Understanding Disease in Old Age: Basic Themes of Pathophysiology

Richard W. Besdine, MD, FACP
Professor of Medicine
Professor of Health Services Policy & Practice
Greer Professor of Geriatric Medicine
Director, Division of Geriatrics and Palliative Medicine
Director, Center for Gerontology and Healthcare Research

ALPERT MEDICAL SCHOOL

BROWN

Disclosures for Richard W. Besdine, MD

- I have no financial relationship with a commercial entity producing health-care related products and/or services
- I have a deep and abiding passion for improving health and healthcare for older persons, and will do almost anything to achieve the goal

Learning Objectives

Demonstrate the ability to

- Understand and explain the importance of health care of older persons to the US economy
- Describe pure aging in the organ systems
- Understand and explain the importance of distinguishing pure aging from disease in elders
- Use the themes of aging to differentiate pure aging from disease

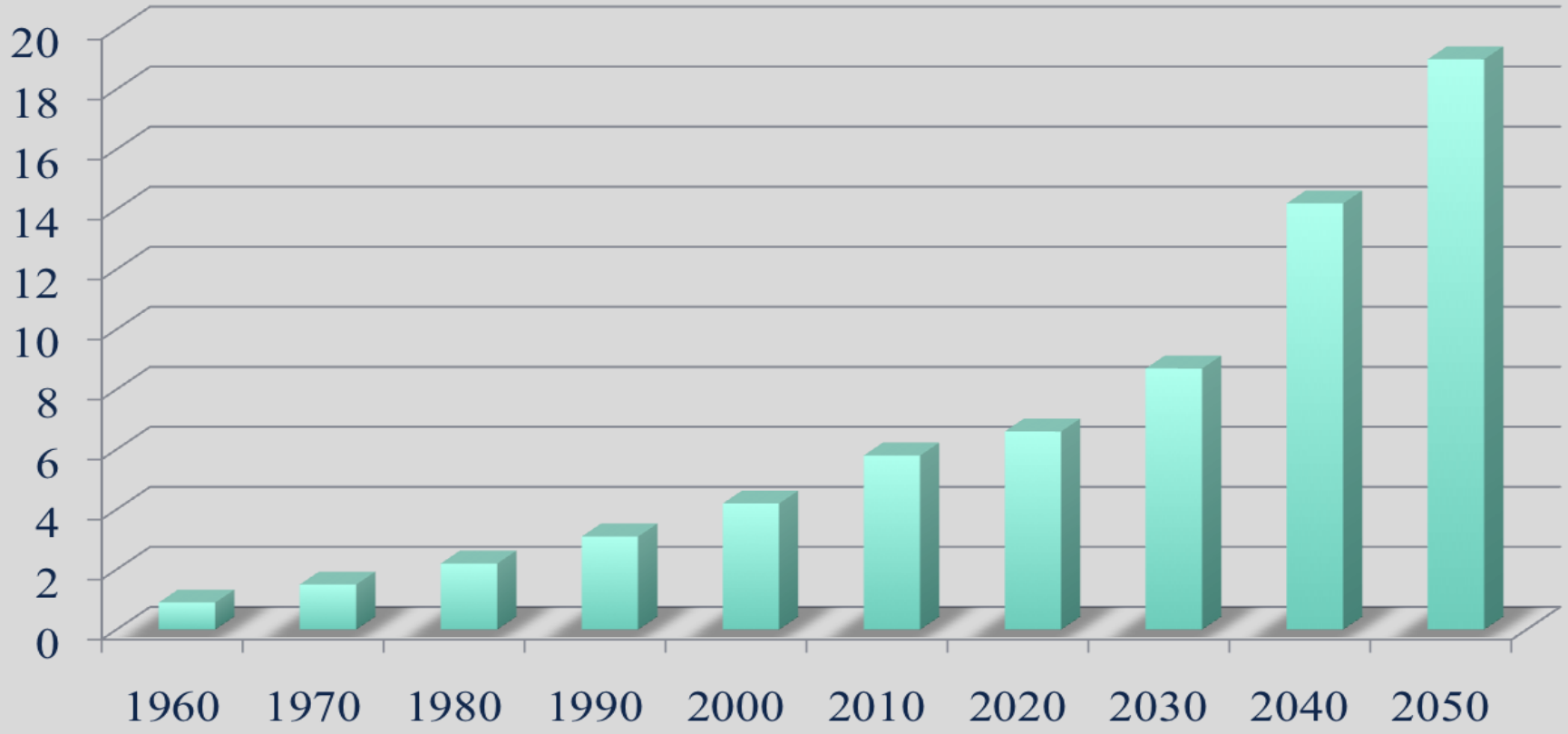
Maybe Aging isn’t so Bad

Fufi Harlan, age 79

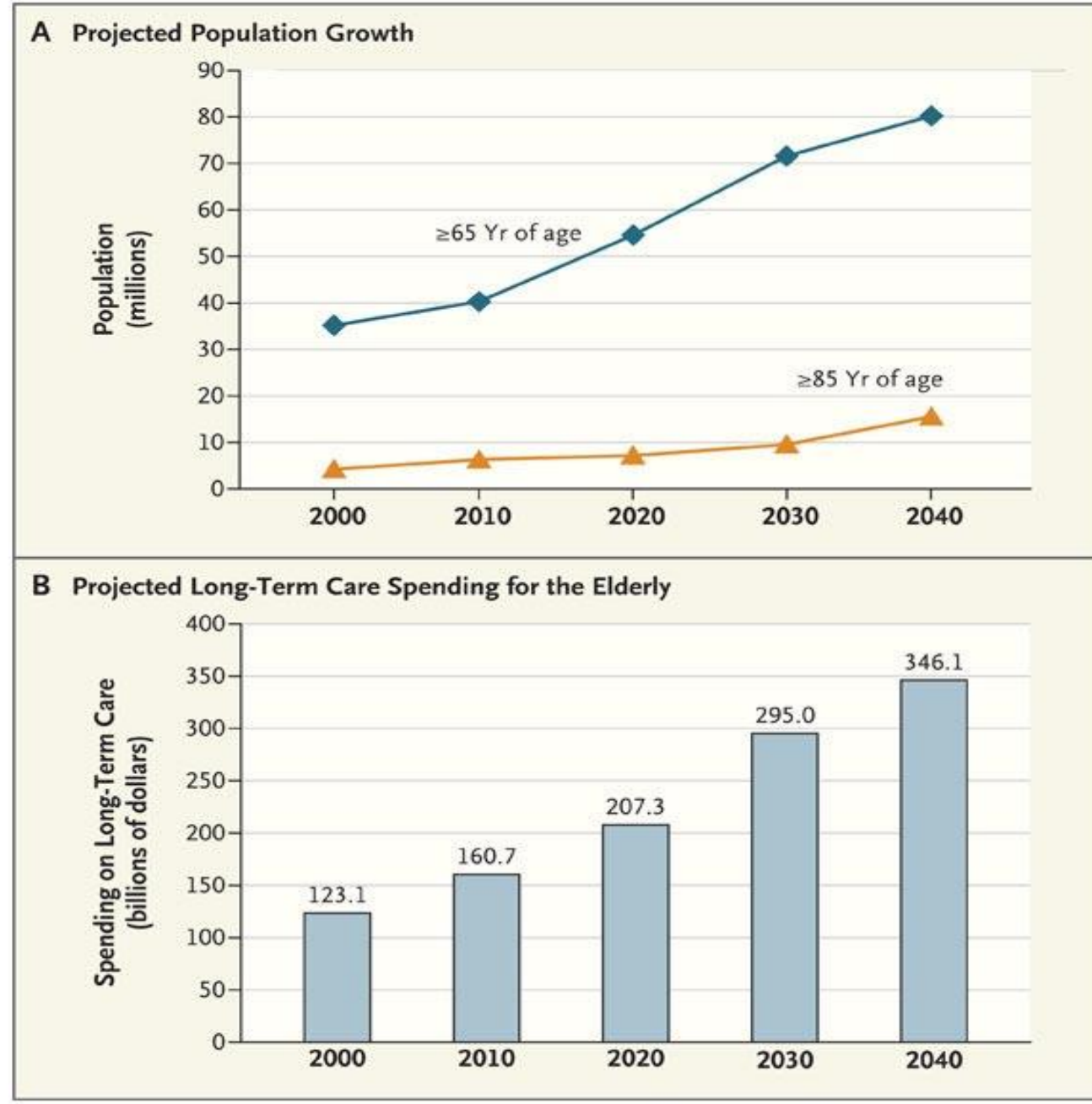
Population Aging

- Average life expectancy (ALE) at birth in ancient Rome for a citizen was ~25 years; 35 years in England during the American Revolution
- In 1900 America, 48: 50 for ♀ , 47 for ♂ ; in 2012, 81 and 76, respectively – 1900 years for 1st 25-year gain in ALE, <100 years for the next
- For Americans reaching adulthood in 2012, ALE is 85+ for women and 80 for men
- Maximum life span increase, though slower than increase in ALE, has not slowed since 1950s

US Population Projections ≥ Age 85 (in Millions)

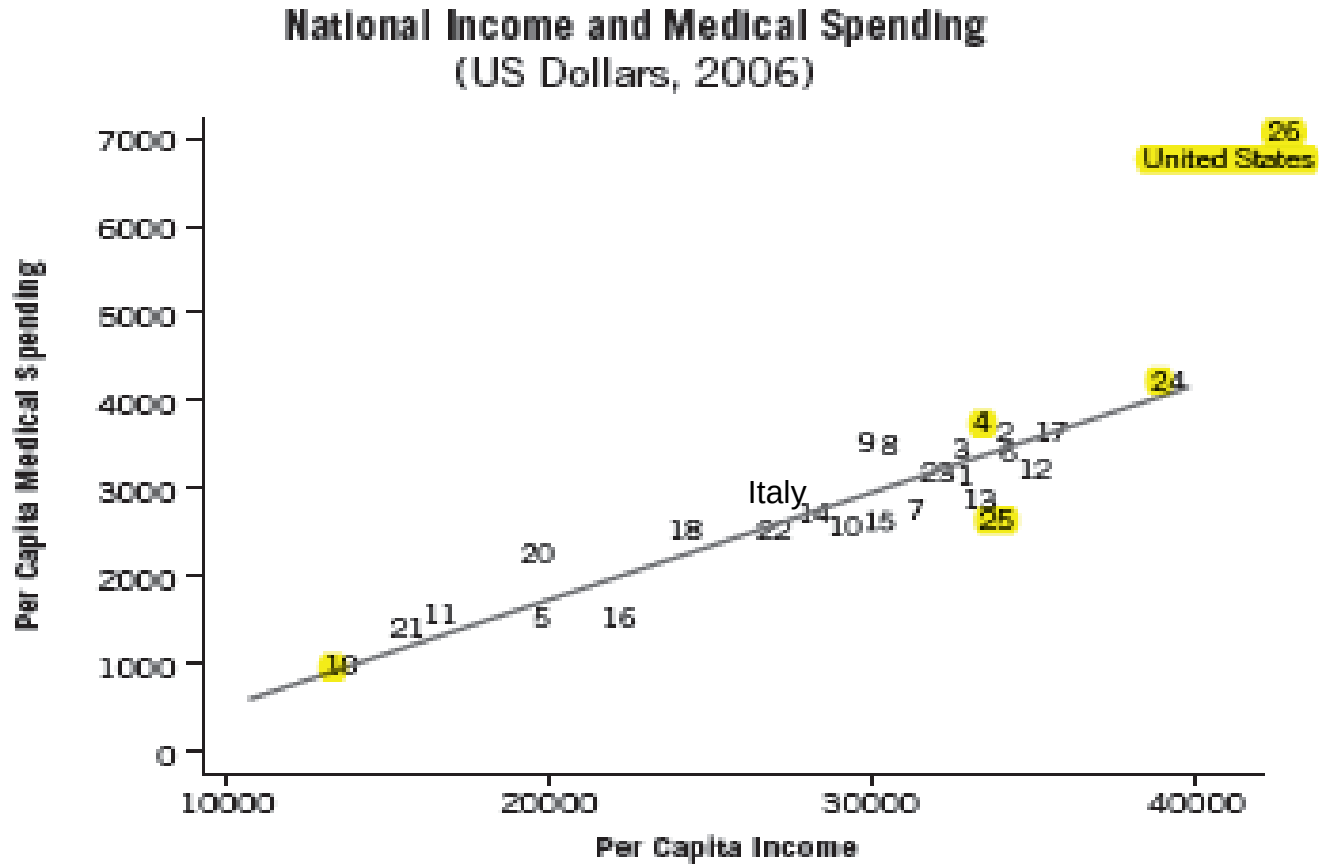


Growth of Older US Population (A), and US Spending on Long-Term Care for Elders (B)



Stevenson D. N Engl J Med 2008;358:1985-1987

America Outspends the World on Healthcare



Legend for Figures 1.1 through 1.4

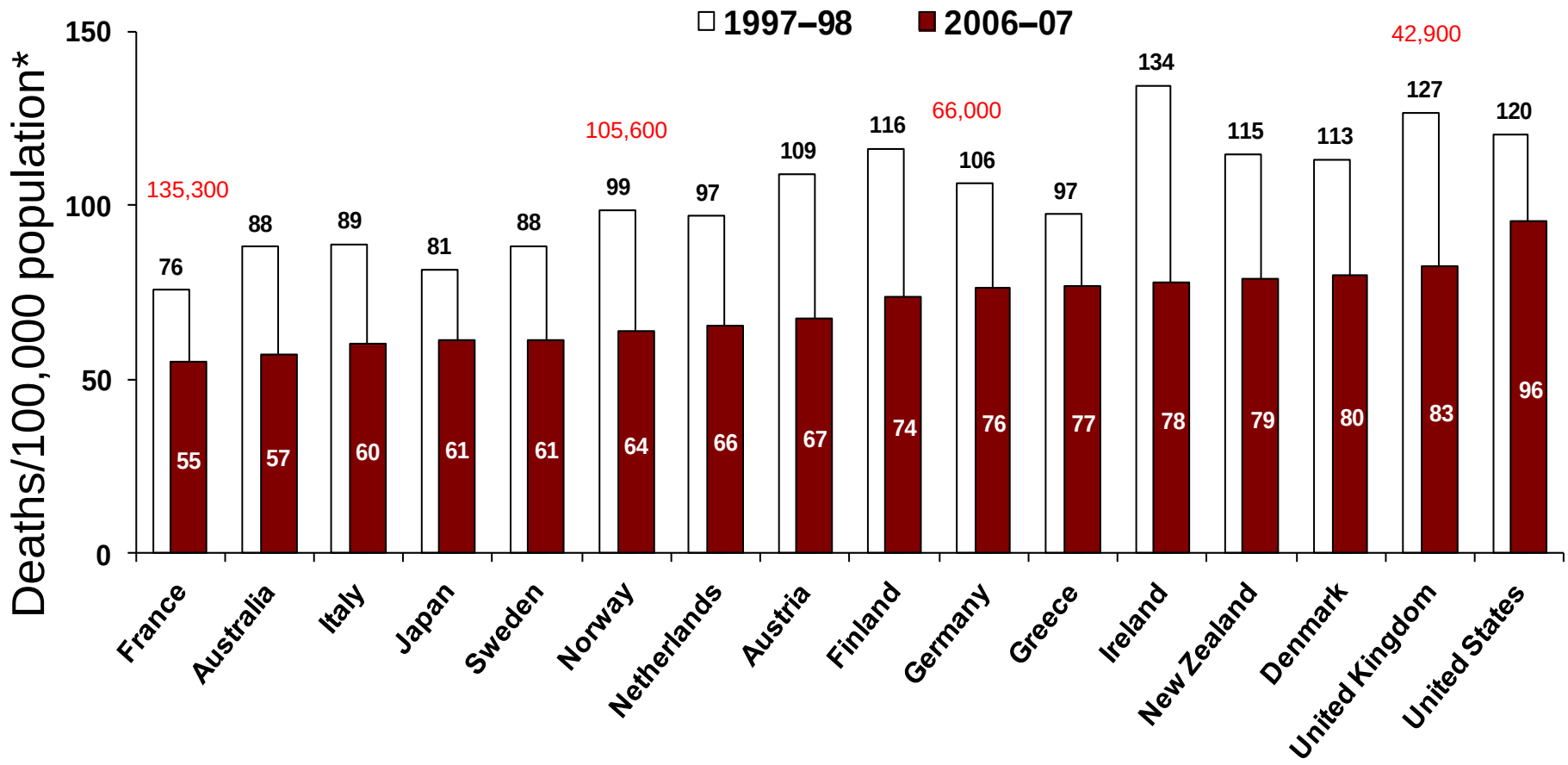
1. Australia	10. Greece	19. Poland
2. Austria	11. Hungary	20. Portugal
3. Belgium	12. Iceland	21. Slovak Republic
4. Canada	13. Ireland	22. Spain
5. Czech Republic	14. Italy	23. Sweden
6. Denmark	15. Japan	24. Switzerland
7. Finland	16. South Korea	25. United Kingdom
8. France	17. Netherlands	26. United States
9. Germany	18. New Zealand	

Data source: OECD

US Healthcare Quality Measures

- Percent population with health insurance
- Preventable deaths (WHO definition) – of 19 industrialized nations, we have highest death rates from diseases defined as preventable (Schroeder. NEJM 2007)
  - AMI
  - CHF
  - Stroke
- Smoking and obesity
- Healthy Life Expectancy (years lived prior to onset of disability in a population)

U.S. Lags Other Countries: Mortality Amenable to Health Care



*Countries' age-standardized death rates before age 75; including ischemic heart disease, diabetes, stroke, and bacterial infections (WHO and CDC mortality data)

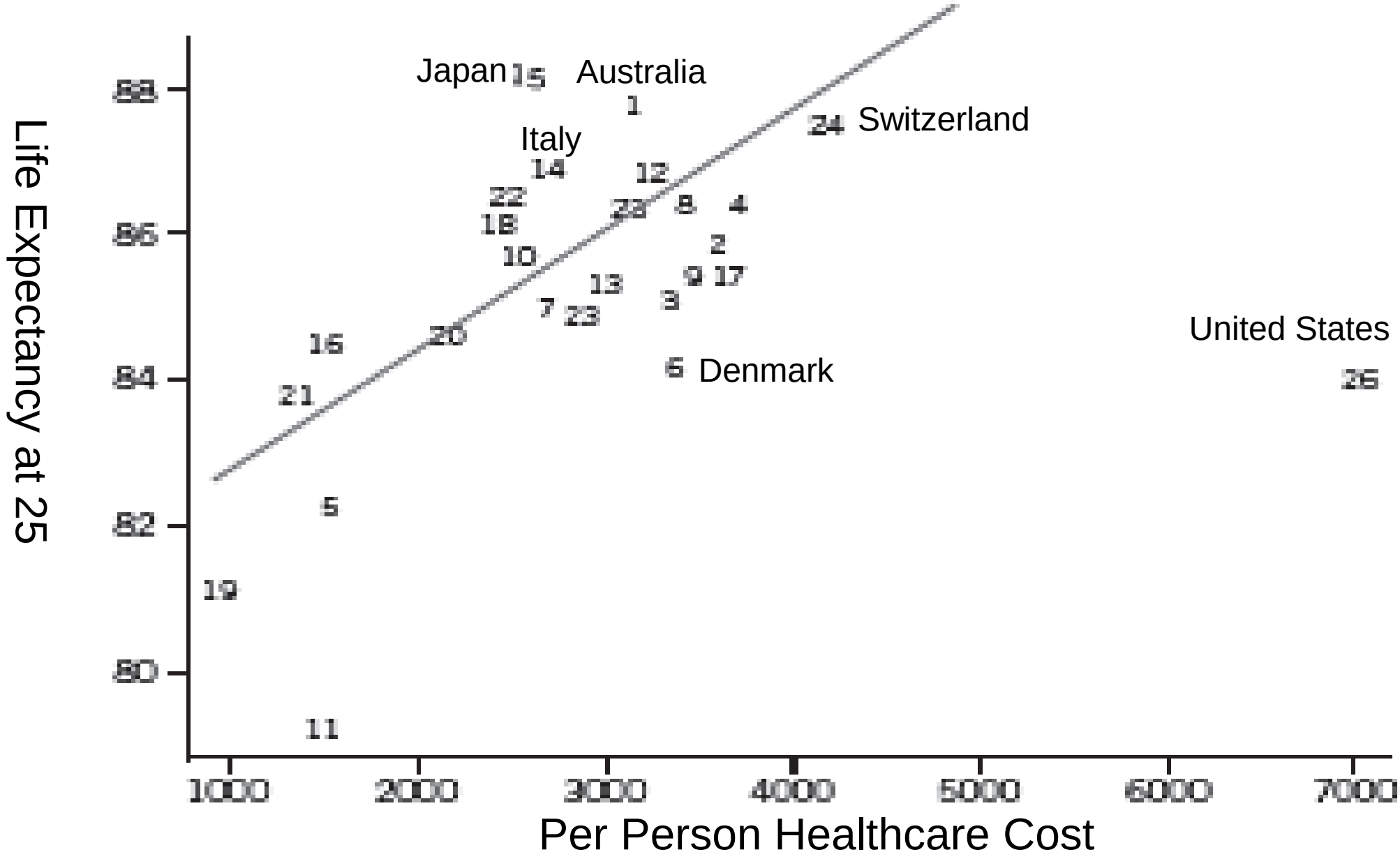
Nolte E, McKee M. Variations in Amenable Mortality - Trends in 16 High-Income Nations," *Health Policy,* online 9/12/11

Life Expectancy (2010 Estimates)

Rank	Country	Years
1	Macau	84.36
3	Japan	82.12
6	Australia	81.63
7	Canada	81.23
8	France	80.98
18	Italy	80.20
21	Spain	80.05
32	Germany	79.26
36	United Kingdom	79.01
49	United States	78.11
71	Mexico	76.06
162	Russia	66.03
224	Angola	38.20

Source: https://www.cia.gov/library/publications/the-world-factbook/rankorder/2102rank.html

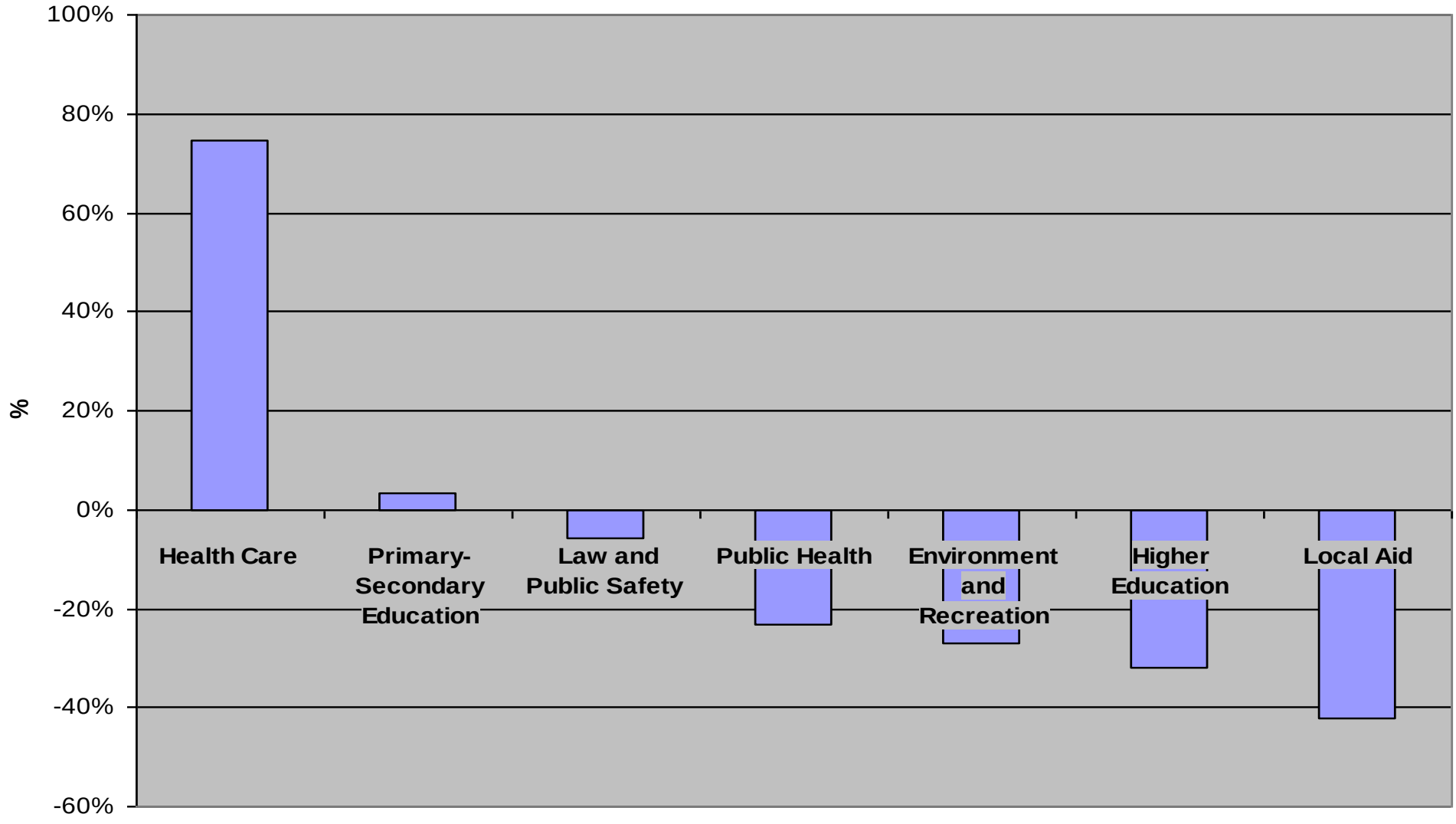
Life Expectancy Compared to Healthcare Spending



Health Care vs Determinants of Health
Growth in Massachusetts State Budget Spending FY2001 to FY2012

(Inflation adjusted)

Source: Massachusetts Budget & Policy Center Budget Browser



Future of Geriatrics Care

- Demographics are urgent and compelling
- Build anticipatory system to meet challenge
- Most care delivered to most older Americans is by non-geriatricians; good, but these MDs need geriatrics knowledge, skills for success
- Geriatricians are needed to teach optimal care of elders to all MDs in the educational pipeline, and to do research to improve that care – also to manage most frail 5%

Newsweek
SEPTEMBER 21, 2009

THE CASE FOR KILLING GRANNY

CURBING EXCESSIVE END-OF-LIFE CARE IS GOOD FOR AMERICA
BY EVAN THOMAS

I WAS A TEENAGE DEATH PANELIST
BY JON MEACHAM

PLUS

THE WAY OUT OF AFGHANISTAN
BY FAREED ZAKARIA

THE ROOTS OF THE NEXT CRASH
BY NIALL FERGUSON

OBAMA'S CREDIBILITY GAP
BY GEORGE F. WILL

$5.95 US
$6.95 CD/VI/PR/BM
0 706285 8

Nine Themes of Aging

- These themes are the conceptual basis for understanding the interactions of aging changes with diseases and risk factors
- Themes explain the relationships of symptoms, signs and diagnostic tests to disease and changes in organ function in older persons - special knowledge base of geriatric medicine
- The themes facilitate analysis and understanding of the most complex and challenging clinical problems of older patients

Themes of Aging[1]

1. Pure Aging – What happens if you survive, no matter how well you live your life (e.g., diet, habits, exercise) – changes in all organs (kidney, heart, lung et al.) - inevitable and irreversible, if truly aging, as opposed to disease – presbyopia, wrinkles

2. Restricted capacity in each organ to maintain homeostasis under stress, leading to rapid decompensation of “weak link” systems (CNS, CV, renal) – delirium complicating pneumonia

Themes of Aging$_2$

3. Geriatrics syndromes - interaction of diseases and risk factors with pure aging effects of “weak links” to produce stereotypic loss of function; usually multi-factorial cause – falls, delirium, dizziness, UI, weight/appetite loss, syncope
4. Disease in elders often modified (presentation, clinical course, response to treatment, outcomes) beyond the syndromes by pure aging effects – SDH more frequent, less trauma

Themes of Aging$_3$

5. Pure aging effect is misinterpreted as disease – slow information retrieval called dementia
6. Disease misinterpreted as pure aging effect – obvious dementia symptoms called “old age”
7. Medication Hazards – pure aging & disease ↑ risks for adverse drug effects – CNS, CV
8. Multiple Pathology – Interactions of multiple diseases accelerate potential for harm
9. Diseases Special in Aging – Common only in elders; adult medicine must know – DCHF, AD

More on Geriatrics Syndromes

- Geriatrics syndromes begin with development of weak links as a result of pure aging; with superimposed disease, weak links fail, producing stereotypical physical or cognitive function losses as major manifestation
  - Confusion (Delirium or Dementia)
  - Dizziness
  - Falls
  - Syncope
  - Urinary incontinence
  - Weight or appetite loss

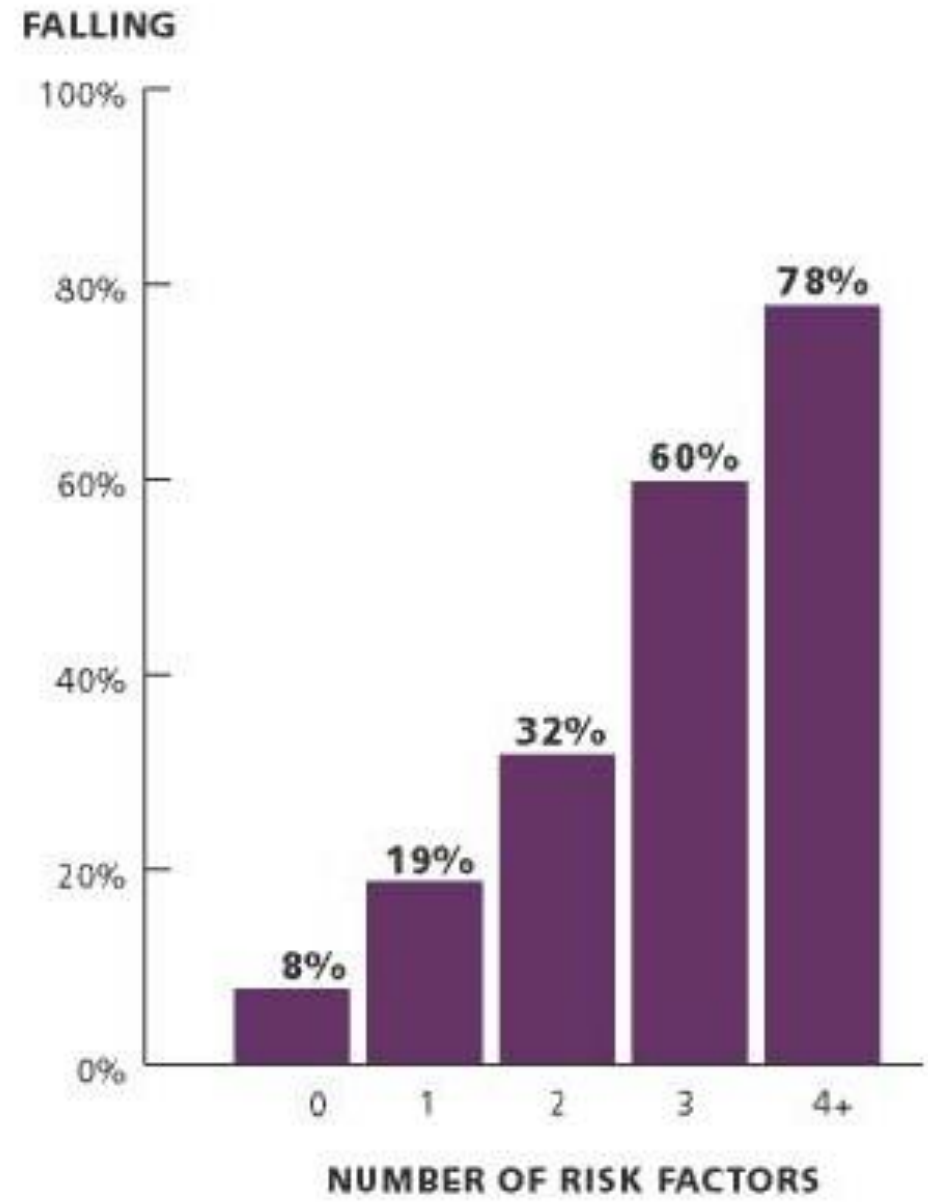
Recognizing Geriatrics Syndromes

- Most often, syndromes result from interaction of multiple predisposing risks with pure aging
- Syndromes may result from interaction of a single disease with pure aging
  - Confusion following administration of meperidine (demerol – an old narcotic; hallucinogenic) for post-operative pain
  - Falling as the first sign of pneumonia
  - Urinary incontinence heralding the development of a brain tumor

Recognizing Geriatrics Syndromes$_2$

- Each syndrome that has been carefully studied (falls, dizziness, delirium) exhibits a consistent pattern of causation
- Multiple risks have been discovered for each, and the number of risk factors determines the level of risk
- Falling was the first syndrome to be defined – 1980s by Mary Tinetti

Risk of Falls Annually by Count of Risk Factors



Tinetti ME et al. Risk factors for falls among elderly persons living in the community. NEJM 1988;319:1701-7.

Risk Factors

- History of fall
- Cognitive impairment
- Age >80
- Multiple co-morbidities
- Visual impairment
- Medications (sedative, hypotensive, multiple)
- Lower extremity weakness
- Balance or gait abnormality
- ADL impairment
- Depression
- Use of assistive device

Managing Geriatrics Syndromes

- The exciting part is that:
  - By identifying risk factors and intervening on those that are modifiable YOU can prevent the development of syndromes
  - Syndromes, when present, also respond to interventions, although harm may have already occurred - prevention vital
  - Risk-reducing interventions often are simple and inexpensive

Evidence-Based Interventions for Falls

- Exercise or physical therapy
- Modification of home hazards
- Medication withdrawal or adjustment
- Nutritional or vitamin supplementation
- Referral for correction of visual deficiency
- Cardiac pacemaker for syncope-associated falls
- Multifactorial, health & environmental risk-factor screening and intervention
- System Δ to prevent falls in high-risk hospital patients
- Education of physicians in CT (Tinetti M et al.NEJM. 2008;359:252)

Reducing Risk of Falling

Risk Factor	1 Year Fall Risk (%)	Intervention Reduces Risk To (%)
Fall Past Year	50	30
Minor Gait Problem	30	20
One Risk	20	10
Two Risks	30	20
Three Risks	60	40
Four or More	80	50

Treatable Risks: Problem walking or moving; Orthostatic hypotension; ≥ 4 meds or 1 psychoactive; Unsafe footwear or foot problems; Environmental hazards

www.fallprevention.org

PHYSIOLOGY OF AGING

Characteristics of age-related changes

- Inevitable
- Irreversible
- Variable within and among individuals
- Usually decremental
- Linear
- Plasticity (organ reserve)
- Surviving

Variables That Decline With Age[1]

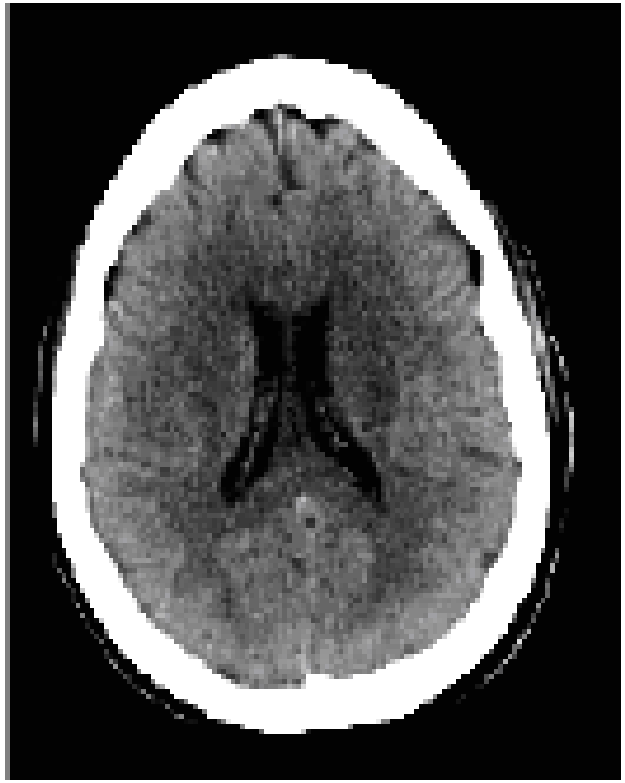
- Lung - elastic recoil, alveolar exchange area, Arterial $Pa0_2$ (until 65), ↑V/Q mismatch, FVC, FEV1, vital capacity, survival probability with pneumonia
- Immunity – ↓overall, but no causality proven for cancer or infection; antibody production, clonal expansion, helper T cells & their function, DTH
- Body composition – lean mass (↑fat), weight >65
- Metabolism – glucose tolerance (↑diabetes risk)

Variables That Decline With Age[2]

- Renal - weight, volume, glomeruli, RBF, GFR, C_{CR}
- Heart - maximum rate & O_2 consumption; cardiac output at maximum exercise, reserve; LV elasticity, survival from AMI
- Bone – density, architecture, fracture resistance
- Skin - D3 production, thickness & vascularity, eccrine glands, melanocytes; ↑malignancy
- Urogenital – bladder control, fertility, potency, sex hormones

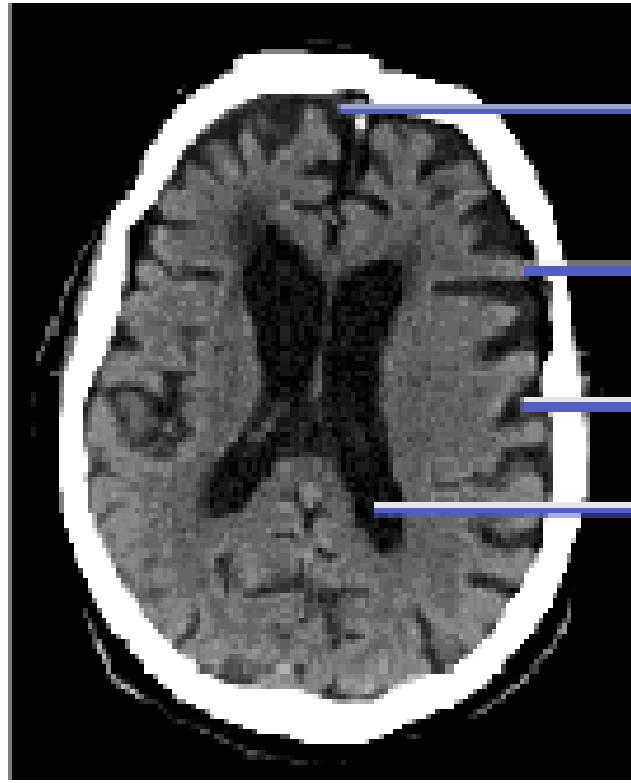
Age-related Structural Brain Changes

Young



CT head (cross-section view)

Old



CT head (cross-section view)

Enlarged subdural space predisposes to SDH

Narrower gyri

Wider sulci

Enlarged ventricles

Variables Not Changing With Age

- Fasting blood sugar
- Electrolyte composition of the blood, pH
- Hematocrit
- Leukocyte and platelet counts
- Number of teeth
- Cardiac output (at rest and moderate exercise)
- Levels of most hormones (insulin, cortisol, thyroxin, testosterone (complex) , parathormone; not estrogen)
- Cognitive function

Disease Cascade in Older Persons

Young Adults

1 Disease → Pathophysiology → Symptoms → Rx

Older Persons

- Multiple Pathologies
- Pure Aging Syndrome
- Socioeconomics and Environment
- Habits, Lifestyle, Behaviors

→ Interacting cascade of problems

→ Symptoms Functional Loss Disabilities

Diseases and Problems of Aging

- Congestive heart failure
- Osteoarthritis
- Ischemic heart disease
- Diabetes mellitus
- Hypertension
- Stroke
- Cancer (lung, colon, prostate, breast)
- Renal failure
- Hypothyroidism
- Osteoporosis
- Parkinson's disease
- Spinal stenosis
- Arterial insufficiency (LE)
- Depression
- End of Life Care

Diseases and Problems of Aging$_2$

- Atrial fibrillation
- CLD
- Pneumonia
- Pressure sores
- Syncope
- Hip fracture/falls
- Dementia (AD, strokes)
- Pneumonia
- Impaired hearing, vision
- Urinary incontinence
- Deconditioning
- Functional decline
- MVA
- Drug toxicity
- Under-nutrition
- Pain management

Illness Behavior[1]

Behavior of sick older persons

- Overestimate healthiness, underestimate severity of disease
- Under-reporting of symptoms
- Least likely to act on symptoms
  - Ageism
  - Previous experience with healthcare
  - Depression
  - Dementia

Illness Behavior$_2$

Behavior of disease in sick older persons

- Multiple Pathology - clustering of diseases
- Importance
  - Unattended disease-disease interactions
  - Disease-therapy interactions - Incomplete problem list risks negative impact of treatment or evaluation of one illness on another, as yet unidentified illness

Impact of Aging on Disease:
Atypical Presentation

- Non-specific - functional losses - weak links
- Altered - specific, but usually seen in older adults
  - Thyrotoxicosis - masked or apathetic
  - Hyperosmolar diabetes
  - Appendicitis as FUO and a mass
  - Depression as “what do you expect when you are old?”
- One symptom obscures others
- None

Impact of Aging on Disease$_2$

None - common diseases presenting commonly

Increased chance of Illness - geriatrics textbook

Laboratory Values

- Most don't change (+/- within normal range)
- Some normal values are erroneously thought to be abnormal; e.g., hematocrit, albumin, glucose
- BUN, creatinine overestimate renal function in old age

Achievements in Care of Elders[1]

- Geriatric assessment and management
- Special units for acute & transitional care
- Improved use of drugs
- Improved pain management
- Prevention of pressure ulcers
- Prevention of delirium
- Exercise as prevention and treatment

Achievements in Care of Elders$_2$

- Reduction in rates of rehospitalization
- Glimmers in treatment of AD
- Treatment of hypertension in very old
- Prevention of osteoporotic fractures
- Improved treatment of depression
- Value of anticoagulants in stroke prevention
- Thrombolytic therapy for AMI
- Improved nursing home care quality