Interprofessional Geriatrics Training Program

The Process of Aging

Acknowledgements

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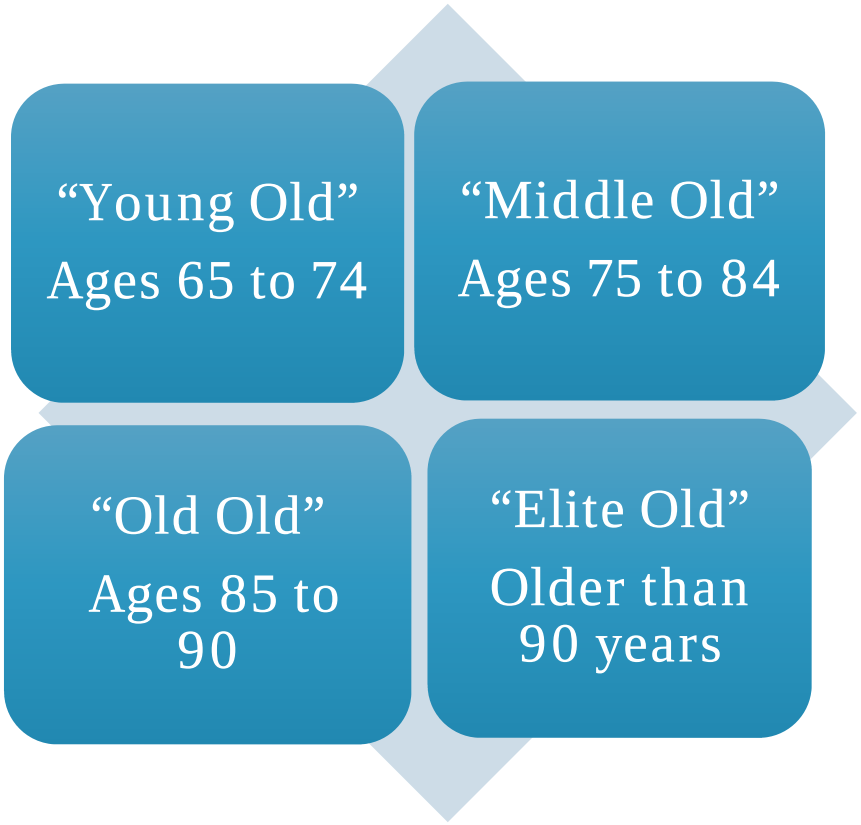
Older Adult Interviewee: Kathleen, 90-year-old

Learning Objectives

Upon completion of this module, learners will be able to:

1. Describe the current theories of physiologic aging
2. Explain the effects of aging on major organ systems
3. Differentiate normal aging from pathology
4. Recognize age-related changes in patients

Definitions of Aging



(Transgenerational Design Matters, 2016; Zizza et al., 2009)

Interview with Expert: Kathleen, 90-Year-Old

Expert Interview: Kathleen

Listen to Our Expert Discuss:

- Her personal experience with aging
- When does a person become “older”?

Theories of Aging

Physiologic Theories of Aging

Theory	Description
Target Genetic Damage	Genes are susceptible to “hits” from radiation or other damaging agents that alter the function of structural signaling and repair molecules
Mitochondrial DNA Damage	• Genes encoded within mitochondria are more likely to lose their integrity as mitochondrial DNA is not surrounded by proteins like nuclear DNA • This damage results in the loss of function and accumulation of damaged molecules
Telomeres	Progressive shortening of telomeres, the ends of linear chromosomes, with each DNA replication, and when it gets short enough, the cell stops replicating

(Weinert & Timiras, 2003)

Physiologic Theories of Aging

Theory	Description
Transposable Element Activation	• Pieces of DNA can move from one location in the genome to another, for better or worse • Activation of transposable elements may occur with aging, leading to more mutations
Epigenetics	<u>Detailed Description Below: Not in the Film</u> • Changes in gene expression can be caused by other factors (e.g., drugs, diet, environmental chemicals, etc.) and processes (e.g., aging, phenotype drift [inherited traits changing because of dysfunction], DNA methylation and histone acetylation • As opposed to Genetic theory which postulates aging is the result of changes to sequences of DNA (genotypes) which are inherited

(Weinert & Timiras, 2003)

Physiologic Theories of Aging

Theory	Description
Error Catastrophe	RNA and transfer proteins become damaged and transfer incorrect information from DNA to proteins for synthesis
Free Radical	Free radicals cause damage to proteins, lipids, and DNA leading to altered structure and function
Accumulation	Cross-linked collagen, amyloid, lipofuscin and mitochondrial membranes accumulate compromising cells and tissue
Rate of Living	Rate of energy metabolism predicts the rate of aging
Endocrine	Decreases in hormone secretion cause loss of function of organ systems

(Weinert & Timiras, 2003)

Physiologic Theories of Aging

Theory	Description
Immune	• Deficits in immune response and T-cell function cause an increase in infection and disease • Immune cells accumulate and produce pro-inflammatory cytokines leading to chronic molecular inflammation with systemic effects
Stem Cells and Progenitor Cells	The cells involved in tissue remodeling and repair are depleted over time

(Weinert & Timiras, 2003)

Expert Interview: Kathleen

Listen to Our Expert Discuss:

- Her personal experience with aging
- How she describes the physical experience of aging

Assessment Question 1

A cohort study examines the longevity of identical twins. Results indicate that older twin pairs have significant differences in histone acetyltransferase compared to younger twin pairs.

This is an example of which theory of aging?

a) Free-radical theory

b) Target theory of genetic damage

c) Telomere theory

d) Epigenetic modifications

Assessment Question 1: Answer

A cohort study examines the longevity of identical twins. Results indicate that older twin pairs have significant differences in histone acetyltransferase compared to younger twin pairs.

This is an example of which theory of aging?

a) Free-radical theory

b) Target theory of genetic damage

c) Telomere theory

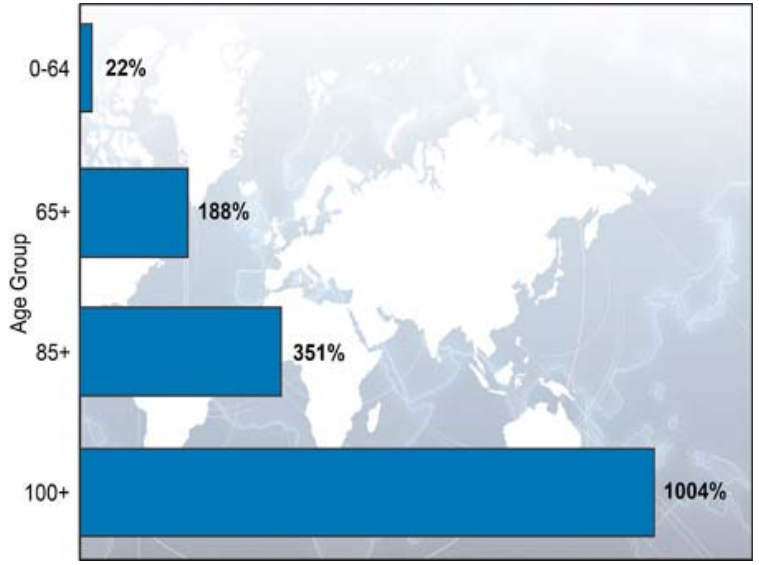
d) Epigenetic modifications (Correct Answer)

People Are Living Longer

People Are Living Longer

- People are living longer
- Life expectancy in Japan (the current leader) is > 83 years
- 81 years in several other countries
- People aged 85 or older constitute 8% of the world's 65-and-over population
- Need for clinicians across disciplines to understand the effects of aging on the body grows proportionally to the population

Percentage change in the world's population by age: 2010-2050



(United Nations, 2015)

Knowing the Effects of Aging: Clinicians' Imperative

Physiologic Aging System: Cardiovascular

- Increased stiffness of vasculature -> decreased responsiveness to receptor-mediated agents, increased afterload [not in narration], increased peripheral resistance, increased left ventricular wall stiffness
- Increased left ventricular wall stiffness -> diastolic function is reduced
  - Joint National Committee (JNC) 8 Guidelines Normal BP: (James et al., 2014)
    - 60+ years old: Normal BP: <150/90mm Hg [not in narration]
    - Below age 60 years old: <140/80mm Hg

<u>Not in the Film</u>

- Lipofuscin and fat deposits -> decreased mobility of heart
- Decreased heart rate variability -> reduced functional reserves under stress
- Decline in maximum heart rate -> stressed heart less able to respond

(North & Sinclair, 2012)

Physiologic Aging System: Pulmonary

- Decrease in elastin fibers, increase in collagen cross-links -> decreased elastic recoil of lungs, increased residual volume
- Decreased vital capacity, forced vital capacity -> decreased exercise tolerance and pulmonary reserve
- Increased residual volume, reduced FEV1 -> decreased quiet and forced breathing

(Lalley, 2013)

Physiologic Aging System: Gastrointestinal

- Varicosities on the tongue develop -> decreased saliva production
- Dysphagia from increase in nonperistalic contractions of esophagus -> decreased calorie intake
- Decreased production of hydrochloric acid -> altered intestinal absorption
- Lipofuscin and fat deposition in the pancreas -> altered intestinal absorption
- Mucosal cell atrophy -> increased diverticulum, transit time, and constipation

(Soenen et al., 2016)

Physiologic Aging System: Endocrine

- Atrophy of glands -> decreased gonadotropin hormone (GH), dehydroepiandrosterone (DHEA), testosterone, and estrogen
- Increased parathyroid hormone (PTH), atrial natriuretic peptide (ANP), norepinephrine (NE), baseline cortisol, erythropoietin -> changes in target organ response, homeostasis, response to stress, and functional capacity
- Delayed negative feedback after stressor -> altered homeostasis of hormones

<u>Not in the Film</u>

- Thyroid -> decrease in thyroid stimulating hormone (TSH), thyroxine (T_4), and plasma triiodothyronine

(Fedarko & McNabney, 2016)

Physiologic Aging System: Nervous

- Decreased number of neurons, action potential speeds, and axon and dendrite branches -> decreased muscle innervation and fine motor control
- Loss of sympathetic and parasympathetic tone -> autonomic dysfunction, including more positional dizziness, more falls, more problems with heat stroke and hypothermia
- Loss of mu receptors -> reduced narcotic sensitivity
  - Narcotics are not recommended for geriatric patients and are on the Beers list

(Fedarko & McNabney, 2016)

Physiologic Aging System: Immune

- Atrophy of the thymus -> decrease in function and production of T-cells, natural killer (NK) cells, and cytokines
- Decline in acquired immune function-> decreased response to new pathogens
- Decreased T-cell function -> decreased immune response
- Decreased B-cell function -> abnormal antibodies
- Increased autoimmune antibodies -> immune dysregulation

(Castelo-Branco & Soveral, 2014)

Physiologic Aging System: Immune

CDC Vaccination Recommendations

- Geriatric patients are at increased risk of pneumonia, which is why the CDC guidelines recommend both:
  - Pneumococcal 13 valent conjugate (PCV13)
  - Pneumococcal polysaccharide (PPSV23)

Physiologic Aging System: Genitourinary

- Decrease in number of functioning glomeruli and renal tubules -> impaired permeability and a decrease in glucose reabsorption which can lead to diabetes
- Decrease in glomerular filtration rate (GFR) and renal blood flow -> decreased renal clearance which can cause accumulation of medications in the system
- Decrease in ability to concentrate urine -> loss of fluids which can predispose patients to dehydration
- Edema, lymphocyte infiltration, and mucosal atrophy of the bladder -> decreased function
- Prostate enlargement in men -> lower urinary tract symptoms of urgency, hesitancy, incomplete emptying, and nocturia

(Fedarko & McNabney, 2016)

Physiologic Aging System: Muscular

- Lipofuscin and fat deposits in the muscle tissue -> loss of functional muscle tissue
- Loss of muscle tissue -> decrease in lean body mass
- Loss of type II (fast twitch) muscle fibers -> decreased muscle tone and contractility
- Decreased muscle tone and contractility -> decreased strength and endurance
- Decreased strength and muscle atrophy -> higher risk for falls

(Fedarko & McNabney, 2016)

For a comprehensive training module see the ENGAGE-IL module "Preventing Falls Among Community-Dwelling Older Adults" at engageil.com

Physiologic Aging System: Integument

- Thinning of the epidermis -> decreased thickness of skin
- Decreased melanocytes -> decreased melanin
- Decreased collagen cross-links and elastin -> loss of skin elasticity
- Atrophy of hair follicles -> decrease in hair density and color
- Slowing of linear nail growth -> brittle, dull, opaque and yellow nails
- Thinning of skin -> higher risk for pressure ulcers and ulcers from shearing forces

(Fedarko & McNabney, 2016)

Physiologic Aging System: Musculoskeletal

- Decrease in bone mass/density -> brittle bones, decreased height, kyphosis -> osteoporosis (4% of men and 16% of women over 50 have osteoporosis) (Looker, et al., 2012)
- Decrease in muscle mass
- Decrease in joint fluid -> joint stiffening and osteoarthritis
- Joint stiffening -> slower and more limited movement

(Loeser, 2010)

Physiologic Aging System: Eyes

- Loss of periorbital fat -> sunken eyes and laxity of eyelids
- Lipid deposits in cornea -> loss of vision
- Fibrosis of the iris -> decreased accommodation and darkness adaptation
  - Patients should be discouraged from driving at night
- Increase in lens size and rigidity -> decreased ability to focus
- Increase in annular layers of the lens -> cataracts
- Dysregulation of rods and cones -> drusen (yellow or white plaques)
- By age 75, almost 50% of people in the United States have cataracts, according to the American Academy of Ophthalmology

(Fedarko & McNabney, 2016)

Physiologic Aging System: Ears

- Tympanic membrane thickens -> loss of elasticity
- Atrophy of hair cells in the organ of Corti, loss of cochlear neurons in the spiral ganglion, and atrophy of stria vascularis in the cochlea -> hearing loss (predominantly high frequency)
  - One way to communicate with patients who have high frequency hearing loss is to lower the pitch of your voice when speaking to them
- Decreased neurons in the utricle, saccule, and ampulla -> decrease in detection of gravity, changes in speed, and rotation and increased risk for falls

(Lin et al., 2011)

Physiologic Aging System: Ears

- Prevalence of hearing loss in ages:
  - 60-69: 27%
  - 70-79: 55%
  - > 80: 79%

(Lin et al., 2011)

Physiologic Aging System: Nose

- Decreased sense of smell -> decreased taste of food and may have decreased desire to eat

(Lin et al., 2011)

Assessment Question 2

Which of the following is true regarding protein and energy requirements in geriatric patients?

a) Resting energy expenditure increases in older adults

b) The most physically active older adults on average lose similar muscle mass over time compared with more sedentary young adults

c) Energy expended during activity is significantly greater in older men than in younger men

d) Older adults need proportionally lower amounts of protein in their diets than younger adults

Assessment Question 2: Answer

Which of the following is true regarding protein and energy requirements in geriatric patients?

a) Resting energy expenditure increases in older adults

b) The most physically active older adults on average lose similar muscle mass over time compared with more sedentary young adults (Correct Answer)

c) Energy expended during activity is significantly greater in older men than in younger men

d) Older adults need proportionally lower amounts of protein in their diets than younger adults

Assessment Question 3

Which of the following is not considered physiologic aging?

a) Thinning of the lens of the eye

b) Thinning of the skin

c) Decreased number of blood vessels

d) Lipofuscin and fat deposits in the heart

Assessment Question 3: Answer

Which of the following is not considered physiologic aging?

a) Thinning of the lens of the eye (Correct Answer)

b) Thinning of the skin

c) Decreased number of blood vessels

d) Lipofuscin and fat deposits in the heart

Aging as a Patient

Expert Interview: Kathleen

Listen to Our Expert Discuss:

- Her personal experience with aging
- What would she like others to know about being older?
- Have people treated her differently?

Normal Versus Abnormal Aging

- Aging changes vary on an individual basis
- Organ systems continue to function despite age-related changes; however, they have decreased ability to maintain homeostasis under stress
- Age-related changes can be magnified by pathology

ENGAGE - IL
Enhancement of Geriatric Care for All

(Reuben et al., 2014)

Normal Versus Abnormal Aging

- To distinguish normal aging changes from pathology, observe system function in the non-stressed state
  - If pathology is present, compromised system function is evident in the non-stressed state
  - If no pathology is present, homeostasis is maintained
- Many diseases, though pathologic, have increased incidence with increased age
  - Coronary artery disease (CAD)
  - Cerebral vascular accident (CVA)
  - Dementia

(Reuben et al., 2014)

Normal Versus Abnormal Aging

- Many diseases, though pathologic, have increased incidence with increased age (continued)
  - Pressure ulcers
  - Fungal infections of the nails
  - Neoplasms
  - Osteoporosis
  - Arthritis
  - Hypertension
  - Heart failure

(Reuben et al., 2014)

Normal Versus Abnormal Aging

- Many diseases, though pathologic, have increased incidence with increased age (continued)
  - Myocardial infarction (MI)
  - Bronchitis
  - Chronic obstructive pulmonary disease (COPD)
  - Pneumonia (PNA)
  - Sleep apnea
  - Pulmonary embolism (PE)
  - Cataracts

(Reuben et al., 2014)

Normal Versus Abnormal Aging

- Many diseases, though pathologic, have increased incidence with increased age (continued)
  - Glaucoma
  - Macular degeneration
  - Presbycusis
  - Hiatal hernia

(Reuben et al., 2014)

Expert Interview: Kathleen

Listen to Our Expert Discuss:

- Her personal experience with aging
- Is she happy with her relationship with her doctor?
- What expectations does she have for her doctor?

Assessment

History

- Complete and thorough medical history
- Patient's activity level
  - Functional history: Instrumental activities of daily living (IADLs), activities of daily living (ADLs), nutrition, and fall history
- Review of Systems
  - Include special senses, pain, bowel and bladder function, appetite, cognition, and memory
- Medication Review
  - Medications, over-the-counter and herbal medications

(Reuben et al., 2014)

Assessment

Physical Exam

- Include skin, dentition, gait, balance, vision, hearing

Social, Financial, Environmental, Emotional and Spiritual Status Tools

Geriatric Assessment Tool	Link
Geriatric Depression Scale (GDS)	http://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/depression-in-adults-screening
Montreal Cognitive Assessment (MOCA)	http://www.mocatest.org/
The Timed Up and Go (TUG) Test, recommended by STEDI toolkit	http://www.cdc.gov/steadi

(Reuben et al., 2014)

Assessment

Labs

- To assess renal function, liver function, endocrine function, anemia, and vitamin deficiencies
- Other testing: Electrocardiogram (EKG), stress echo, transthoracic echocardiogram (TTE), and imaging

- This thorough medical history does not have to be completed in one visit
  - It is common for geriatricians to have a new patient return frequently to the clinic when first establishing care to complete a thorough assessment

(Reuben et al., 2014)

Expert Interview: Kathleen

Listen to Our Expert Discuss:

- Her personal experience with aging
- Significant events that have affected her aging process
- Advice she would give someone concerned about the process of aging

Maintain Homeostasis

Patients Should

- Control their chronic medical problems
- Avoid polypharmacy
- Keep active and engaged both mentally and physically
- Follow with ophthalmology, audiology, dentistry as needed
- Use **physical** and **occupational therapy** to assess and help maintain function
- Use **social workers** to assist with obtaining resources and services
- Avoid devices that will decrease mobility (avoid motorized scooters)
- Optimize functional status (use glasses, hearing aids, canes, walkers, dentures)

- Degree of functionality is directly related to longevity and quality of life

Assessment Question 4

Which of the following is the best tool for assessing your geriatric patients' aging process?

a) Montreal Cognitive Assessment (MOCA)

b) The Timed Up and Go (TUG) Test

c) History and physical

d) Routine laboratory evaluations

Assessment Question 4: Answer

Which of the following is the best tool for assessing your geriatric patients' aging process?

a) Montreal Cognitive Assessment (MOCA)

b) The Timed Up and Go (TUG) Test

c) History and physical (Correct Answer)

d) Routine laboratory evaluations

Resources

http://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/depression-in-adults-screening Accessed September 23, 2016

http://www.mocatest.org/ Accessed September 23, 2016

http://www.cdc.gov/steadi Accessed September 23, 2016

www.aao.org/newsroom/eye-health-statistics Accessed September 23, 2016

www.cdc.gov/nchs/fastats/osteoporosis.htm Accessed September 23, 2016

www.cdc.gov/aging/pdf/state-aging-health-in-america-2013.pdf Accessed September 23, 2016

www.Geriatricscareonline.org Accessed September 23, 2016

www.nia.nih.gov/research/publication/global-health-and-aging/living-longer Accessed September 23, 2016

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