Healthy Aging Perspectives

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Image from: http://www.aoa.acl.gov/AoA_Programs/HPW/Oral_Health/Index.aspx

What is health?

. . . a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity

WHO, 1946, http://www.who.int/about/definition/en/print.html

[2]

What is Healthy Aging?

Living a long time . . .

Life span . . . "interactions between genes and the environment in which we live"

http://www.cnpp.usda.gov/USDAFoodPatterns

Rudi GJ Westendorp, What is healthy aging in the 21st century? AJCN, 2006, http://ajcn.nutrition.org/content/83/2/404S.full.pdf+html

What is Healthy Aging?

Living a long time . . .

Life span . . . "interactions between genes and the environment in which we live"

http://www.cnpp.usda.gov/USDAFoodPatterns

And living in good health . . .

When living conditions improve, "mortality decreases, evolutionary pressures for early survival and reproduction relax, and further resources can be invested in body maintenance and repair, which increases both average life expectancy and maximum life span"

Rudi GJ Westendorp, What is healthy aging in the 21st century? AJCN, 2006, http://ajcn.nutrition.org/content/83/2/404S.full.pdf+html

To be more specific, Healthy Aging involves reductions in . . .

- **Mortality**
- **Morbidity**
  - Chronic conditions
  - Mobility limitations
  - ADL limitations*
  - Sensory changes
  - Declining cognition

ADL, activities of daily living: eating, bathing, dressing, toileting, transferring (walking) and continence

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- **Mortality**
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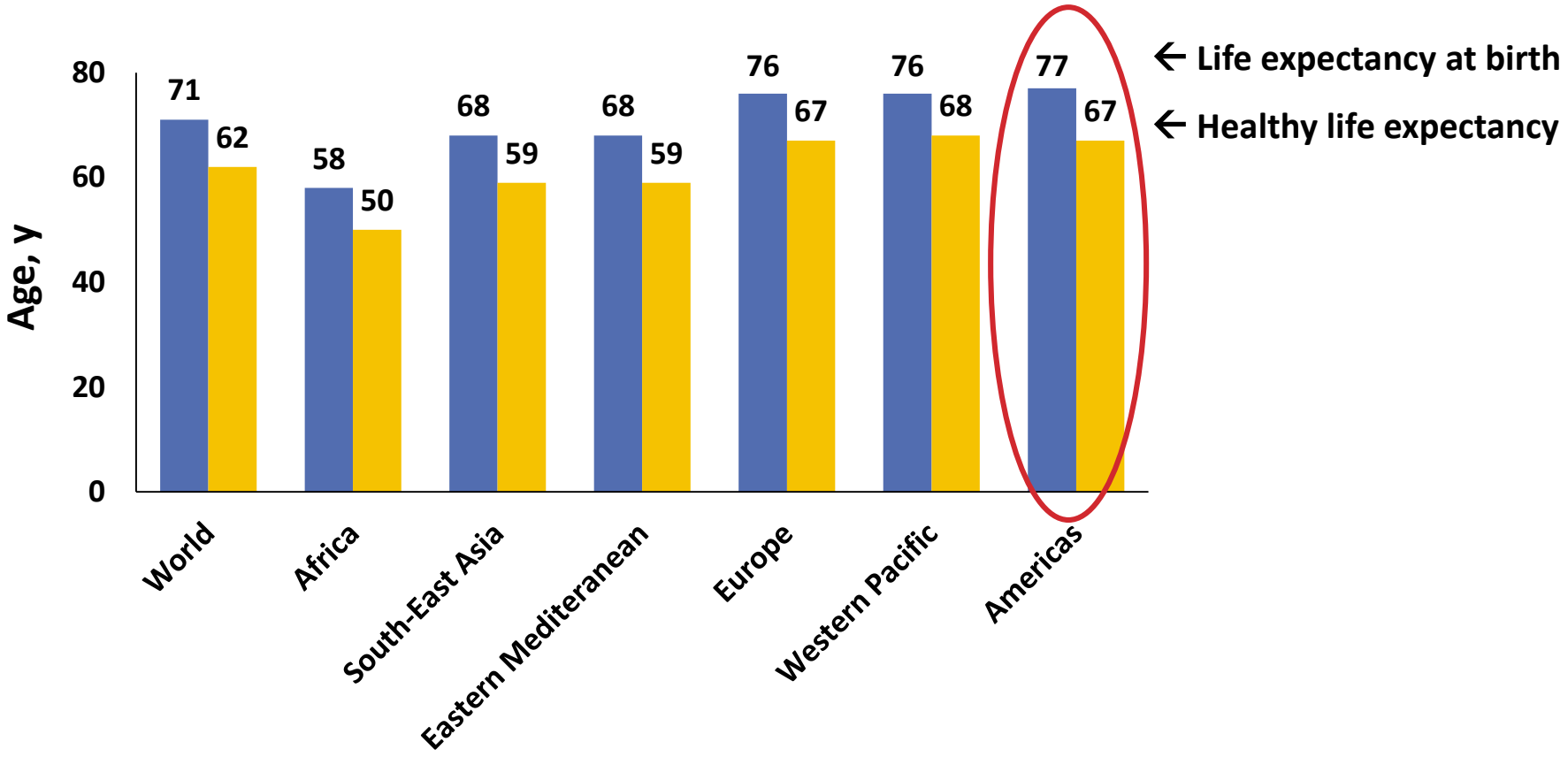
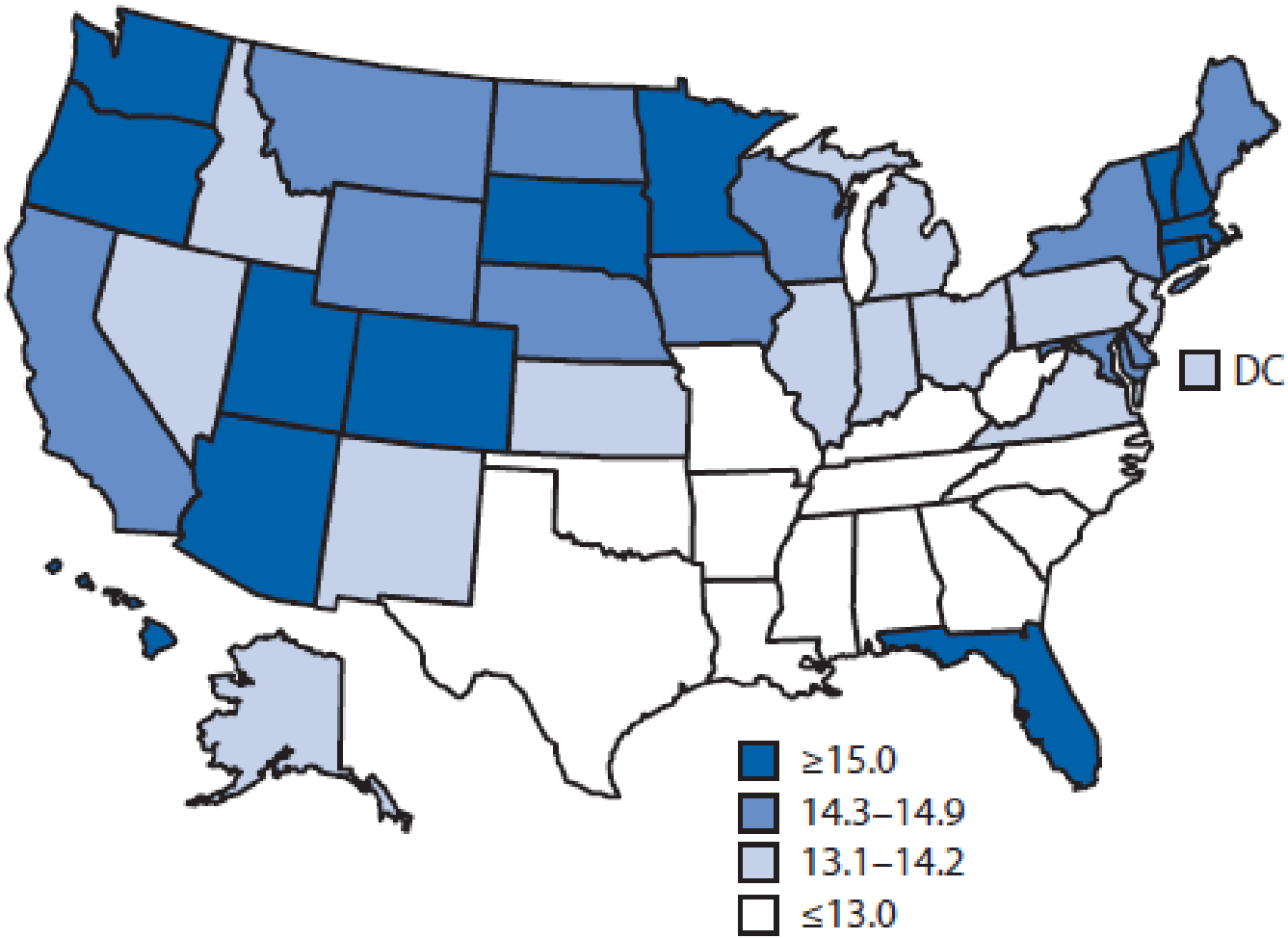
  - Chronic conditions
  - Mobility limitations
  - ADL limitations
  - Sensory changes
  - Declining cognition
- **Population metrics of Healthy Aging include improving (examples)**
  - Life expectancy
  - Healthy life expectancy

"Healthy Life Expectancy"
Subtracts years lived in less than full health due to disease and/or injury



World Population Ageing, United Nations, 2015, page 92, by WHO region in 2013, http://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2015_Report.pdf

Healthy life expectancy at age 65



Centers for Disease Control and Prevention (CDC). State-specific healthy life expectancy at age 65 years--United States, 2007-2009. MMWR Morb Mortal Wkly Rep. 2013 Jul 19;62(28):561-6. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6228a1.htm [8]

Biomarkers of Healthy Aging

- Disease onset, progression, severity
- Physiologic function
- Endocrine and immune function
- Inflammatory responses
- Genetics: telomeres, epigenetics

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Biomarkers of Healthy Aging

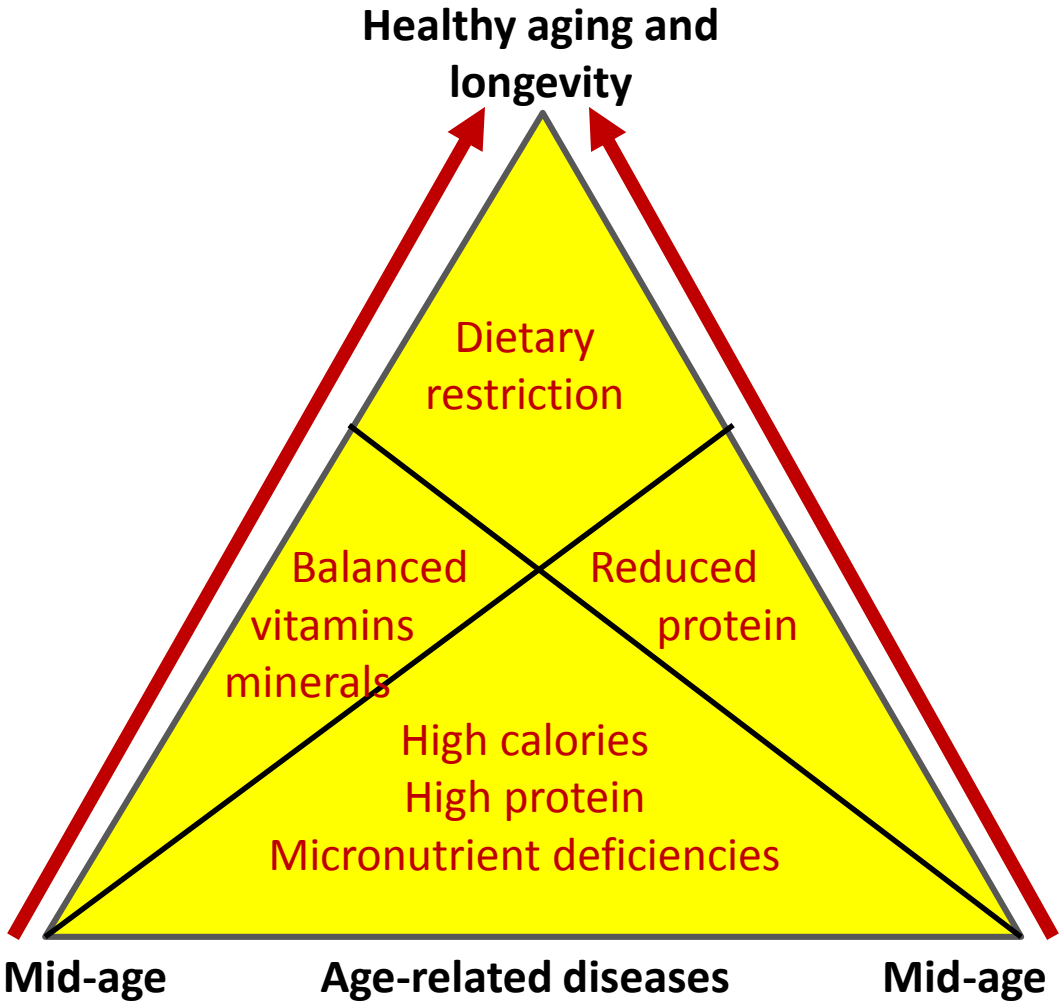
- Disease onset, progression, severity
- Physiologic function
- Endocrine and immune function
- Inflammatory responses
- Genetics: telomeres, epigenetics
- Physical and mental capability
- Health care, transitions of care
  - Maintain independence
  - Avoid nursing home admissions
  - Prevent hospital readmissions
- Examples of the search . . .

The search for biomarkers of Healthy Aging

- **Aging rate**
  - Cellular and animal studies (Dato et al., 2016)
- **Biologic age**
  - Biomarkers in MARK-AGE (Bürkle et al., 2015)
- **Longevity phenotype**
  - Healthy Aging Index (Sanders et al., 2014)
- **Mortality predictors**
  - Systematic reviews of cohort studies (Barron et al., 2015)
- **Function**
  - Geriatric perspective (Lara et al., 2015)

Aging rate

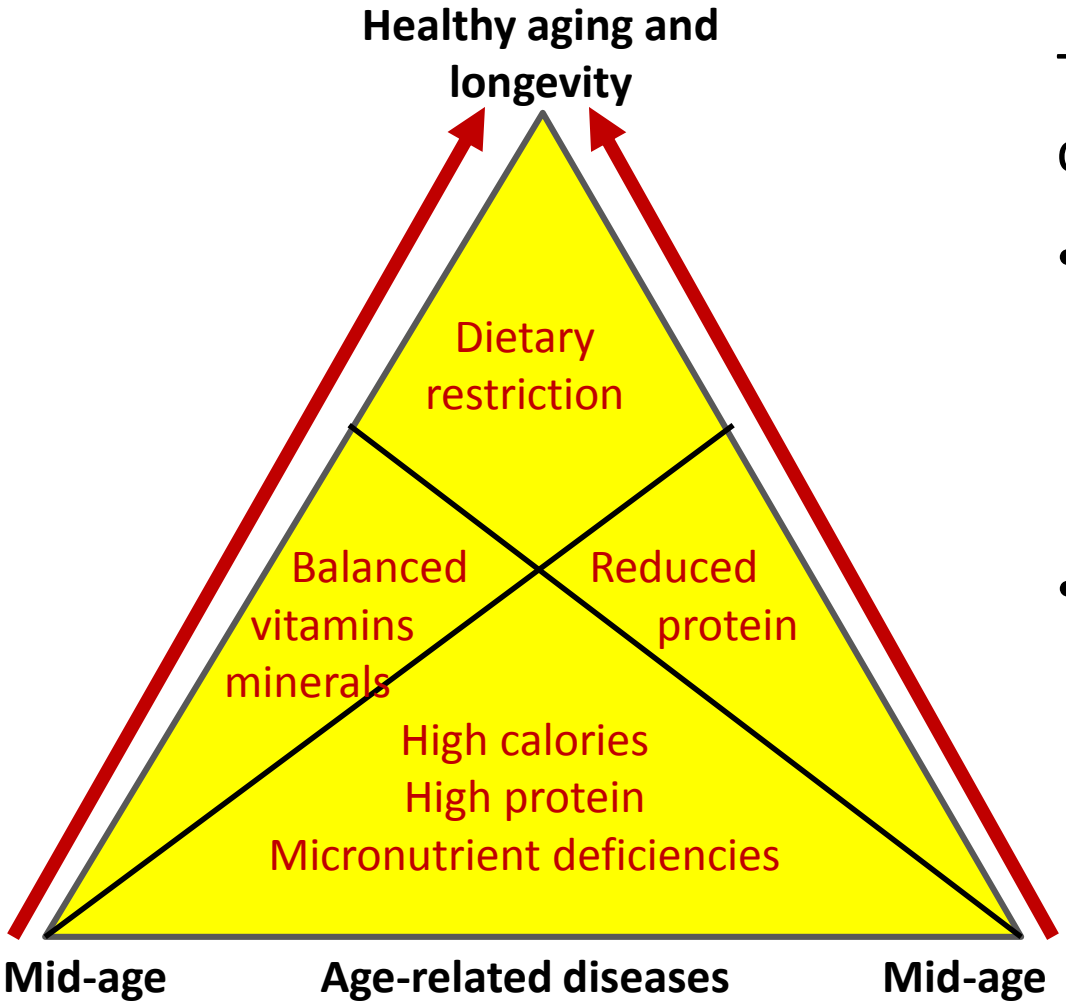
Cellular and animal studies



Adapted from: Dato et al., Mech Ageing Dev. 2016, http://www.sciencedirect.com/science/article/pii/S0047637416300082

Aging rate

Cellular and animal studies



Translate to humans with caution

- Human requirement for protein *may be* higher than current recommendations
- High prevalence of food insecurity in populations with highest chronic disease incidence, prevalence, severity

Adapted from: Dato et al., Mech Ageing Dev. 2016, http://www.sciencedirect.com/science/article/pii/S0047637416300082

Biologic age
Biomarkers in MARK-AGE

- N = 3200 participants in Europe:
  - a) 35-74 y, b) long-lived families, c) some longitudinal
- Work package (or work groups)
  1. Recruitment of probands and physiological markers
  2. DNA-based markers
  3. Markers based on proteins and their modifications
  4. Immunological markers
  5. Clinical chemistry, hormones and markers of metabolism
  6. Oxidative stress markers
  7. Emergent biomarkers for model systems
  8. Data analysis and bioinformatics
  9. Dissemination and training
  10. Project management and ethical issues

Bürkle et al., Mech Ageing Dev. 2015,
http://www.sciencedirect.com/science/article/pii/S0047637415000317

Longevity phenotype
Healthy Aging Index

- Identify subset of variables → **heritable** and predict **mortality**
- From the Cardiovascular Health Study, ongoing community-based study of CVD risk in 5,888 participants 65 and older
  - Systolic blood pressure
  - Pulmonary vital capacity
  - Creatinine
  - Fasting glucose
  - Modified Mini-Mental Status Examination
- "Worst" vs. "best" HAI score → mortality HR 2.62 (2.22, 3.10)*

Sanders et al., J Gerontol A Biol Sci Med Sci, 2014, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3968826 (*Adjusted)

Mortality predictors
Systematic reviews of cohort studies

- 23 studies met inclusion criteria (from initial 11,555)
- Blood biomarkers of mortality, baseline sample age 50-75 y
  - 51 potential biomarkers
  - 20 biomarkers identified, including 25-hydroxyvitamin D
  - Only a few under went meta-analyses; these were associated with all cause mortality, HR (95% CI)
    - **C-reactive protein**: 1.42 (1.25-1.62), p< 0.001
    - **White cell count**: 1.36 (1.13-1.64), p<0.001
    - **NT-proBNP, N-terminal pro brain natriuretic peptide**, 1.43 (1.18-1.74), p < 0.001

Barron et al., PLOS ONE, 2015,
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4454670

Function
Geriatric perspective

- John Mather's group in Newcastle
- Responded to request from Medical Research Council, and reviewed literature in several domains
  - Expert feedback and workshop (2012)
  - MRC Population Health Sciences overviews
    - Panel of biomarkers of healthy aging
    - 5 groups

Lara et al., BMC Medicine, 13: 222, 2015, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4572626

Geriatric perspective – functional biomarkers

- **Physiological function**
  - Cardiovascular: blood pressure, blood lipids
  - Lung function: forced expiratory volume (FEV1)
  - Glucose metabolism: fasting glucose, HbA1C
  - Body composition: waist circumference, BMI, bone mass or density, muscle mass
- **Endocrine function**
  - HPA-axis: DHEAS, DHEAS:cortisol ratio
  - Sex-hormones: testosterone, estrogen
  - Growth hormones: GH, IGF-1

Lara et al., BMC Medicine, 13: 222, 2015, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4572626

Geriatric perspective – functional biomarkers

- **Physical capacity**
  - Strength: grip strength
  - Balance: standing balance
  - Dexterity: pegboard test
  - Locomotion: gait speed, timed up and go, chair rising
- **Cognitive function**
  - Memory: Rey auditory verbal learning test, California verbal learning test, NIH Toolbox picture sequence memory test
  - Processing Speed: digit symbol coding
  - Executive function: verbal fluency
- **Immune function**
  - Inflammatory factors: IL-6, TNF-alpha

Lara et al., BMC Medicine, 13: 222, 2015, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4572626

Where does nutrition fit in?

- Biological pathways of aging
- Disease prevention and treatment, including obesity
- Meeting current dietary recommendations (DRIs, DGA) - HEI
- Food insecurity in older people*
  - 8.69% nationally and > 50% in vulnerable subgroups

*Lee, Fischer, Johnson, J Nutr Elderly, 2013, and USDA, 2008-2014, http://www.ers.usda.gov/data-products/food-security-in-the-united-states/interactive-chart-food-security-trends.aspx

Where does nutrition fit in?

- Biological pathways of aging
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- Meeting current dietary recommendations (DRIs, DGA) - HEI
- Food insecurity in older people*
  - 8.69% nationally and > 50% in vulnerable subgroups
- Nutrition interventions for biomarkers used in health care
  - Care transitions
  - Readmissions to hospitals, rehabilitation facilities
  - Affordable Care Organization Quality Care Measures
    - Depression, HbA1c, blood pressure, heart failure, CVD

*Lee, Fischer, Johnson, J Nutr Elderly, 2013, and USDA, 2008-2014, http://www.ers.usda.gov/data-products/food-security-in-the-united-states/interactive-chart-food-security-trends.aspx

Nutrition concerns in care transitions

Independent Living

Traditional community setting

Home and Community Based Services (HCBS)

Congregate meals

Home Delivered meals

"Meals on Wheels"

Home health care

Acute Care

Hospitals

Rehabilitation

Long Term Care

Nursing homes

AoA: 2.4 M older adults received 219 million meals in 2013, http://www.aoa.acl.gov/Program_Results/docs/2015/AoA-Research-Brief-8-2015.pdf

Obesity in older adults

Obesity (US)

~40% in 65-74 y

~28% in 75+ y

“Accelerate” Aging

Poor mobility

Diabetes

Other chronic diseases

More medications

Acute Care

Hospitals

Rehabilitation

Long Term Care

Nursing Homes

NHANES, Obesity is BMI > 30 kg/m^2, CDC 2012

Healthy Aging Perspectives – Summary

- **Biomarkers for food, nutrition, and healthy aging**
  - Biomarkers that reflect how nutrition influences age-related changes in function, e.g.,
    - CVD, renal, lung function
    - Cognition and other senses
    - Physical capability, musculoskeletal health, frailty
    - Endocrine and immune function
  - Identify nutrition interventions for “costly” biomarkers
    - Care transitions
    - Readmissions to hospitals, other health services
    - Affordable Care Organization Quality Care Measures*
      - Diabetes, CVD

https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/sharedsavingsprogram/Downloads/2016-ACO-NarrativeMeasures-Specs.pdf

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