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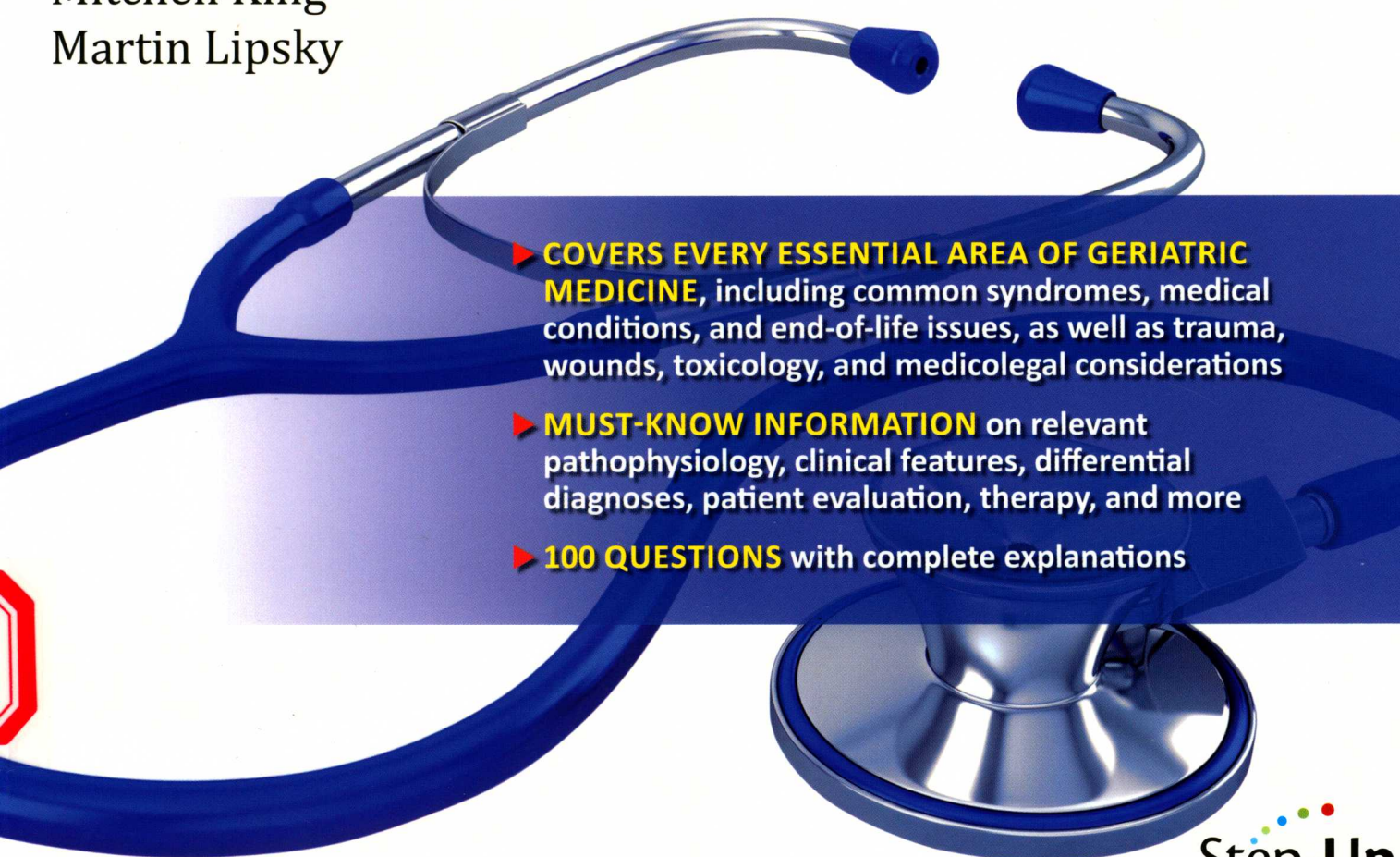
STEP-UP to GERIATRICS

Mitchell King
Martin Lipsky



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STEP-UP to GERIATRICS

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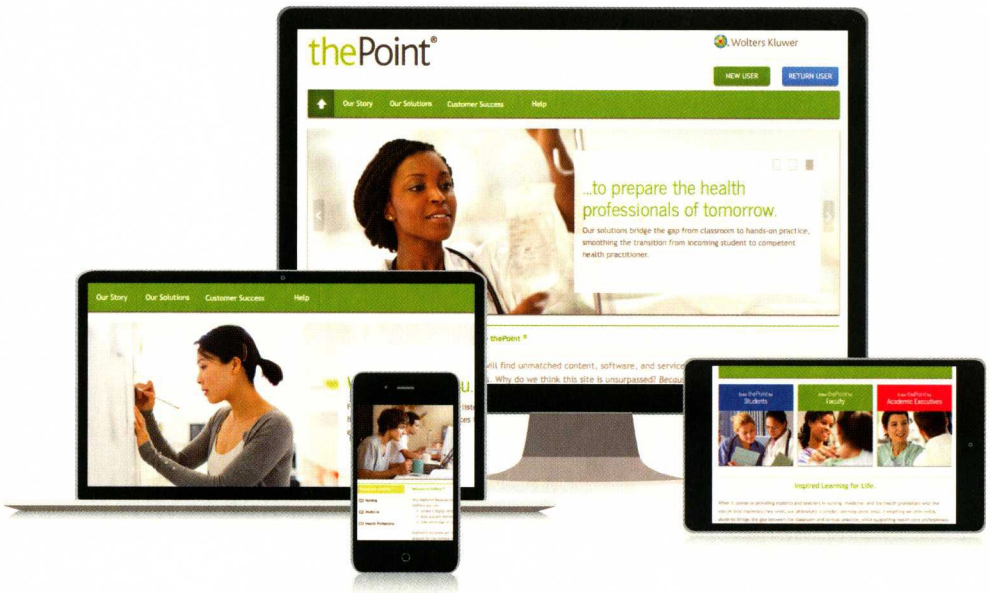

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PREFACE

Over the past few decades, the United States has experienced a tremendous growth in the number of individuals over age 65. The vast majority of these individuals have at least one chronic condition, making the care of elderly individuals a disproportionally large part of practice for anyone caring for adult patients. The challenge of providing successful and cost-effective geriatric care will become even more important for clinicians currently in training as the population continues to age.

Our goal for *Step-Up to Geriatrics* is to provide a comprehensive, straightforward, high-yield review of the essentials of geriatrics. While caring for the older adult is a key element of both family medicine and internal medicine, this book is specifically designed to supplement more general texts and the *Step-Up* series in other subjects. We included material that will be helpful for students taking a geriatric clerkship, residents on a geriatrics rotation, geriatric fellows, or physicians seeking a text for overall review. Physician assistants or advanced practice nurses with a focus on caring for older adults will also benefit greatly from the material in this text.

The book is organized to allow someone to quickly look up a topic, prepare for an exam, or read the entire text section by section for a more comprehensive review and to better understand how to care for the elderly patient. The *Step-Up* format—which combines numerous callouts, tables, charts, flow diagrams, Quick Hit bullet points, and summary of key facts with comprehensive paragraphs as needed—allows for a quick and easy understanding of the most important information. We have designed the text to be short enough for a student on a 4-week rotation to master key facts and concepts, yet detailed enough to provide a good analysis of specific elements of geriatric care when needed for a nongeriatric rotation.

Both of us enjoy caring for older patients and hope we have instilled some of the enthusiasm and interest we have in geriatrics. We also encourage readers to contact us by e-mail with any suggestions about how to make future editions better, or to correct any omissions or inadvertent errors that we may have overlooked.

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We would like to thank all those who helped make this book possible. If readers feel that this book contributes to their understanding of geriatrics, it is largely because of the many people who helped create this book.

First, we thank Wolters Kluwer for giving us this opportunity, and, in particular, Tari Broderick, senior acquisitions editor, who trusted us to get this project started, Matt Hauber and Christine Fahey, who helped guide this project along and transform our manuscript into a final formatted product that looked like an actual book. Each of these individuals added their expertise and insight along the way.

We also thank the reviewers who gave us critical feedback and also pointed out key errors in earlier drafts. Their suggestions and comments, while sometimes painful and ego-deflating, made this book so much better. In addition, we would like to acknowledge our contributors who did so much to develop the material for this book.

Finally, and most importantly, both of us gratefully acknowledge the support of our friends and families, especially our wives, Darice Zabak, MD, and Jacqueline King. Darice, in particular, provided insightful review and gave us several great suggestions. Her keen eye and attention to detail picked up several errors that we might have easily missed. Without Darice and Jackie, this project and many others would not be possible.

CONTENTS

THE GERIATRIC PATIENT

1

Introduction to Aging

A. Geriatric patients are arbitrarily defined as patients aged 65 and older.

1. Historically, the age of 65 as a retirement age can be traced to Otto Bismarck, Chancellor of Germany in the late 19th century, when only 2% of Germans lived past 65. Bismarck believed that the cost of social welfare programs starting at age 65 would be acceptably small for the population.
2. Geriatric patients are frequently complex patients with multiple chronic conditions.
3. Their decreased physiologic reserves place them at greater risk for complications from both disease and treatment than younger individuals.

B. Gerontology and geriatrics

1. Gerontology is the study of aging and the processes and phenomena associated with aging.
   a. Gerontology incorporates all facets of aging, drawing upon such varied fields as biology, sociology, economics, history, and medicine.
   b. Gerontologists are scientists who study aging.
2. Geriatrics is the study of clinical practice as it relates to older individuals.
   a. It includes the diagnosis and treatment of diseases and health problems of older adults.
   b. Physicians specializing in caring for older adults are geriatricians.

Quick HIT

Geriatric patients, who are defined as >65 years of age, have less physiologic reserve, placing them at higher risk for morbidity and mortality.

C. What is aging?

1. Aging is the inevitable chronologic changes from year to year. It can be defined from both biologic and psychosocial perspectives.
2. Biologic aging involves changes at the molecular, cellular, and organ levels.
   a. Starting at about age 30, aging in humans results in an internal physiologic deterioration.
   b. Biologic aging is genetically determined and environmentally modulated.
3. Cellular senescence is the process by which a cell loses its ability to divide, grow, and function, ultimately leading to cell death.
4. Aging can be characterized by the acronym CUPID, meaning that aging is **C**umulative, **U**niversal, **P**rogressive, **I**ntrinsic, and **D**eleterious (see Table 1-1).
   a. All humans age, making this phenomenon universal.
   b. Cumulative means the effects of aging are irreversible and accumulate over time.
   c. Aging is unidirectional. For example, a postmenopausal woman cannot become ovulatory again.
   d. Because even under the best environmental conditions an individual ages, aging is intrinsic to the organism.
   e. Deleterious means that aging is harmful, resulting in decreased vitality and an increased vulnerability to disease and environmental stresses.

Quick HIT

Biologic aging is genetically determined and environmentally modulated.

TABLE 1-1 Characteristics of Aging

CUPID
Cumulative
Universal
Progressive
Intrinsic
Deleterious

Quick HIT

Ageism is prejudice or discrimination on the basis of age.

Quick HIT

Psychological theories of aging relate to psychological transformations as a person ages.

Quick HIT

Erikson's theory of development views old age as a time to maintain ego integrity versus despair.

Quick HIT

A key concept of aging is the decrease in the ability to maintain homeostasis.

Quick HIT

Homeostasis is the ability of an organism or cell to regulate its internal conditions through a system of feedback controls that preserves function in the face of external stresses.

Quick HIT

A common rule is that individuals lose about 1% of their physiologic reserve (starting at around age 30).

5. Ageism is prejudice or discrimination on the basis of a person's age.
   a. Examples include adults portrayed as being senile, hard of hearing, grumpy, set in their ways, and as needing help.
   b. Heterogeneity is common among older persons, and although some older adults do not function well, the vast majority of those over 65 live independently.
   c. Healthcare providers are not immune to ageism and may infantilize older adults and talk down to them or use derogatory terms to address or talk about them.
   d. Awareness is the first step toward addressing ageism.

D. Psychosocial theories of aging include the disengagement theory, activity theory, and social clock.

1. Disengagement theory is the process of individuals withdrawing from prior social interactions as they age. Although popular in the 1950s, the greater health and vitality of older individuals today means they tend to remain more engaged in society than in the past.
2. Activity theory proposes that while involvement is a human need, the meaning and focus of involvement changes with age.
   a. For example, when an individual retires, they may transition to volunteer work or devote more time to a hobby.
   b. In contrast, the continuity theory states that aging adults do change their interactions with age, but still maintain many of the same activities, behaviors, personality traits, and relationships as they did earlier in life.
3. The social clock theory proposes that behavioral expectations at different ages are dictated by norms connected to a particular age. As individuals remain healthier for longer, societal views of older individuals will change.
4. Psychological theories of aging relate to psychological transformations that individuals experience as they age.
   a. Erikson's theory of development views old age as a time to maintain ego integrity versus despair, e.g., to hold on to one's sense of wholeness while avoiding the fear that there is too little time to begin a new life course.
   b. Older age is a time to review one's life, reconcile successes and failures, and to put it all in perspective.

E. Biologic theories of aging

1. Biologic aging impairs an organism's ability to maintain homeostasis.
   a. Homeostasis is the ability of an organism or cell to regulate its internal conditions through a system of feedback controls that preserves function in the face of external stresses.
2. The loss of physiologic reserve, which diminishes the ability to buffer stress, is what makes older individuals more vulnerable to disease and environmental stresses.
3. A common rule of thumb of aging is that individuals lose about 1% of their physiologic reserve per year, starting at around age 30. This is mostly true for the pulmonary, renal, cardiovascular, and musculoskeletal systems.

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TABLE 1-2 Major Theories of Aging

Evolutionary Theories	Stochastic or Error Theories	Nonstochastic or Biologic Clock	Psychological—Attempts to Explain Behavior and Roles
Programmed death, mutation accumulation, antagonistic pleiotropy, disposable soma	Free radical theory Somatic mutation Wear and Tear theory Cross-linkage Rate of living	Biologic clock theory Neuroendocrine Immunologic theory	Disengagement theory Activity theory Social clock theory

4. Heterogeneity is another key concept of aging.
   a. There is an increase in variability from individual to individual and also within an individual's organ systems.
   b. For example, someone might have good pulmonary function, yet have poor renal function.
5. Successful aging can be thought of as maintaining good health, good functional ability, good cognition, and remaining socially engaged.
6. Theories of aging
   a. Theories of aging fall into three broad categories: evolutionary, programed, and error theories (see Table 1-2).
   b. No single theory entirely explains aging, and to a certain degree, aging theories overlap.
   c. Most experts believe that aging results as a combination of evolution, genetic factors, and errors interacting in ways that are not fully understood.
   d. Evolutionary theories of aging include the theories of programmed death, mutation accumulation, antagonistic pleiotropy, and the disposable soma. In many cases, programmed and error theories are consistent with genetic selection.
      - The theory of programmed death is one of the oldest evolutionary arguments to explain aging.
        (1) This theory proposes that programmed death favors the survival of a species by freeing up resources for younger generations to survive and reproduce.
      - The mutation accumulation theory proposes that aging is an inevitable result of the declining force of natural selection with age.
        (1) For example, a mutation that kills young children will be strongly selected against if it prevents reproduction, while a lethal gene at an older age may have no selection bias, because the mutation will have already passed to offspring.
        (2) Over generations, late-acting harmful mutations can accumulate.
      - Antagonistic pleiotropy is based on the presumption that a gene may have multiple effects (pleiotropy).
        (1) In antagonistic pleiotropy, effects are opposite, in which one effect may be beneficial, and another detrimental.
        (2) In this theory late-acting harmful genes may be favored if they have a beneficial effect early in life.
        (3) For example, a gene that enhances oxidative phosphorylation might increase the burden of free radicals (FRs).
        (4) Enhanced phosphorylation might allow an animal to be faster and stronger, favoring natural selection early in life, but, over the long term, might produce more FRs that age an organism (see free radical theory).
      - The disposable soma theory presumes that the body has limited energy resources and must budget the amount of its energy available.
        (1) There may be a selective advantage for organisms to adopt a strategy where energy to accelerate development and reproduction is favored over the repair of somatic cells with the eventual consequence of deterioration and death.

Quick HIT

Heterogeneity is a key concept of aging.

Quick HIT

No single theory entirely explains aging, and to a certain degree, aging theories overlap.

Quick HIT

Accumulated mutation occurs because nature selects for genes with immediate survival and reproductive value, and there is no evolutionary pressure for longevity.

Quick HIT

The disposable soma theory presumes that the body has limited energy resources and must budget the amount of its energy available.

Quick HIT

Programmed theories propose that the human body is designed to age and follows an internal clock encoded into our DNA.

Quick HIT

Neuro-endocrine theory proposes that changes in hormones control aging.

Quick HIT

The biologic clock theory proposes that cells of a species are programmed for a certain number of divisions.

Quick HIT

Cell senescence has been linked to the length of telomeres and to telomerase activity.

Quick HIT

The immune theory argues that the immune system is programmed to decline over time, leaving a person more susceptible to disease.

Quick HIT

Error theories assert that aging is caused by damages to our body's systems which accumulate over time.

Quick HIT

FRs can damage cells and lead to impaired function.

Quick HIT

Mitochondria generate oxygen-free radicals as a byproduct of their energy-producing mechanisms

e. Programmed theories of aging propose that aging and longevity are coded into the genome and include the neuro-endocrine, biologic clock, and autoimmune theories.
- The neuro-endocrine theory proposes that aging is a part of the developmental process, that hormones control the pace of aging, and that aging is a sequence of events such as puberty and menopause coded into the genes.
- The biologic clock theory proposes that cells of a species are programmed for a certain number of divisions.
  (1) Hayflick found that human fibroblasts stop dividing after about 50 divisions.
  (2) The discovery of telomeres, areas of DNA at the end of chromosomes involved in the replication and stability of DNA, supports this theory.
  (3) With each cellular division in a differentiated cell, the telomeres shorten until the cell becomes inactive and is no longer capable of dividing.
  (4) The shortening process is associated with aging, and telomeres in cells from older individuals are shorter than the telomeres in cells of healthy, younger individuals.
  (5) Telomeres in cells from individuals with chronic diseases such as cirrhosis and congestive heart disease are shorter than healthy age matched controls.
  (6) Longer telomeres are found in germ cells, pluripotent stem cells, and tumor cells.
  (7) Telomerase is the enzyme that helps maintain the telomeres, and telomerase levels decrease with age. Research on aging and cancer explores ways to block the enzyme as a tool to fight cancer and also ways to potentially restore telomere length as an antiaging tool.
- The immunologic theory of aging is based on the programmed decline of the immune system over time.
  (1) Impaired immunity leads to an increased vulnerability to infection.
  (2) Dysregulation of the immune system is also linked to diseases such as cancer and cardiovascular disease that have an increased prevalence among older adults.

f. Stochastic or error theories are another major category of aging theories. Many error theories overlap and share in common the idea that aging results from accumulated damage to our cells over time.
- The Wear and Tear theory suggests that similar to an aging car, vital parts of the human body wear out with age and from the inability to continually repair damage to crucial systems.
  (1) This theory probably holds true for mechanical systems such as joints and teeth.
- The free radical theory is one of the most popular theories of aging.
  (1) FRs are highly reactive chemical species that have an unpaired electron.
  (2) FRs can react with and damage cellular components such as proteins, DNA, lipids, and sugars.
  (3) Simply put, the free radical theory postulates that aging is caused by the accumulation of oxidative damage.
  (4) FRs can originate intrinsically as a byproduct of metabolism or extrinsically from exogenous sources such as ionizing radiation and sunlight.
    (a) One type of highly reactive FR is the oxygen-free radical. Mitochondria generate oxygen-free radicals as a byproduct of their energy-producing mechanisms.
    (b) The body possesses natural defenses, or anti-oxidants, in the form of enzymes such as superoxide dismutase and catalase peroxide that can convert highly reactive oxygen molecules into inert molecules. Because not all highly reactive oxygen molecules are FRs, many prefer the oxidative stress or the oxidative theory of aging rather than the free radical theory.

(c) Vitamin C and E are examples of extrinsic antioxidants. Despite the appeal of taking supplemental antioxidants to slow aging, there is no evidence that supplemental antioxidants ameliorate aging. In fact, giving high doses of the antioxidant β-carotene to smokers increases their risk of lung cancer, and supplemental vitamin E increases the risk of prostate cancer.

(d) Defense mechanisms prevent most oxidative damage, but small amounts of damage accumulate over time and contribute to the deterioration of tissues and organs.

(e) FRs are used as part of the body's immunologic defenses.

- The rate of living theory postulates that the faster an organism's metabolism the shorter the life span.
  (1) First proposed by Pearl in the 1920s, the theory postulates that metabolic processes consume a vital cellular element. When this element is exhausted, it leads to death.
  (2) More recent arguments suggest that mitochondria generate fewer highly reactive oxygen free species through slower metabolism, thus slowing aging and extending life span.
  (3) Caloric restriction in mice can increase life span, an argument supporting the rate of living theory. However, when looking across the animal kingdom, not all animals with slow metabolisms live longer.
  (4) Caloric restriction has not been proven to extend life span in humans. In addition to being difficult to maintain over time, caloric restriction in humans have shown negative consequences, including muscle wasting, osteoporosis, and fatigue, as well as the difficulty of ensuring that a restricted calorie diet is nutritionally adequate.
- Somatic damage theory proposes that DNA damage occurs over time and impairs cellular function.
  (1) A related theory of accumulated error proposes that aging is a consequence of errors that occur during DNA replication.
  (2) Although repair enzymes fix most damage, both theories attribute aging to an imbalance between damage and repair function, which allows errors to accumulate, leading to the damage of genetic integrity, thus causing aging.
- Another damage theory is the cross-linkage theory, which proposes that the accumulation of cross-linked proteins and DNA disrupts function.

Quick HIT

There is no evidence that taking supplemental anti-oxidants slows aging.

Quick HIT

Somatic damage theories propose that genetic mutations over time cause malfunction and aging.

Demographics and Epidemiology

A. Life expectancy is defined as the average number of years a population of certain age can expect to live.

1. It is a commonly used measure to describe the overall health of a population.
2. **Healthy People 2020** monitors two life expectancy measures: life expectancy at birth and at age 65.
3. The average life expectancy at birth in the US in 2010 was 78.7 years, which ranks as 26th in the world. For men, the life expectancy is 76 years, and for women, 81 years.
4. The gender gap for life expectancy between men and women is present in all developed countries, but narrows with age. By age 65, the life expectancy for men at age 65 is 17.7 years, and for women, 20.3 years.
5. In 1900 the average life expectancy in the US was 47 years, and only 4% of Americans lived to age 65.
6. There are now more Americans aged over 65 than at any other time in the US history. Improvements in public health measures such as better sanitation, immunizations and advances in medicine such as antibiotics have all contributed to the increase in life expectancy.

Quick HIT

The average life expectancy at birth in the US in 2010 was 78.7 years.

Quick HIT

In the US, the average life expectancy at birth is about 5 years longer for woman, but decreases to about 2.5 years at age 65.

7. In 2010, the number of people over age 65 was 40.3 million, about 13% of the population. By 2030, about 20% or one in five Americans will be aged over 65.
   a. Individuals over 65 can be divided into the "young-old"—ages 65 to 74, "old-old"—ages 75 to 84, and the "oldest-old"—those aged over 85. The oldest-old are sometimes referred to as the frail elderly.
   b. Each group of elderly has different needs and services, and programs should be tailored to the needs of each group.
   c. The young-old need programs and services that reintegrate them into meaningful roles and activities after retirement, whereas the older-old need supportive and protective programs.
   d. However, the aging process is so highly individualized that, although these categories help in planning for populations, chronologic age may not serve as an accurate predictor of an individual's physical ability and health.
8. The average age of the US population is shifting as people live longer, fertility rates decrease and immigration declines.
9. As more people are living longer, a higher proportion of deaths are being compressed into a shorter age interval at the end of life. This is known as the compression of mortality.
10. The shift to an aging population has important implications for work force projections. Although only accounting for about 13% of the population, older adults account for about one-third of physician visits and one-third of hospitalizations.

Quick HIT

For humans the maximum life span is considered to be 120 years.

B. The maximum life span is defined as the length of life the members of a species can expect to live.

1. For humans, the maximum life span is considered to be 120 years, and the oldest documented human was Jeanne Calment, who lived to an age of 122.
2. Unlike life expectancy there has not been an increase in the maximum life span.
   a. The linear decline in organ reserve mandates a point at which function is unable to support life. About 20% of physiologic reserve is the minimum needed for basic life processes.
   b. The frail elderly individual who gradually fails at home or who experiences a catastrophic hospital course with multiple organ failure from a relatively minor insult are examples of humans reaching their physiologic limits.

Quick HIT

The maximum recorded life span for humans has not increased over the past century.

C. Causes of death and chronic disease (see Figure 1-1)

1. At the turn of the century, the leading causes of death were pneumonia, influenza, and tuberculosis.
2. Over the past century there has been a shift in the causes of death in the US from acute infectious diseases to chronic diseases. Now the three leading causes are heart disease, cancer, and stroke, which combine to account for almost 60% of all deaths among those aged 65 and older.
3. Although there is a decline in rates of disability, about 85% of older adults can expect to have at least one chronic illness and 60% of those over 85 have two or more chronic illnesses.

Quick HIT

The three leading causes of death in the US are heart disease, cancer, and stroke, which account for about 60% of all deaths of those aged 65 and older.

D. Compression of morbidity and mortality

1. As more individuals live longer, there has been a compression of mortality or a reduction in the variability of the age at death, leading to a progressive squaring of survival curves (Figure 1-2).

Clinical Vignette 1-1

The oldest documented life span was that of Jean Calment, a French woman who lived to be 122 years old. She was physically active, played tennis, roller skated, swam, and enjoyed music. She rode a bicycle until age 100. At age 110 increasing frailty forced her to move into a nursing home and at age 115 she fell and fractured two bones. By age 120 her memory was impaired and she was very hard of hearing. She died at 122.

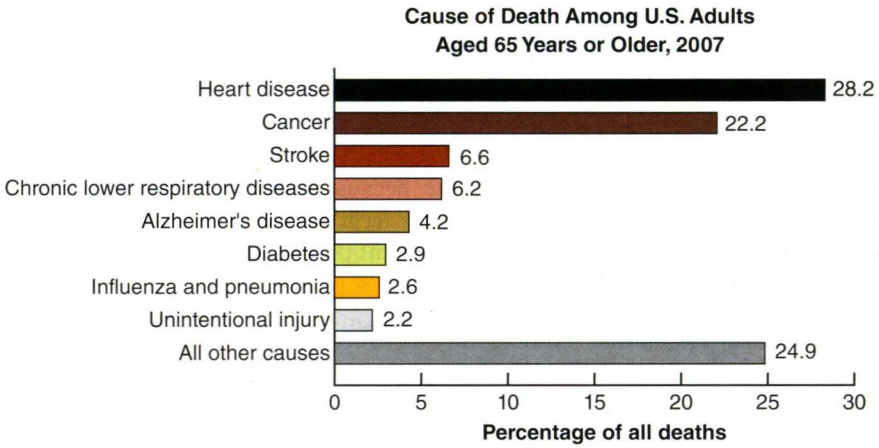

FIGURE 1-1 **Leading causes of death among US adults.**

(Adapted from CDC, National Center for Health Statistics. *National Vital Statistics System.* Atlanta, GA: CDC, 2007.)

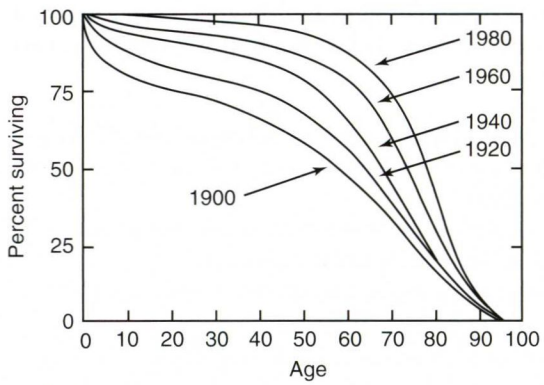

FIGURE 1-2 **Changes in survivorship in the United States. As more individuals live longer the curves squares off, sometimes referred to as the squaring of mortality.**

(Adapted from Fries JF, Crapo LM. *Vitality and Aging.* San Francisco, CA: W.H. Freeman, 1981.)

2. Fries also proposed the concept of compression of morbidity.
   a. This occurs if the age of onset of infirmity can be postponed more rapidly than the age of death, thereby compressing the burden of illness into a shorter period of time before death.
   b. Delaying the onset of aging manifestations and chronic disease shortens or "compresses" the period of morbidity prior to death and allows a person to maintain a higher quality of life into their later years.
   c. The assumption of the compression of morbidity theory is that while it will be possible to delay the onset of disease, the corresponding increases in longevity will be more modest.
   d. While compression of morbidity is generally accepted, others suggest that in the future we will experience a "failure of success" as the first symptoms of aging and chronic illness will remain the same, but life expectancy is extended.
   e. In this situation, although humans will live longer, they will also experience more years of disability and illness.

Changes of Aging

Quick HIT

Although the aging process makes individuals more vulnerable to illness and disease, pathology is not inevitable with age.

A. Aging and disease are not synonymous. Although the aging process makes individuals more vulnerable to illness and disease, pathology is not inevitable with age.

B. Most geriatricians do not view aging as a disease, because aging is a natural process and, unlike disease, aging is universal. Because the term disease carries negative connotations, adopting the aging-as-disease viewpoint potentially adds to the negative view of aging so prevalent in today's society.

C. Aging is a diverse process, in that it differs not only from individual to individual but also among the organ systems of an individual.
1. Biologic aging and chronologic age are not the same.
2. Aging alone generally does not cause symptoms.

D. Some changes previously attributed to aging are now thought to be related to lifestyle variables.
1. Genetic make up may only account for 25% of the variability in human longevity, with much of our health and well-being determined by environmental factors.
2. Aging may be slowed to some extent by maintaining a healthy diet, exercising, and engaging in other healthy lifestyle habits. Figure 1-3 shows how lifestyle influences fitness.

Quick HIT

The major age-related biologic change is a lessened reserve capacity and the inability to maintain homeostasis in the face of stressors such as a disease or adverse environmental factors such as excessive heat.

E. The major age-related biologic change is a diminished reserve capacity and the inability to maintain homeostasis in the face of stressors such as a disease or adverse environmental factors such as excessive heat.
1. Although physiologic aging can be viewed as the erosion of organ system reserve, most organ systems generally function adequately unless stressed.
2. Age-related changes are most pronounced in the oldest-old, e.g., those aged over 85.
3. Sometimes it may be difficult to distinguish normal aging from pathology. For example, the anatomic changes of plagues and neurofibrillary tangles seen in those with Alzheimer disease may also be seen in normal individuals, although usually not to the same degree.

F. A diminished physiologic reserve makes older individuals more vulnerable to disease.
1. About 90% of older individuals have at least one chronic disease. Many may have multiple chronic conditions, making management more complex and challenging than in younger adults.

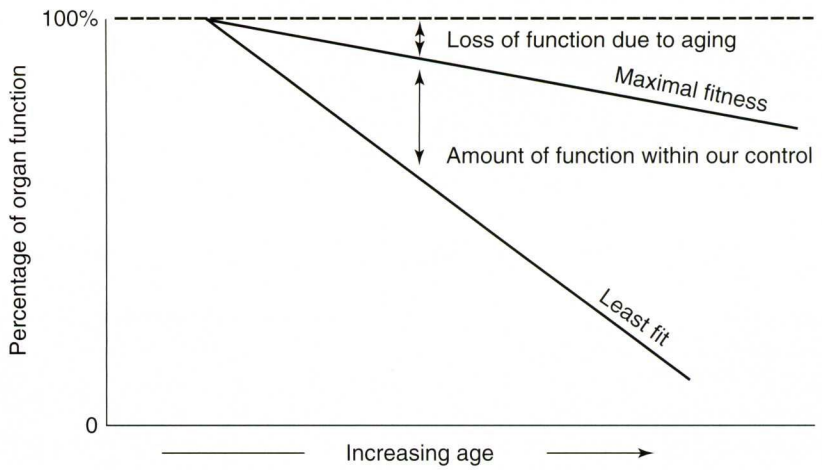

FIGURE 1-3 **How lifestyle influences fitness.**

(Adapted from Rosenthal TC, Williams ME, Naughton BJ. *Office Care Geriatrics.* Philadelphia, PA: Lippincott Williams & Wilkins, 2006.)

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