoy, MD*  
Assistant Professor  
Department of Anesthesia and  
Perioperative Medicine  
Medical University of South Carolina  
Charleston, SC, USA

*Kathryn E. McGoldrick, MD*  
Professor and Chair  
Department of Anesthesiology  
New York Medical College  
Valhalla, NY, USA

*Charles H. McLeskey, MD*  
Salt Lake City, UT, USA

*Jessica Miller, MD*  
Fellow  
Department of Pediatric Anesthesiology and  
Critical Care  
Children's Hospital of Philadelphia  
Philadelphia, PA, USA

*Terri G. Monk, MD*  
Professor  
Department of Anesthesiology  
Duke University Health System  
Durham, NC, USA

*Stanley Muravchick, MD, PhD*  
Professor  
Department of Anesthesiology and Critical Care  
Hospital of the University of Pennsylvania  
Philadelphia, PA, USA

*Steven M. Neustein, MD*  
Associate Professor  
Department of Anesthesiology  
Mount Sinai School of Medicine  
New York, NY, USA

*J.G. Reves, MD*  
Vice President for Medical Affairs  
Dean, College of Medicine  
Department of Anesthesiology/College of Medicine  
Medical University of South Carolina  
Charleston, SC, USA

*G. Alec Rooke, MD, PhD*  
Professor  
Department of Anesthesiology  
University of Washington and the Veterans Affairs  
Puget Sound Health Care System  
Seattle, WA  
Visiting Professor of Anesthesia, Critical Care, and  
Pain Medicine  
Harvard Medical School  
Beth Israel Deaconess Medical Center  
Boston, MA, USA

*Daniel I. Sessler, MD*  
Chair  
Department of Outcomes Research  
The Cleveland Clinic  
Cleveland, OH, USA

*Steven L. Shafer, MD*  
Professor  
Department of Anesthesia  
Stanford University  
Palo Alto, CA  
Professor  
Department of Biopharmaceutical Sciences and  
Anesthesia  
University of California San Francisco  
San Francisco, CA, USA

*Jeffrey H. Silverstein, MD*

Professor

Department of Anesthesiology, Surgery,  
and Geriatrics and Adult Development

Vice Chairman for Research

Associate Dean for Research

Mount Sinai School of Medicine

New York, NY, USA

*Juraj Sprung, MD, PhD*

Professor

Department of Anesthesiology

Mayo Clinic College of Medicine

Rochester, MN, USA

*Takahiro Suzuki, MD, PhD*

Assistant Professor

Department of Anesthesiology

Nihon University Surugadai Hospital

Tokyo, Japan

*Tamas A. Szabo, MD, PhD*

Assistant Professor

Department of Anesthesiology

Ralph H. Johnson Veterans Administration

Medical Center

Charleston, SC, USA

*Bernadette Veering, MD, PhD*

Associate Professor

Department of Anesthesiology

Leiden University Medical Center

Leiden, The Netherlands

*David O. Warner, MD*

Professor

Department of Anesthesiology

Mayo Clinic College of Medicine

Rochester, MN, USA

*R. David Warters, MD*

Professor

Department of Anesthesiology

Ralph H. Johnson Veterans Administration

Medical Center

Charleston, SC, USA

# Part I

## Introduction to Clinical Geriatrics

# 1

## The Practice of Geriatric Anesthesia

Jeffrey H. Silverstein

The approach to and management of surgery and anesthesia in geriatric patients is different and frequently more complex than in younger patients. In caring for the elderly in the operating room, recovery room, and intensive care unit, the members of the perioperative medical team should be aware of the nature of aging physiology, the interaction of these alterations with pathologies, and the likelihood of multiple diagnoses and polypharmacy. The context of geriatric care encompasses multiple levels, stretching from primary care, through acute hospitalization, acute and subacute rehabilitation, nursing home care, and hopefully back to sufficient function to require additional primary care. By the nature of their practices, anesthesiologists and geriatricians have different approaches to patient care and the time frame over which such care occurs. In communicating with patients and geriatricians, one should understand that expectations for recovery are frequently different than in younger patients, marked by issues of maintenance of function and independence. There is an evolving understanding that specific approaches taken in the perioperative period have an impact that remains apparent months to years following surgery. Integrating care across this continuum can be difficult but invariably improves patient outcomes.

Geriatric medical care has evolved from an empiric specialty in the 1950s and 1960s to a largely evidence-based practice today. An excellent short reference guide called *Geriatrics at Your Fingertips* is available in a small pocket edition as well as on the Internet<sup>1</sup> (<http://www.geriatricsatyourfingertips.org/>). Perioperative geriatrics, however, is very much at the beginning of the process of developing sufficient primary data on which to base practice guidelines. There are few randomized controlled trials that provide class I evidence regarding perioperative care of the elderly, leaving the practitioner to extrapolate data from literature that has accumulated on geriatric care in other contexts, from ret-

rospective reviews, and from the nonoperative geriatric literature.

This introductory chapter presents some of the common concepts of geriatrics and a general approach to caring for geriatric patients presenting for anesthesia and surgery. Virtually every chapter in this book elaborates on this foundation chapter. In approaching the elderly as patients, the anesthesiologist must understand that there is tremendous heterogeneity or variability in aging, both in the body as a whole as well as in individual systems. Thus, the alterations described in this and the following chapters are likely, on average, to be present in geriatric surgical patients. However, each individual patient will manifest these changes differently. The reader is encouraged to develop expertise and judgment and to identify those areas in need of improved approaches with the goal of developing an evidence-based practice for perioperative geriatrics.

### Demography

As a result of nationwide improvements in health care, nutrition, education, and general living standards, the elderly account for an increasing percentage of the United States population (Figure 1-1). One in eight Americans were elderly (age 65 and older) in 1997. By 2030, according to the United States Bureau of the Census, one in five could be elderly. Between 2010 and 2030, as the baby boom generation reaches age 65, anesthesiologists will face a variety of challenges. The fastest-growing segment of the population is that aged 85 and older.

The average life expectancy in the United States is almost 72 years for men and 79 years for women. However, those who reach the age of 65 can expect to live 17.4 more years; a life expectancy of 82.4 years. There are racial disparities in longevity. In the United States, white men who reach age 65 can expect to live 15.7 more



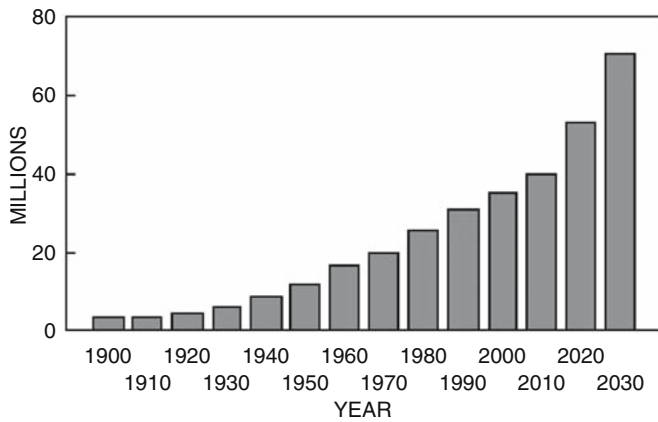


FIGURE 1-1. Growth of the Elderly Population, 1900–2030. (Reprinted from He W, Sengupta M, Velkoff VA, DeBarros KA. U.S. Census Bureau. Current Population Reports, P23-209, 65+ in the United States: 2005. Washington, DC: U.S. Government Printing Office; 2005.)

years whereas black men who reach 65 can expect to live 13.6 more years. Women are generally longer lived than men; however, the racial discrepancy is similar, with 19.4 and 17.6 additional years, respectively, of additional life expected for white and black women who reach age 65.

In 2004, 7.9 million patients over the age of 65 underwent a surgical procedure.<sup>2</sup> The number of patients over the age of 65 years who undergo noncardiac surgery has been projected to increase to 14 million over the next three decades<sup>3</sup> with similar increases expected for cardiac surgery. Seventy years ago, surgery was considered a desperate measure for patients older than 50 years of age, who were thought to be incapable of sustaining the rigors of even an inguinal hernia repair.<sup>4</sup> Advances in anesthesia during the past century have allowed surgeons to develop an extraordinary array of procedures with excellent outcomes in an increasingly aged population. Recent estimates confirm that the amount of surgical activity in the aging population is increasing.<sup>5</sup> Bolstered by the evolving demographics noted above, anesthesiologists can expect an ever-increasing portion of their overall workload to involve geriatric patients.

## Definitions of Aging

Aging is a process of gradual and spontaneous change resulting first in maturation and subsequently decline through middle and late life. Senescence is the process by which the capacity for growth, function, and capacity for cell division are lost over time, ultimately leading to death. Aging comprises both a positive component of development (e.g., wisdom and experience) along with the negative component of physiologic and often cognitive decline.

Researchers and clinicians have found advantages in differentiating normal aging from age-related disease processes. Normal aging is those changes measured, on average, across the population. Some of these changes, for example, decrease in muscle mass, occur even in the well-conditioned, exercising elderly. In order to distinguish aging from disease, researchers have had to carefully screen patients for disease processes. This process has allowed gerontologists to determine that many long-held truisms concerning aging were not accurate. For example, it is now clear that aging per se does not involve neuronal loss in the brain, and cognitive decline is not an inevitable aspect of aging. Although it is evident to clinicians that diseases progressively accumulate in aging, many of these processes are no longer considered synonymous with increased age. That is not to suggest that aging is an innocent bystander, that is, that age-related disease accumulation could occur simply as a function of time. Lakatta and Levy,<sup>6</sup> in their studies of cardiac physiology, explained that age-related changes alter the substrate upon which disease processes evolve. In this conception, age affects the severity of disease manifestations for a given time at risk.

In contrast to normal aging, Rowe and Kahn<sup>7</sup> described the idea of successful aging. In successful aging, the deleterious effects of senescence are minimized such that the individuals suffer few of the unwanted features of aging. These individuals are vibrant and active into late age, with limited impairment. The combination of genetic and environmental status that leads to longevity is discussed in the chapter Theories of Aging (Chapter 3). The distinction between normal and successful aging highlights one of the principal phenomena in gerontology: that there is tremendous variability in aging between individuals of a given species. Although it is extremely convenient to categorize and even stereotype

patients by age, chronological age is a poor predictor of physiologic aging.

Currently, morbidity, mortality, and recovery times for elderly patients undergoing surgery are substantially greater than those for younger patients.<sup>8</sup> (See also the section Surgical Outcomes and Functional Decline later in this chapter.) Age frequently alters the presentation of surgical illness. Symptoms of disease may be diminished, ignored, or inappropriately attributed to old age. Obtaining an accurate history can be challenging in the elderly. One of the results of the complexity of the patient population is an increased likelihood of preventable adverse events and consequences.<sup>9</sup> Thus, improving anesthetic care for geriatric patients represents the primary challenge of anesthesiology in the next few decades.

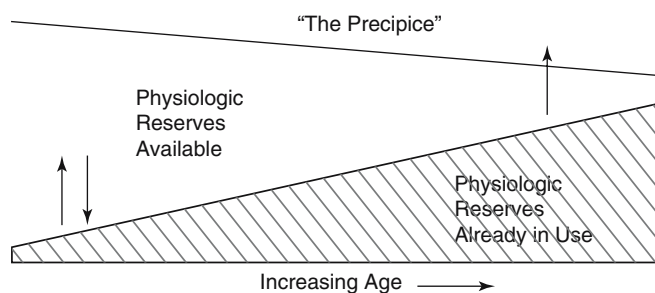


FIGURE 1-2. Schematic of homeostenosis. This diagram shows that maintaining homeostasis is a dynamic process. The older person uses or consumes physiologic reserves just to maintain homeostasis, and therefore there are fewer reserves available for meeting new challenges. (Reprinted with permission from Taffet GE. Physiology of aging. In: Cassel CK, Leipzig R, Cohen HJ, Larson EB, Meier DE, eds. *Geriatric Medicine: An Evidence-Based Approach*. 4th ed. New York: Springer; 2003.)

## General Physiology of Aging

A homeostatic system is an open system that maintains its structure and functions by means of a multiplicity of dynamic equilibriums rigorously controlled by interdependent regulatory mechanisms.<sup>10</sup> Such a system reacts to change through a series of modifications of equal size and opposite direction to those that created the disturbance. The goal of these modifications is to maintain the internal balances. The term homeostenosis has been used to describe the progressive constriction of homeostatic reserve capacity. Another common means of expressing this idea is that aging results in a progressive decrease in reserve capacity. Diminishing reserve capacity can be identified at a cellular, organ, system, or whole-body level. As an example, glomerular filtration rate (GFR) progressively decreases with aging, limiting the capacity to deal with any stress on this excretory mechanism, be that a fluid load or excretion of medications or other toxic substances. Once again, the variability associated with aging is a key modifier of the decrease in physiologic function. So, although in general GFR decreases 1 mL/year, 30% of participants in a large study that defined this change had no change in GFR whereas others showed much greater decrements.<sup>11</sup> The concept of reserve has also been used in describing cognitive function.<sup>12</sup> Taffet has expanded the general interpretation of the decrease in physiologic reserve to emphasize that the reserve capacity is not an otherwise invisible organ capacity but the available organ function that will be used to maximal capacity by the elderly to maintain homeostasis (Figure 1-2). When the demands exceed the capacity of the organ or organism to respond, pathology ensues. This is ever more likely as aging decreases the capacity of any system to respond. The concept of organ reserve will be invoked in many chapters of this textbook.

## Frailty

A term frequently applied to elderly patients is “frail.” One would expect the frail elderly to be at higher risk for functional decline following surgery. Unfortunately, much like Justice Potter Stewart’s 1964 definition of obscenity, most physicians can identify frailty when they see it, but a clinically relevant scientific definition has been elusive. Linda Fried and colleagues<sup>13</sup> have defined frailty, focusing primarily on muscle loss, or sarcopenia, as a clinical syndrome in which three or more of the following criteria are present: unintentional weight loss (10lbs. in past year), self-reported exhaustion, weakness (grip strength), slow walking speed, and low physical activity. In the initial evaluation of the participants from the Cardiovascular Health Study (5317 men and women 65 years and older), the overall prevalence of frailty was 6.9%.<sup>13</sup> Frailty is perceived, in this context, as a cyclical decline that perpetuates itself (Figure 1-3). Frailty has been described as a form of predisability, which is distinct from functional impairment.<sup>14</sup> However, in the setting of sarcopenia, further muscle loss associated with surgical illness could be functionally disastrous. Indeed, Wolfe<sup>15,16</sup> has recently shown that the catabolic response to the stress of surgery and the subsequent loss of muscle mass is of even greater concern in the elderly. Frailty as a specific measure has not been prospectively characterized as a preoperative risk factor. The American Society of Anesthesiologists physical status score does not easily capture frailty, although clinicians may factor significant frailty into their assessment of a patient’s physical status. Current research efforts should help define the relevance of frailty in the assessment and management of elderly patients.

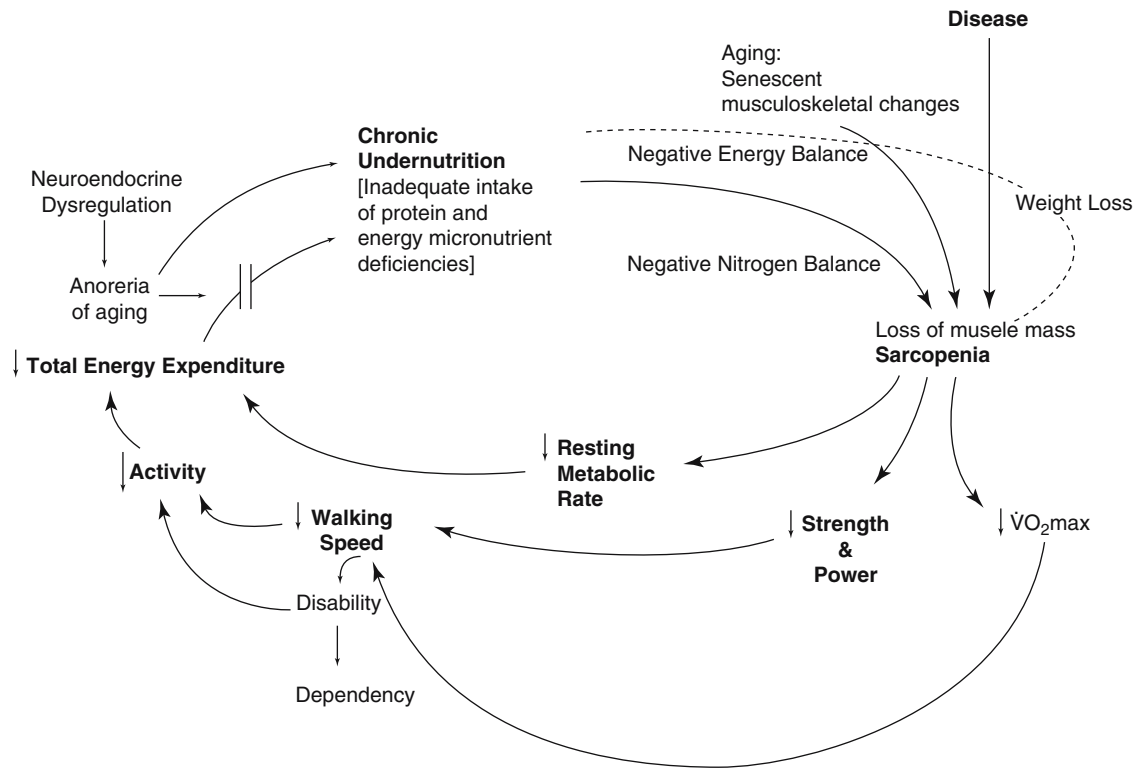


FIGURE 1-3. Cycle of frailty hypothesized as consistent with demonstrated pairwise associations and clinical signs and symptoms of frailty. (Reprinted with permission from Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C,

Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G, McBurnie MA; Cardiovascular Health Study Collaborative Research Group. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci.* 2001 Mar; 56(3):M146-56.)

## Surgical Outcomes and Functional Decline

Traditional surgical outcomes include morbidity and mortality within a defined period following a procedure, frequently 30 days. Data from the Veterans Administrations National Surgical Quality Improvement Program (NSQIP) provides the most current insight into surgical outcomes for elderly patients. Hamel et al.<sup>17</sup> reported on 26,648 patients aged ≥80 (median age 82) and 568,263 patients <80 (median age 62) from the NSQIP database. Thirty-day mortality varied by procedure but was always higher for patients >80 (Table 1-1). Mortality was low (<2%) for many common procedures (transurethral prostatectomy, hernia repair, knee replacement, carotid endarterectomy, vertebral disc surgery, laryngectomy, and radical prostatectomy). The incidence of complications increased, but probably more important was that the impact of complications on mortality and functional recovery increased with age. Twenty percent of patients >80 had one or more complications, and the presence of a complication increased mortality from 4% to 26%. Respiratory and urinary tract complications were the most common.

For the mid- to late-life patient, symptoms and disability are the principal outcomes of most disease processes. They may become the focus of protracted care. In order to conceptualize disability in a format that supports medical and survey research, Verbrugge and Jette<sup>18</sup> elucidated The Disablement Process. The pathway to disability (Figure 1-4) begins with a disease or pathology. Impairments occur at the organ-system level and are dysfunctional and structural abnormalities in specific body systems, such as cardiovascular or neurologic. Functional limitations subsequently occur at the organism, or entire

TABLE 1-1. Thirty-day mortality for operations.

	<80 years	>80 years
General surgery	4.3	11.4
Vascular surgery	4.1	9.4
Thoracic surgery	6.3	13.5
Urologic surgery	0.7	1.9
Neurosurgery	2.4	8.6
Otolaryngological surgery	2.5	8.8
Orthopedic surgery	1.2	8.3

Source: Hamel et al.<sup>17</sup>

Note: Median age for the <80 group = 62 years, median age for >80 = 82 years.

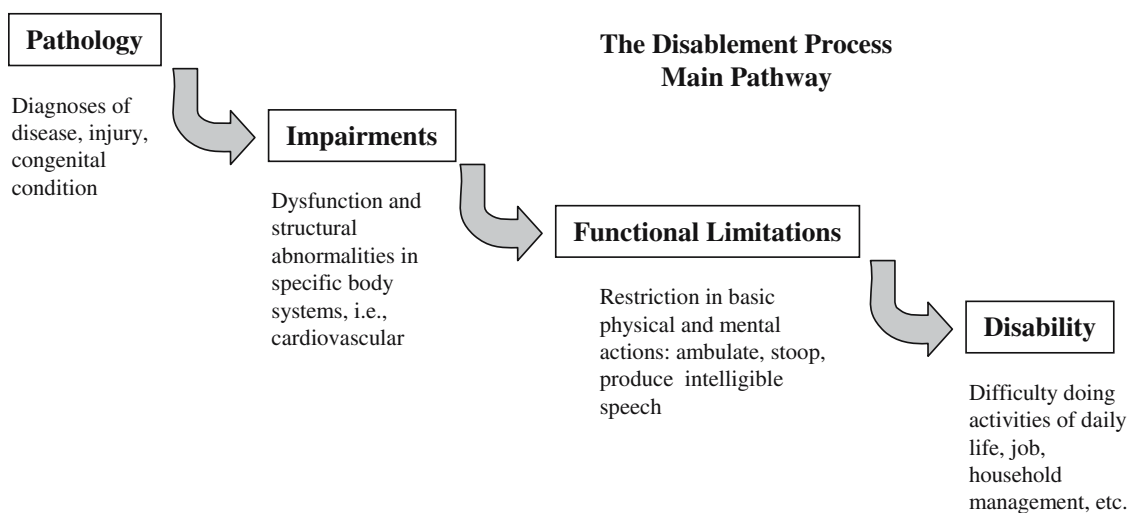


FIGURE 1-4. The disabling process: main pathway. (Adapted with permission from Verbrugge and Jette.<sup>18</sup>)

being, level and comprise restrictions in basic physical and mental abilities such as ambulation, reaching, bending, and communicating intelligibly. Disability occurs when there is an insurmountable gap between an individual and environmental demands such that their expected social role is compromised. Intra-individual (e.g., age, socioeconomic status) and extra-individual (e.g., acute medical events, preventive interventions) factors can influence the Disabling Process in either direction. These factors may be preexisting or new occurrences.

The goals of therapy for a geriatric patient are frequently motivated by a desire to avoid disability and preserve or perhaps improve functional status. The most common measures of functional status are called activities of daily living (ADL) and instrumental activities of daily living (IADL)<sup>19</sup> (Tables 1-2 and 1-3). ADLs are those basic activities fundamental to self-care whereas IADLs are those functions necessary to live independently. ADLs and IADLs are subjective reported measures. In a research context, it is common to include objective measures of function to assess strength, time to perform specific activities, or distance covered in a fixed period of time. Measurement of cognitive function by neuropsychologic tests is analogous to measures of physical function. In general medical patients, there has been extensive research regarding both the basis for functional decline as well as approaches to improving outcomes in elderly patients hospitalized for acute illness. Many of the published clinical trials studied variations of the comprehensive geriatric assessment, described below.

The disabling process model is the theoretical basis for a model of elements that influence functional recovery after elective major surgery (Figure 1-5). There are two types of preexisting factors or determinants: 1) variable elements of function that may be modifiable

or amenable to interventions; 2) relatively fixed elements in the context of daily living, which shape function and the roles of the variable elements, but may not be feasible targets for improving recovery. Variable elements are a comprehensive array of psychosocial, behavioral, and preoperative biomedical factors that can influence the evolution of function directly or indirectly through their influences on, and/or interaction with, other determinants. These elements are potentially amendable to intervention prior to an elective surgical procedure. Fixed elements are a separate constellation of contextual factors of daily living in which determinants and functional evolution interact and unfold. Anesthesia incorporates pharmacologic techniques to eliminate pain and the stress response attendant to surgical procedures. Within the acute event, there are surgical options (e.g., laparoscopic procedures) that may decrease the stress of the surgical procedure as well as the potential for anesthetic choices that may impact the trajectory of recovery. The model is qualitatively similar to a model for acute medical illness developed by Palmer et al.<sup>20</sup> and provides a framework for the identification of potential interventions to enhance postoperative recovery, prevent disability, and prolong independence in elders undergoing surgery.

The impact of surgery on functional outcomes in elderly patients has been most clearly described by Lawrence et al.<sup>21</sup> in their report on a prospective cohort of 372 patients, 60 years or older, undergoing abdominal surgery by surgeons in private practice and two university-affiliated hospitals in the San Antonio area. The participants were assessed preoperatively and postoperatively at 1, 3, and 6 weeks, 3 and 6 months, using self-report and performance-based measures ADL, IADL, the Medical Outcomes Study Short Form-36 (SF-36) Physical Component and Mental

TABLE 1-2. Activities of daily living. In each category, circle the item that most closely describes the person's highest level of functioning and record the score assigned to that level (either 1 or 0) in the blank at the beginning of the category.

<b>A. Toilet</b>	
1. Care for self at toilet completely; no incontinence	1
2. Needs to be reminded, or needs help in cleaning self, or has rare (weekly at most) accidents	0
3. Soiling or wetting while asleep more than once a week	0
4. Soiling or wetting while awake more than once a week	0
5. No control of bowels or bladder	0
<b>B. Feeding</b>	
1. Eats without assistance	1
2. Eats with minor assistance at meal times and/or helps with special preparation of food, or in cleaning up after meals	0
3. Feeds self with moderate assistance and is untidy	0
4. Requires extensive assistance for all meals	0
5. Does not feed self at all and resists efforts of others to feed him or her	0
<b>C. Dressing</b>	
1. Dresses, undresses, and selects clothes from own wardrobe	1
2. Dresses and undresses self with minor assistance	0
3. Needs moderate assistance in dressing and selection of clothes	0
4. Needs major assistance in dressing but cooperates with efforts of others to help	0
5. Completely unable to dress self and resists efforts of others to help	0
<b>D. Grooming (neatness, hair, nails, hands, face, clothing)</b>	
1. Always neatly dressed and well-groomed without assistance	1
2. Grooms self adequately with occasional minor assistance, e.g., with shaving	0
3. Needs moderate and regular assistance or supervision with grooming	0
4. Needs total grooming care but can remain well-groomed after help from others	0
5. Actively negates all efforts of others to maintain grooming	0
<b>E. Physical ambulation</b>	
1. Goes about grounds or city	1
2. Ambulates within residence or about one-block distance	0
3. Ambulates with assistance of (check one) a ( ) another person, b ( ) railing, c ( ) cane, d ( ) walker, e ( ) wheelchair	0
1. _____ Gets in and out without help.	
2. _____ Needs help getting in and out	
4. Sits unsupported in chair or wheelchair but cannot propel self without help	0
5. Bedridden more than half the time	0
<b>F. Bathing</b>	
1. Bathes self (tub, shower, sponge bath) without help	1
2. Bathes self with help getting in and out of tub	0
3. Washes face and hands only but cannot bathe rest of body	0
4. Does not wash self but is cooperative with those who bathe him or her	0
5. Does not try to wash self and resists efforts to keep him or her clean	0

Source: Lawton and Brody.<sup>19</sup>

Scoring interpretation: For ADLs, the total score ranges from 0 to 6. In some categories, only the highest level of function receives a 1; in others, two or more levels have scores of 1 because each describes competence at some minimal level of function. These screens are useful for indicating specifically how a person is performing at the present time. When they are also used over time, they serve as documentation of a person's functional improvement or deterioration.

Component Scales (PCS, MCS), Geriatric Depression Scale (GDS), Folstein Mini-Mental State Exam (MMSE), timed walk, functional reach, and hand-grip strength. The mean recovery times were: MMSE, 3 weeks; timed walk, 6 weeks; ADL, SF-36 PCS, and functional reach, 3 months; and IADL, 6 months (Figure 1-6). Mean grip strength did not return to preoperative status by 6 months. This result, that most functional recovery takes 3 to 6 months or longer, provides an indication of the impact that surgery makes on an elderly population. It should be noted that this cohort was accumulated before the popularity of laparoscopic procedures, so the stress of surgery and the recovery period may now be, on average, shorter.

In preparing a patient for surgery, informing him or her regarding the prolonged time that it will take to recover

to preoperative status or better can be extremely important. Patients who understand that recovery is a prolonged process are less likely to become discouraged and more likely to continue prolonged efforts to regain strength and endurance.

## Approach to the Patient

Although a variety of investigations in elderly patients have explored specific issues in geriatric care, a comprehensive evidence-based approach to the perioperative care of the elderly is not available in 2007. Therefore, the current approach is based on the few studies that have addressed these issues directly, extrapolation from studies

TABLE 1-3. Instrument (independent) activities of daily living. In each category, circle the item that most closely describes the person's highest level of functioning and record the score assigned to that level (either 1 or 0) in the blank at the beginning of the category.

<b>A. Ability to use telephone</b>	
1. Operates telephone on own initiative; looks up and dials numbers	1
2. Dials a few well-known numbers	1
3. Answers telephone but does not dial	1
4. Does not use telephone at all	0
<b>B. Shopping</b>	
1. Takes care of all shopping needs independently	1
2. Shops independently for small purchases	0
3. Needs to be accompanied on any shopping trip	0
4. Completely unable to shop	0
<b>C. Food preparation</b>	
1. Plans, prepares, and serves adequate meals independently	1
2. Prepares adequate meals if supplied with ingredients	0
3. Heats and serves prepared meals or prepares meals but does not maintain adequate diet	0
4. Needs to have meals prepared and served	0
<b>D. Housekeeping</b>	
1. Maintains house alone or with occasional assistance (e.g., domestic help for heavy work)	1
2. Performs light daily tasks such as dishwashing, bedmaking	1
3. Performs light daily tasks but cannot maintain acceptable level of cleanliness	1
4. Needs help with all home maintenance tasks	1
5. Does not participate in any housekeeping tasks	0
<b>E. Laundry</b>	
1. Does personal laundry completely	1
2. Launders small items; rinses socks, stockings, etc.	1
3. All laundry must be done by others	0
<b>F. Mode of transportation</b>	
1. Travels independently on public transportation or drives own car	1
2. Arranges own travel via taxi but does not otherwise use public transportation	1
3. Travels on public transportation when assisted or accompanied by another	1
4. Travel limited to taxi or automobile with assistance of another	0
5. Does not travel at all	0
<b>G. Responsibility for own medications</b>	
1. Is responsible for taking medication in correct dosages at correct time	1
2. Takes responsibility if medication is prepared in advance in separate dosages	0
3. Is not capable of dispensing own medication	0
<b>H. Ability to handle finances</b>	
1. Manages financial matters independently (budgets, writes checks, pays rent and bills, goes to bank); collects and keeps track of income	1
2. Manages day-to-day purchases but needs help with banking, major purchases, etc.	1
3. Incapable of handling money	0

Source: Lawton and Brody.<sup>19</sup> Copyright by the Gerontological Society of America.

Scoring interpretation: For IADLs, from 0 to 8. In some categories, only the highest level of function receives a 1; in others, two or more levels have scores of 1 because each describes competence at some minimal level of function. These screens are useful for indicating specifically how a person is performing at the present time. When they are also used over time, they serve as documentation of a person's functional improvement or deterioration.

that provide some insight into the broader care of elderly surgical patients, and some general suggestions derived from the experience of the author and his colleagues.

Stanley Muravchik nicely delineated the approach to the preanesthetic assessment of the elderly by specifying an organ-based vertical approach, as opposed to the horizontal approach of traditional diagnostic medicine (Figure 1-7). The specific age-related changes to major organ systems as well as the interaction between aging and disease processes are each covered in individual chapters in this book. For each organ system, the anesthesiologists should determine the functional status and attempt to assess the reserve capacity. In some cases, reserve

capacity can be directly tested, as in a cardiac stress test. Many systems, particularly many of the homeostatic mechanisms of concern in the elderly, e.g., the autonomic nervous system, immune system, or even thermoregulatory control, remain difficult to assess. Neither baseline function nor reserve capacity have easily administered tests with reliable results for these systems. Maintenance of intraoperative normothermia can be a challenging goal in some elderly patients, although it is difficult to predict which will be particularly resistant.<sup>22</sup> (See Chapter 8.) The clinician should be attempting to distinguish age-related changes from disease, acknowledging that there are important interactions between the two, and that it can

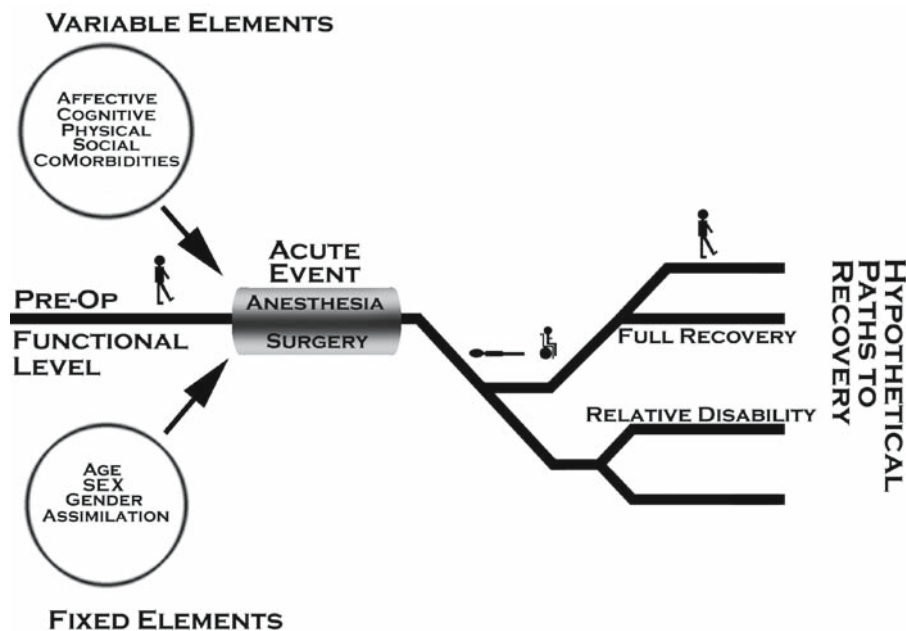


FIGURE 1-5. This model, developed by Valerie Lawrence, MD, from the University of Texas Medical Center at San Antonio, Texas, and Jeffrey H. Silverstein, MD, from the Mount Sinai School of Medicine in New York, divides preoperative elements into those that are potentially variable and those that are not amenable to preoperative alteration. An important aspect is the management of the acute event. The combination of these factors determines the functional outcomes of patients undergoing surgery.

be difficult to determine what is aging and what is actual disease.

In addition to a focus on senescent physiology of standard organ systems, proper evaluation in elderly patients requires attention to areas that are not frequently evaluated in younger patients (Table 1-4). Sometimes it is difficult to imagine an anesthesiologist evaluating a patient's pressure points for early skin breakdown or specifically asking a patient about incontinence. The thrust of this chapter is that *someone* on the perioperative team must be cognizant of these issues. The team taking care of the patient has to have both the acute event and the recovery period as their focus of cooperation.

The skin and musculoskeletal system can undergo tremendous alterations. Up to 10% of elderly patients develop serious skin breakdown during prolonged operations in which pressure is exerted over debilitated areas.<sup>23</sup> Patients with severe arthritis, other limitations of range of motion, or prosthetic joints should, to the extent possible, be positioned on an operating room table in a position they find comfortable before the induction of anesthesia. This avoids severe strain on ligaments and joints that can be severely painful in the postoperative period.

The elderly take a large percentage of the medications prescribed in the United States. Patients frequently consume multiple medications. The management of these medications is frequently chaotic. The patient may present a bag full of prescription bottles and is not totally sure which one they take, or, somewhat more likely, convey a few of the many medications that they have been prescribed. Many of these medications have interactions

with drugs used by anesthesiologists in the perioperative period. These issues are presented in some detail in Chapter 14.

Acquiring information can be challenging and may involve discussion with not only the patient, but also their immediate caregiver as well as reference to previous medical records. A comprehensive approach to caring for the geriatric surgical patient may assign some of the assessment goals to the geriatrician, anesthesiologist, or surgeon. Additional time should be scheduled to accomplish an appropriate preoperative assessment. The area in which the preoperative assessment is conducted should be relatively quiet and well lit.

Hearing loss is a common complaint and should be generally understood by the anesthesiologist. Presbycusis generally involves impaired sensitivity, particularly to higher pitched sounds, a derangement in loudness perception, impaired sound localization, and a decrease in time-related processing tasks. The summary behavior is frequently expressed as "I can hear you, but I can't understand you." The examiner can maximize the potential for communicating effectively with the patient by placing themselves 3–6 feet away, directly facing the patient. Use deliberate, clear speech at a somewhat slower (not comically or sarcastically) rate. The general tendency to speak louder needs to be tempered by the realization that shouted speech is often perceived as distorted by the elderly who are hard of hearing. Hearing aid technology has expanded dramatically and includes a variety of both external and surgically implantable technologies.<sup>24</sup> In general, patients should always be interviewed with their hearing aids in

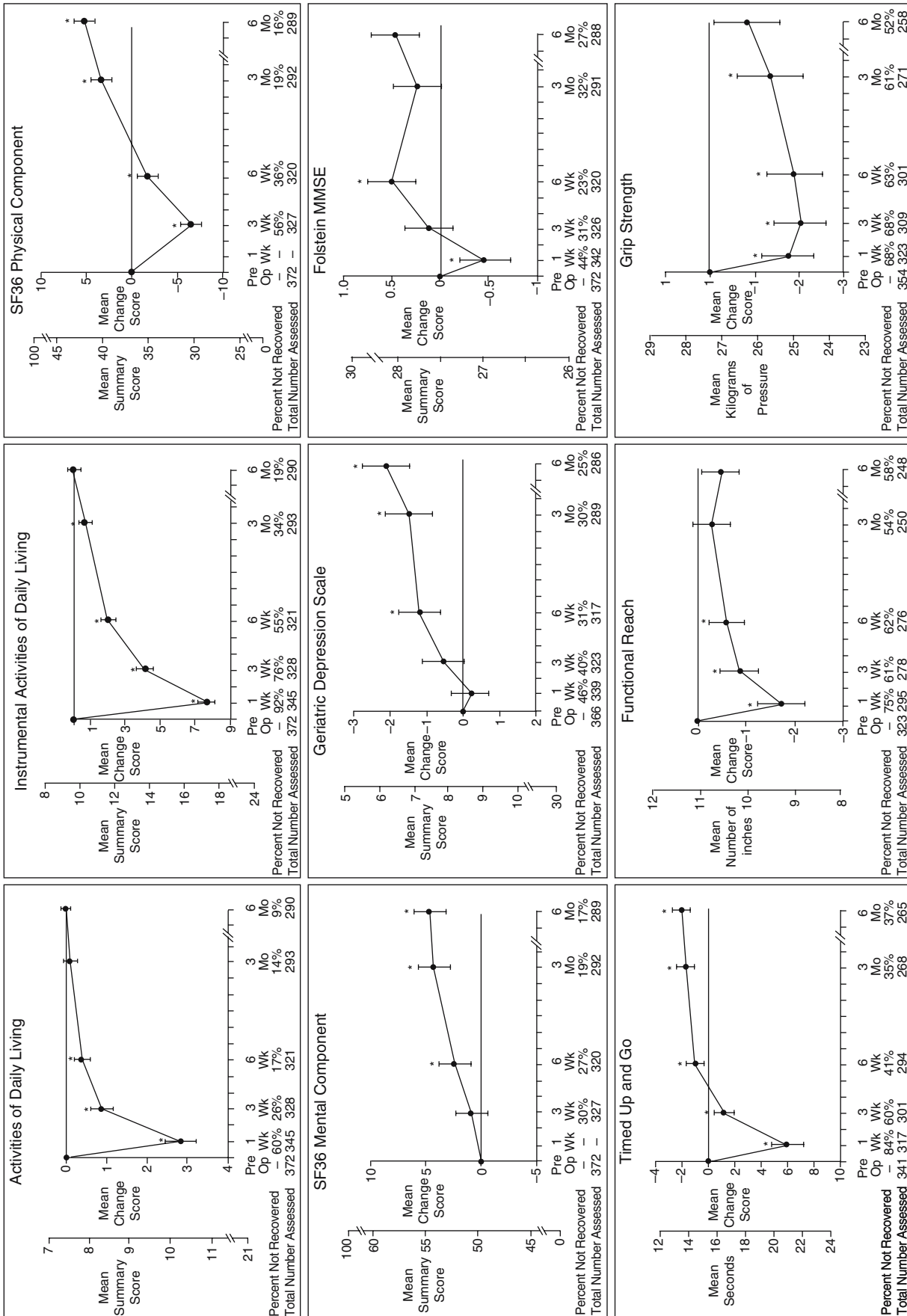


FIGURE 1-6. Functional recovery after major abdominal operation. Recovery is scores. Asterisks indicate statistically significant differences from preoperative baseline shown as mean individual change from preoperative baseline and 95% confidence line, adjusted for multiple comparisons. MMSE, Mini-Mental State Exam; SF36, intervals, with worsened function below a zero line representing preoperative status; Medical Outcomes Study Short Form-36. (Reprinted with permission from Lawrence a score of -1 indicates a one-point worsening relative to the preoperative baseline. et al.<sup>21</sup>) An additional "shadow" y-axis is shown for orientation to mean summary or total



place, and, barring an operation in which the ear is within the sterile operative field, hearing aids can be left in during surgery. Modern hearing aids do not pose a risk to the patient associated with the use of electrocautery and, if not within the primary electrical path, are not at risk for damage from electrocautery units. Having the hearing aid in place assists communication during emergence and in the postanesthesia care unit.

Loss of visual acuity is also common in the elderly. Visual acuity is included in a number of geriatric-care paradigms, including those that approach the prevention of perioperative delirium by means of making visual orientation easier. Cataracts can be particularly problematic. Before major surgery that is truly elective and schedulable, such as a total hip replacement, serious thought should be given to correcting the patient’s vision if they have bilateral dense cataracts. Although less likely to have major impact, given the opportunity, a visit to an eye doctor to maximize visual acuity, perhaps through a change in correction, may be beneficial to the patient. The patient may be better able to read and utilize rehabilitation aids.

A particularly important issue in perioperative geriatrics is the role of the geriatrician. In the 1980s, geriatricians began evaluating a concept generally referred to as comprehensive geriatric assessment (CGA). CGA is a multidimensional, interdisciplinary, diagnostic process to identify care needs, plan care, and improve outcomes of frail older people.<sup>25</sup> The benefits of CGA are to improve diagnostic accuracy, optimize medical treatment, and improve medical outcomes (including functional status and quality of life).

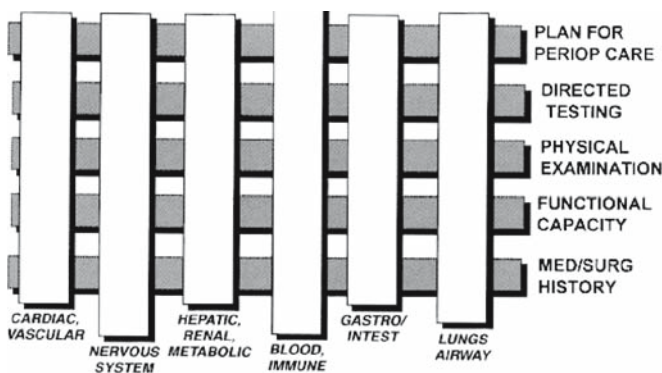


FIGURE 1-7. Organ system–based vertical approach to preoperative assessment of the elderly patient by an anesthesiologist differs from the traditional diagnostic approach because it applies the various techniques of inquiry (shaded bars) sequentially to each major organ system (open bars) in order to assess organ function and functional reserve. The primary objective of preoperative assessment should be evaluation of physical status rather than the identification of specific underlying disorders. (Reprinted with permission from Muravchick S. Preoperative assessment of the elderly patient. *Anesthesiol Clin North Am* 2000;18(1):71–89, vi.)

TABLE 1-4. Focus areas for assessment of geriatric patients.

<b>Medical</b>
Organ function and reserve
Medical illnesses
Medications
Nutrition
Dentition
Hearing
Vision
Pain
Urinary incontinence
<b>Mental</b>
Cognitive status
Emotional status
Spiritual status
<b>Physical</b>
Functional status
Balance and gait
Falls
<b>Environmental</b>
Social, financial status
Environmental hazards

In the perioperative arena, cooperative programs that feature some version of CGA have been evaluated. The most common perioperative environment for these programs has been hip fracture services. In a review of orthogeriatric care, Heyburn and colleagues<sup>26</sup> described four models that have been applied to hip fracture patients: the traditional model in which care is directed by the orthopedic surgeon and medical queries are directed to a consultant; the second is a variation in which multidisciplinary rounds with geriatricians and surgeons increase awareness of cross-specialty issues; the third involves early postoperative transfer to a geriatric rehabilitation unit; and the fourth is combined orthogeriatric care in which the patient is admitted to a specialized ward where care is coordinated by geriatricians and orthopedic surgeons. Delirium is a common complication following hip fracture and has been the primary outcome of interest for some of these studies. (See also Chapters 9 and 24.) Edward Marcantonio conducted a randomized trial of proactive geriatric consultation based on a structured protocol for patients with hip fractures (Table 1-5). The intervention reduced delirium by more than one-third.

In his review for the Freeman lecture, Rubenstein succinctly summed up the general state of affairs when he remarked that, despite the relatively consistent body of evidence supporting the utility of CGA and other geriatric follow-up programs, they have failed to be instituted on a wide scale. Soon after the initial successful reports, the institution of prospective payment diagnostic related groups (DRG) as part of the Medicare program made any additional stay in the hospital unprofitable. In fact, although CGA is effective at preventing rehospitaliza-

TABLE 1-5. Module with recommendations from Marcantonio's Active Geriatric Consultation.

1. Adequate central nervous system oxygen delivery:
  - a) Supplemental oxygen to keep saturation >90%, preferably >95%
  - b) Treatment to increase systolic blood pressure >2/3 baseline or >90 mm Hg
  - c) Transfusion to keep hematocrit >30%
2. Fluid/electrolyte balance:
  - a) Treatment to restore serum sodium, potassium, glucose to normal limits (glucose <300 mg/dL, <16.5 mmol/L for diabetics)
  - b) Treat fluid overload or dehydration detected by examination or blood tests
3. Treatment of severe pain:
  - a) Around-the-clock acetaminophen (1 g four times daily)
  - b) Early-stage breakthrough pain: low-dose subcutaneous morphine, avoid meperidine
  - c) Late-stage breakthrough pain: oxycodone as needed
4. Elimination of unnecessary medications:
  - a) Discontinue/minimize benzodiazepines, anticholinergics, antihistamines
  - b) Eliminate drug interactions, adverse effects, modify drugs accordingly
  - c) Eliminate medication redundancies
5. Regulation of bowel/bladder function:
  - a) Bowel movement by postoperative day 2 and every 48 hours
  - b) D/c urinary catheter by postoperative day 2, screen for retention or incontinence
  - c) Skin-care program for patients with established incontinence
6. Adequate nutritional intake:
  - a) Dentures used properly, proper positioning for meals, assist as needed
  - b) Supplements: 1 can Ensure, 3 cans Ensure for poor oral intake
  - c) If unable to take food orally, feed via temporary nasogastric tube
7. Early mobilization and rehabilitation:
  - a) Out of bed on postoperative day 1 and several hours daily
  - b) Mobilize/ambulate by nursing staff as tolerated, such as to bathroom
  - c) Daily physical therapy; occupational therapy if needed
8. Prevention, early detection, and treatment of major postoperative complications:
  - a) Myocardial infarction/ischemia—electrocardiogram, cardiac enzymes if needed
  - b) Supraventricular arrhythmias/atrial fibrillation—appropriate rate control, electrolyte adjustments, anticoagulation
  - c) Pneumonia/chronic obstructive pulmonary disease—screening, treatment, including chest therapy
  - d) Pulmonary embolus—appropriate anticoagulation
  - e) Screening for and treatment of urinary tract infection
9. Appropriate environmental stimuli:
  - a) Appropriate use of glasses and hearing aids
  - b) Provision of clock and calendar
  - c) If available, use of radio, tape recorder, and soft lighting
10. Treatment of agitated delirium:
  - a) Appropriate diagnostic workup/management
  - b) For agitation, calm reassurance, family presence, and/or sitter
  - c) For agitation, if absolutely necessary, low-dose haloperidol 0.25–0.5 mg every 4 hours as needed; if contraindicated, use lorazepam at same dose

Source: Marcantonio ER, Flacker JM, Wright RJ, Resnick NM. Reducing delirium after hip fracture: a randomized trial. *J Am Geriatr Soc* 2001;49(5):516–522.

tion, the financial incentives of the DRG system (see Chapter 2) favor multiple hospitalizations for multiple medical problems. However, some perioperative CGA programs have cut down on length of stay.<sup>27</sup> When a CGA program is instituted, it is essential that there is a mechanism for operationalizing the recommendations generated by the assessment. Programs with only consultation are less effective than programs in which there is a clear mechanism to institute and follow up on recommendations. Current methods for covering the costs of perioperative care have not favored the development of these programs. In the presence of evidence that such programs work, clinicians caring for elderly surgical patients are challenged to organize a care plan that facilitates rapid

recovery and prevents complications. The team caring for the patient should understand the current functional status of the patient and be able to enter into reasonable discussion with the patient and/or their immediate family concerning realistic goals of surgical care.

## Organizations and Resources in Geriatric Anesthesia

Perioperative care of the elderly is an important issue. For many years, the American Society of Anesthesiologists has maintained a Committee on Geriatrics. Among other educational and research efforts, the Committee

maintains the Syllabus on Geriatric Anesthesiology which can be found on the ASA's Web site, [www.asahq.org/clinical/geriatrics/geron.htm](http://www.asahq.org/clinical/geriatrics/geron.htm). The Society for the Advancement of Geriatric Anesthesia (SAGA) was formed in 1999 with the mission of improving the care of older patients having surgery. SAGA sponsors an annual meeting and provides organizational guidance for individuals interested in the perioperative care of the elderly ([www.sagahq.org](http://www.sagahq.org)). A longer-standing effort in the United Kingdom is the Age Anaesthesia Association ([www.aaa-online.org.uk/](http://www.aaa-online.org.uk/)). The American Geriatrics Society has developed a Section on Surgical and Related Specialties that organizes educational efforts as well as supports a number of research funding opportunities to support investigation into perioperative geriatrics ([www.americangeriatrics.org/specialists/](http://www.americangeriatrics.org/specialists/)). The Section supports the Geriatric Syllabus for Specialists as well as the Research Agenda Setting Process.<sup>28</sup>

## Conclusion

This introductory chapter outlines the broad scope of perioperative geriatric care and provides a perspective with which to utilize the information in the remainder of this text. Geriatric care is, by nature complex, multidisciplinary, and evolving. There is much yet to be learned in the area of perioperative geriatrics, but still many practices and procedures are known and can be used to improve the quality of perioperative care today.

## References

1. Reuben DB, Herr KA, Pacala JT, Pollock BG, Potter JF, Semla TP. *Geriatrics at Your Fingertips*. 8th ed. New York: American Geriatrics Society; 2006.
2. DeFrances CJ, Podgornik MN. 2004 National Discharge Survey. 371. 5-4-2006. Hyattsville, MD: National Center for Health Statistics. Advance Data from Vital and Health Statistics.
3. Mangano DT. Preoperative risk assessment: many studies, few solutions. Is a cardiac risk assessment paradigm possible? *Anesthesiology* 1995;83:897-901.
4. Ochsner A. Is risk of operation too great in the elderly? *Geriatrics* 1927;22:121.
5. Klopfenstein CE, Herrmann FR, Michel JP, Clergue F, Forster A. The influence of an aging surgical population on the anesthesia workload: a ten-year survey. *Anesth Analg* 1998;86:1165-1170.
6. Lakatta EG, Levy D. Arterial and cardiac aging: major shareholders in cardiovascular disease enterprises. Part I. Aging arteries: a "setup" for vascular disease. *Circulation* 2003;107:139-146.
7. Rowe JW, Kahn RL. Human aging: usual and successful. *Science* 1987;237:143-149.
8. Tiret L, Desmots JM, Hatton F, Vourch G. Complications associated with anaesthesia: a prospective survey in France. *Can Anaesth Soc J* 1986;33:336-344.
9. Rothschild JM, Bates DW, Leape LL. Preventable medical injuries in older patients. *Arch Intern Med* 2000;160:2717-2728.
10. de Rosnay J. Homeostasis: resistance to change. Heylighen F, Joslyn C, Turchin V, eds. Brussels: Pincipia Cybernetica; 1997. Available at: <http://cleamc11.vub.ac.be/homeosta.html>.
11. Lindeman RD. Renal physiology and pathophysiology of aging. *Contrib Nephrol* 1993;105:1-12.
12. Whalley LJ, Deary IJ, Appleton CL, Starr JM. Cognitive reserve and the neurobiology of cognitive aging. *Ageing Res Rev* 2004;3:369-382.
13. Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001;56:M146-M156.
14. Morley JE, Haren MT, Rolland Y, Kim MJ. Frailty. *Med Clin North Am* 2006;90:837-847.
15. Wolfe RR. The underappreciated role of muscle in health and disease. *Am J Clin Nutr* 2006;84:475-482.
16. Wolfe RR. Optimal nutrition, exercise, and hormonal therapy promote muscle anabolism in the elderly. *J Am Coll Surg* 2006;202:176-180.
17. Hamel MB, Henderson WG, Khuri SF, Daley J. Surgical outcomes for patients aged 80 and older: morbidity and mortality from major noncardiac surgery. *J Am Geriatr Soc* 2005;53:424-429.
18. Verbrugge LM, Jette AM. The disablement process. *Soc Sci Med* 1994;38:1-14.
19. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist* 1969;9:179-186.
20. Palmer RM, Counsell S, Landefeld CS. Clinical intervention trials: the ACE unit. *Clin Geriatr Med* 1998;14:831-849.
21. Lawrence VA, Hazuda HP, Cornell JE, et al. Functional independence after major abdominal surgery in the elderly. *J Am Coll Surg* 2004;199:762-772.
22. Sessler DI. Perianesthetic thermoregulation and heat balance in humans. *FASEB J* 1993;7:638-644.
23. Aronovitch SA. Intraoperatively acquired pressure ulcer prevalence: a national study. *J Wound Ostomy Continence Nurs* 1999;26:130-136.
24. Kim HH, Barrs DM. Hearing aids: a review of what's new. *Otolaryngol Head Neck Surg* 2006;134:1043-1050.
25. Rubenstein LZ, Joseph T. Freeman award lecture: comprehensive geriatric assessment—from miracle to reality. *J Gerontol A Biol Sci Med Sci* 2004;59:473-477.
26. Heyburn G, Beringer T, Elliott J, Marsh D. Orthogeriatric care in patients with fractures of the proximal femur. *Clin Orthop Relat Res* 2004;(425):35-43.
27. Vidan M, Serra JA, Moreno C, Riquelme G, Ortiz J. Efficacy of a comprehensive geriatric intervention in older patients hospitalized for hip fracture: a randomized, controlled trial. *J Am Geriatr Soc* 2005;53:1476-1482.
28. Solomon DH, LoCicero J, Rosenthal RA, eds. *New Frontiers in Geriatrics Research. An Agenda for the Surgical and Related Medical Specialties*. New York: American Geriatrics Society; 2004.

# 2

## Demographics and Economics of Geriatric Patient Care

Maria F. Galati and Roger D. London

Anesthesiologists in geriatric practice care primarily for patients who are insured via Medicare, the federal health insurance program for citizens over the age of 65. The Medicare program has grown steadily in complexity and cost since its inception in 1965. It is expected to come under significant financial pressure as the population of the United States ages and the costs of providing health care continue to grow at ever-increasing rates.

This chapter is intended to provide those anesthesiologists who care for the geriatric patient population with an introduction to key health policy issues related to the Medicare program and to facilitate understanding of the demographics and economics of geriatric care with special emphasis on Medicare. The first part of the chapter is a general introduction and overview of the demographic and financial issues facing Medicare in the near future. The second part of the chapter raises some of the major policy issues that are specific to the practice of anesthesiology under the Medicare program.

### Medicare Demographics and Financing Issues

#### The Enactment of the Medicare Program

Medicare is the federal program that provides health care insurance to all citizens who are at least 65 years old and to some disabled Americans. The program was enacted in 1965 with passage of one of the most important pieces of domestic legislation of the post-World War II period, but the legislative process that preceded it was marked by years of debate and controversy.

From the Eisenhower administration forward, the United States government struggled with how best to meet the high cost of health care for the elderly. Results of the 1950 census revealed that since 1900 the aged population had grown from 4% to 8% of the total population. Two-thirds of the elderly had annual incomes of

less than \$1000, and only 1 in 8 had health insurance.<sup>1</sup> In response to the crisis, bills proposing hospital insurance for the aged were introduced in every Congress from 1952 through 1965.<sup>2</sup>

Legislators recognized and feared the power of organized medicine to thwart passage of legislation that involved government-sponsored health insurance. Therefore, when the Johnson Administration made its proposal, it included only a mandatory plan for covering hospital expenses for the elderly. This plan is what eventually became known as “Medicare Part A.”

It was the Chairman of the House Ways and Means Committee in 1965, Congressman Wilbur Mills, who fashioned a compromise that led to the creation of “Medicare Part B,” a voluntary plan for coverage of physician expenses for the elderly that was acceptable to the American Medical Association (AMA). In the compromise proposal for Medicare Part B, physician expenses were to be reimbursed on “usual and customary” charges as long as they were “reasonable.”<sup>3</sup> Physicians also retained the right to bill patients directly and in excess of the amount reimbursed by the government.

On July 30, 1965, President Lyndon Johnson enacted the Medicare and Medicaid programs by signing the Social Security Act of 1965 with these words:

There are men and women in pain who will find ease. There are those alone and suffering who will now hear the sound of approaching help. There are those fearing the terrible darkness of despair and poverty—despite long years of labor and expectation—who will now see the light of hope and realization.<sup>4</sup>

#### The Organization and Funding of Medicare

The Social Security Administration administered the Medicare program from 1965 until 1977, when Medicare was reorganized under the Health Care Financing Administration (HCFA) within the Department of Health, Education and Welfare. In July 2001, HCFA was renamed the Centers for Medicare and Medicaid Services (CMS).<sup>5</sup> In 1966, the

Medicare program covered more than 19 million citizens over the age of 65. Coverage for the disabled began in 1973 and, as of 2003, the program served more than 40 million Americans: 35 million elderly and 6 million disabled.<sup>6</sup>

The Medicare program provides coverage to the aged, the permanently disabled, and people with end-stage renal disease under two parts: Hospital Insurance (HI) or Medicare Part A, and Supplementary Medical Insurance (SMI) or Medicare Part B. The Medicare + Choice managed-care plan, also known as the “Medicare Advantage” program or Medicare Part C, was added by the Balanced Budget Act of 1997 and allows beneficiaries to opt for enrollment in private-sector–managed Medicare insurance plans. The Medicare Prescription Drug Improvement and Modernization Act of 2003 became effective in 2006, and extended a new prescription drug benefit to Medicare beneficiaries known as Medicare Part D.

The CMS contracts with private-sector agents to administer Medicare program services, including provider enrollment and claims administration processes. Contractors that process Part A claims are known as fiscal intermediaries and those that administer Part B claims are known as carriers. These contractors are usually insurance companies, many of which are Blue Cross-Blue Shield plans around the United States that can act as both fiscal intermediaries and contractors. Contractors are barred by law from making a profit on services provided to the Medicare program.

Enrollment in Medicare Part A is automatic for eligible beneficiaries and covers inpatient hospital care, after-hospital care in skilled nursing facilities, hospice care, and some home health services. Beneficiary enrollment in Medicare Part B is voluntary and covers physician services, outpatient hospital services, diagnostic tests, some home health services, and medical equipment and supplies. By law, 25% of Part B program costs must come from beneficiary premiums.

Employers and employees who make mandatory contributions to the Part A Hospital Insurance Trust Fund finance the majority of the Medicare program costs. Other funding sources include general tax revenues, and the premiums, deductibles, and copayments paid by the beneficiaries. Of the Medicare program’s annual expenses (\$214.6 billion in 1997), 89% are funded by people under the age of 65 in the form of payroll and income taxes and interest from the trust fund. Only 11% comes from monthly premiums paid by the beneficiaries.<sup>7</sup>

## Twenty-First Century Realities and the Future of the Medicare Program

### *Baby Boomer Demographics*

The so-called “baby boomer generation,” the post-World War II Americans born between 1946 and 1964, will have

a significant impact on the demographics of our society and on the Medicare program. It is predicted that as the boomers age, the number of people in the United States aged 65 years and older is expected to roughly double to 77 million by the year 2030.<sup>8</sup>

Given the existing Medicare funding system, it is clear that the aging of the American population will bring fiscal pressures to bear on the Medicare program in two ways. There will be more retired beneficiaries, as boomers age and live longer than their parents, and there will be fewer workers to pay for the retiree expenses.<sup>9</sup>

It is predicted that the over-65 age group will grow from approximately 13% of the total population in 2000 to 20% in 2030 and will remain above 20% for at least several decades thereafter.<sup>10</sup> In addition, life expectancies are continuing to increase, and typical boomers are projected to live approximately 2 years longer than their parents did, spending more years in retirement (Figure 2-1). At the same time, the labor force is expected to grow much more slowly than the population of retirees, resulting in many fewer workers per retiree. In 2000, there were 4.8 people ages 20 to 64 for each person age 65 or older. This ratio is expected to decrease to approximately 2.9 people ages 20 to 64 for each person age 65 or older by 2030 (Figure 2-2).

Although baby boomers report an intention to work longer than their parents did, it remains to be seen whether employers will accommodate this expectation and what effect this may have on the projected decrease in the worker–retiree ratio. Thus, retirement of the baby boomer generation will strain the already vulnerable Medicare program. The Social Security and Medicare

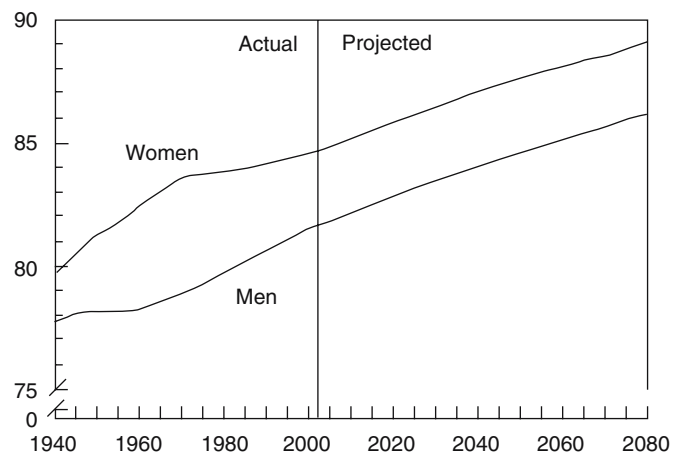


FIGURE 2-1. Life expectancy of 65-year-olds. (From Congressional Budget Office based on Social Security Administration. The 2003 annual report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds. March 17, 2003. p. 86. Available at: [www.ssa.gov/OACT/TR/TR03/tr03.pdf](http://www.ssa.gov/OACT/TR/TR03/tr03.pdf).)

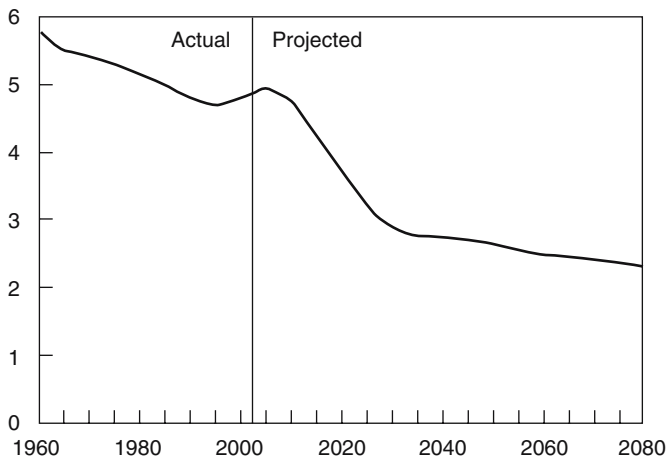


FIGURE 2-2. Ratio of population ages 20 to 64 to population ages 65 and older. (From Congressional Budget Office based on Social Security Administration. The 2003 annual report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds. March 17, 2003. p. 82. Available at: [www.ssa.gov/OACT/TR/TR03/tr03.pdf](http://www.ssa.gov/OACT/TR/TR03/tr03.pdf).)

Boards of Trustees are predicting that starting in 2010, when the baby boom generation begins to retire, the Hospital Insurance Trust Funds will experience rapidly growing annual deficits leading to fund exhaustion by 2019.<sup>11</sup> The report also predicts that the Supplemental Medical Insurance Trust Fund, which pays for physician services and the new prescription drug benefit, will have to be funded by large increases in premiums and increased transfers from general revenues.

### *Baby Boomer Expectations*

The baby boomer generation will bring millions of people into the Medicare program and these new beneficiaries will also bring with them a new set of expectations. Baby boomers constitute the first generation born to the Medicare program and the first with significant experience with managed medical insurance plans. Baby boomers also include a significant number of women with working experience and, in general, are more affluent than their forebears. They expect to enter retirement with more assets and with high expectations of the retirement experience.

A survey conducted by Roper Starch Worldwide for the American Association of Retired Persons (AARP) and entitled, “Baby-Boomers Envision Their Retirement: An AARP Segmentation Analysis,” examined the expectations, attitudes, and concerns of the baby boomers as they approach retirement. There were several key attitudinal findings from the survey. Most baby boomers believe that they will still be working during their retirement years. This is unlike previous generations and has

important implications for employers as well as the Medicare program.

Only one in five boomers expects to move to a new geographic area when they retire and almost one in four expects to receive an inheritance that will affect their retirement planning. Only approximately 35% expect that they will have to scale back their lifestyle during retirement and only 16% believe that they will have serious health problems when they are retired (AARP op. cit.). These are very optimistic views of the extent to which baby boomers’ retirement years will be disrupted by particular life events.<sup>12</sup>

Less optimistic conclusions emerged when the survey examined attitudes toward Social Security and Medicare: 55% had a very or somewhat favorable view of Social Security and 60% had a favorable view of Medicare. However, only 46% said that they were very or somewhat knowledgeable about Medicare and only 40% were confident that Medicare would be available to them during retirement. Indeed, baby boomers were much less confident in their abilities under Medicare to access care, choose their own doctors, or to consult specialists at the same level as under their current health plan (AARP op. cit.).

### Medicare Coverage Gaps

These less optimistic baby boomer attitudes may reflect an astute appreciation of the limitations of the Medicare program. Benefits under the Medicare program are significantly limited. One study has found that 80% of employer-sponsored fee-for-service plans cover a larger proportion of medical expenses than Medicare does.<sup>13</sup>

Medicare has not traditionally covered services such as long-term nursing care, outpatient prescription drugs, or routine vision, dental, hearing, and foot care. The Balanced Budget Act of 1997 extended coverage to include annual mammograms, Pap smears, prostate and colorectal screenings, diabetes management, and osteoporosis diagnosis. In December 2003, when the new prescription drug benefit was signed into law, it was projected that average out-of-pocket prescription drug spending for Medicare beneficiaries would be lower; however, it was also expected that 25% of beneficiaries would actually pay more as a result of the new coverage.<sup>14</sup> Furthermore, it is estimated that 3.1 million low-income subsidy-eligible beneficiaries are not receiving this assistance and therefore still face financial barriers in accessing necessary prescription drugs.<sup>15</sup> It will take years to fully assess the impact of this latest change in Medicare benefits on beneficiaries, providers, and the program itself.

Medicare beneficiaries rely on privately purchased or government-sponsored supplemental insurance plans to “tie in” and complement the array of services covered by the Medicare program. Supplemental insurance coverage