Objectives:

- Identify key features of frailty as currently defined
- Define sarcopenia
- Understand changes in body composition associated with aging
- Describe how a multidisciplinary team might approach frailty in the older adult
- Understand what frailty is and why it is important to patient outcomes
- Learn how to identify frail patients in practice
- Be able to apply evidence based interventions to improve outcomes in frail patients.
Case Presentation

**Case 1:** An 82-year old man with a history of heart failure, knee osteoarthritis, and hypertension presented for elective knee replacement.

**Case 2:** An 82-year-old man with a history of heart failure, knee osteoarthritis, and hypertension presented for elective knee replacement.

**Case 3:** An 82-year-old man with a history of heart failure, knee osteoarthritis, and hypertension presented to the ED after being found by a neighbor on the floor.

- These three patients demonstrate different levels of susceptibility and clinical stability, which strongly affected clinical outcomes.

- There appears to be a spectrum of resilience, from highly independent and robust to the most frail and vulnerable.
Defining Frailty

Break into your small groups and answer the following questions:

- How would you define the term “frail”?
- What makes a person frail?
- Are there key components to frailty?

Frailty Definitions

- A variety of definitions have been used defining frailty as synonymous with:
  - Disability
  - Comorbidity
  - Advanced Old Age

- However, while there is some overlap, frailty appears to encompass more than disability or comorbidity.
Formal definitions

“a state of increased vulnerability to stressors due to age-related declines in physiologic reserves across neuromuscular, metabolic, and immune systems”

American Geriatric Society 2004

Formal Consensus

“a medical syndrome with multiple causes and contributors that is characterised by diminished strength, endurance, and reduced physiological function, that increases an individual’s vulnerability for developing increased dependency and/or death”

J Am Med Dir Assoc 2013
The frailty condition

- Related to the aging process
- Independently associated with adverse outcomes
- Common
- Progressive
- Episodic deteriorations
- Preventable components
- Impact quality of life
- Expensive


Frailty ≠ Age

Frailty lies outside the comfort zone of Guideline-Based Medicine
Frailty: What causes it?

- Dimensions: physical, social, cognitive, psychological, co-morbidities
- Physiologic correlates: weakness, fatigue
- Sarcopenia is likely a key component

Definitions of Components of Frailty

- Shrinking
  - > 10 pounds lost unintentionally in past year
- Self-reported exhaustion
  - Self-report of exhaustion on CES-D questions
- Weakness (grip strength)
  - Grip strength lowest 20% adjusted for gender & BMI
- Slow walking speed
  - Slowest 20% to walk 15 feet
- Low physical activity
  - Lowest quintile of weighted kilocalorie expended per week
Fried’s Model of Frailty

A frail individual

Highest order functions lost first
E.g.: Divided attention
Upright bipedal ambulation
Opposable thumbs
Social interactions

A complex system close to failure

The result of an illness / new tablet
E.g.: Delirium
Falls
Impaired function
Social withdrawal

Impacting quality of life
Another Way to Look At It:

- [https://www.youtube.com/v/Gq_bjaIoNTo&autoplay=1](https://www.youtube.com/v/Gq_bjaIoNTo&autoplay=1)

Pathophysiology of frailty

- Accelerated decrease in physiological reserve
- Failing homeostatic mechanisms

Vulnerability of frail elderly people to a sudden change in health status after a minor illness.

Sarcopenia

- Sarcopenia: age-related loss of muscle mass and strength.

- Changes in the muscle fiber itself, and an increase in infiltration of fat into the muscle (myosteatosis) also common with aging.

- Changes all lead to a decline in muscle function.

Sarcopenia and Myosteatosis

*Petrella et al. Eur J Appl Physiol 2007*

Top: Young Female, age 27
Bottom: Older Female, age 65
Height and weight matched

Top: Young Male, age 25
Bottom: Older Male, age 63
Height and weight matched

---

**Muscle Aging**

↓ Strength  
↓ Power  
↓ Muscular Endurance

↑ Difficulty with weight bearing tasks  
↑ Risk of falls and fracture  
↑ Fatigability

↓ Physical activity  
↑ Disability

↑ Difficulty with weight bearing tasks  
↑ Risk of falls and fracture  
↑ Fatigability

↓ Physical activity  
↑ Disability

---

**Sarcopenia and Myosteatosis**

*Petrella et al. Eur J Appl Physiol 2007*
Endocrine changes

DECREASES in:
- Estrogen and testosterone
- Dehydroepiandosterone, DHEA
- Growth hormone
- Insulin-like growth factor 1, IGF-1
- Cortisol (loss of diurnal variation)
- Vitamin-D

Women’s Health & Aging Study

Vitamin D
- Odds of frailty if:
  - deficient (< 15) = 2.5
  - insufficient (15-30) = 3.6
- All other studies examining Vit D find it is a risk factor
Women’s Health & Aging Study

- IGF-1, DHEAS, and free testosterone
- If one deficiency not more likely to be frail
- If 2 or 3 deficiencies likelihood of being frail increased almost 3 fold (OR=2.79)

Inflammation: Duke EPESE

- Both high IL-6 and D-dimer increase mortality;
- Those with both have highest mortality and greatest functional decline
What Might Cause Weakness and Fatigue?

**Inflammation** in frail people:
- IL-6 ↑
- CRP ↑
May cause
- Catabolism
- Anorexia, ↓ GH & IGF-1

Effects of Inflammation

↑ IL-6 strongly associated with:
- Weight loss,
- Sarcopenia
- Susceptibility to infection
Identifying Frailty

- Gait speed alone & with chair stands, & tandem balance test
- Predicts 12-mo rates of hospitalization, ↓ health, and ↓ function
- Proposed: “vital signs” to screen older adults

Canadian Study of Health & Aging

- Frailty is identified by counting accumulation of deficits in: cognition, mood, motivation, communication, mobility, balance, bowel & bladder function, ADL, IADL, nutrition, social resources, and comorbidities
- Highly predictive of death or institutionalization
The French Three-City Study

- The frail scored lower on MMSE and IST than the prefrail and nonfrail.
- Frail with cognitive impairment were more likely to develop disability in ADLs and IADLs over 4 yrs.
- Cognitive impairment improves prediction of frailty, because it ↑ risk of adverse outcomes.

Cardiovascular Health Study, 2001

- Frailty = a syndrome with a critical mass of signs and symptoms.
- Three out of five:
  - Slow walking speed
  - Poor hand grip
  - Exhaustion
  - Weight loss
  - Low energy expenditure
CHS FRAILTY Criteria

- CHS criteria are unrealistic for clinical use
- SOF tested simpler criteria in both men & women.
- **Exclusion** inability to walk without the assistance of another person
- CHS and SOF were concordant in 71%
- SOF is easily evaluated in a few minutes
## Comparison Of Frailty Indexes

<table>
<thead>
<tr>
<th>Frailty Criteria</th>
<th>SOF</th>
<th>CHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrinking</td>
<td>Wt loss ≥ 5% over 3 yrs</td>
<td>Unintentional wt loss 5% over 3 yrs</td>
</tr>
<tr>
<td>Weakness</td>
<td>Unable to do 5 chair stands</td>
<td>Grip strength in lowest quartile</td>
</tr>
<tr>
<td>Poor energy</td>
<td>“Do you feel full of energy” = no</td>
<td>“Do you feel full of energy” = no</td>
</tr>
<tr>
<td>Slowness</td>
<td></td>
<td>Walking speed in lowest quartile</td>
</tr>
<tr>
<td>Low physical activity</td>
<td></td>
<td>Physical Activity Scale for the Elderly</td>
</tr>
</tbody>
</table>

### Study of Osteoporotic Fracture (SOF) Criteria for Frailty

<table>
<thead>
<tr>
<th>Frailty Criteria</th>
<th>Data Collection</th>
<th>Score</th>
</tr>
</thead>
</table>
| Weight loss ≥ 5% over 3 yrs    | Weight 3 years ago  
Weight today  
Change in weight/Weight 3 years ago= % loss | Score=1 if weight loss ≥ 5%  
Otherwise, Score=0 |
| Inability to do 5 chair stands | Sit in chair, do not use arms, rise 5 times                                     | Score=1, if unable  
Otherwise, Score=0 |
| “Do you feel full of energy?”  | Ask the question, must answer yes or no                                        | Score=1, if yes  
Otherwise, Score=0 |

Sum above scores

If summed score is 2 or 3, patient is frail;  
If score is 1 patient is prefrail;  
If score=0 the patient is robust
Symptom relief
Set patient centered goals
Family & caregiver support

Exercise
Interventions
CGA, GEM, PACE,
ACE
Hospice, comfort
& dignity

INCREASINGLY
FRAIL

Clinical Frailty Scale®

1 Very Fit - People who are robust, active, energetic and motivated. Those people commonly exercise regularly. They are among the fittest for their age.

2 Well - People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally, e.g., seasonally.

3 Managing Well - People whose medical problems are well controlled, but are not regularly active beyond routine walking.

4 Vulnerable - While not dependent on others for daily help, often symptoms limit activities. A common complaint is being "slowed up", and/or being tired during the day.

5 Mildly Frail - These people often have more evident slowing, and need help in high order ADLs (finances, transportation, heavy housework, medications). Typically, mildly frail progressively impairs shopping and walking outside alone, meal preparation and housework.

6 Moderately Frail - People need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (sitting, standing) with dressing.

7 Severely Frail - Completely dependent for personal care, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~ 6 months).

8 Very Severely Frail - Completely dependent, approaching the end of life. Typically, they could not recover even from a minor illness.

9 Terminally Ill - Approaching the end of life. This category applies to people with a life expectancy <6 months, who are not otherwise evidently frail.

Scoring frailty in people with dementia

The degree of frailty corresponds to the degree of dementia. Common symptoms in mild dementia include forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal.

In moderate dementia, recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting.

In severe dementia, they cannot do personal care without help.
Interventions: Assessment

- Inpatient CGA improves functional outcomes
- Outpatient CGA improves mental health
- Neither affect survival
- No increase in cost

VA Population

Interventions: Assessment

- ≥ 70 yrs at risk for hospital admission
- CGA group less likely to:
  - Lose functional ability
  - Have restrictions in ADLs
  - Have depressive symptoms
  - Use HHC services
- Mortality & Medicare payments not differ. Intervention cost $1,350/person.
- CONCLUSION: Targeted outpatient CGA slows functional decline.
Complex Interventions: meta-analysis

- Randomized trials of 97,984 pts.
- **Interventions reduced risk of**: not living at home, NH & hospital admits & falls (not death); & physical function was better
- **In populations with increased death rates**, interventions were associated with reduced nursing-home admission.
- **Interpretation**: Complex interventions help elderly live safely & independently.

What Were the Interventions?

- Geriatric assessment of general elderly people
- Geriatric assessment of elderly people selected as frail
- Community-based care after hospital discharge
- Falls prevention programs
- Group education and counseling
Sarcopenia

- Total body protein = muscle + visceral
  - Declines with age, faster after 65 yrs
- Major contributor is disuse atrophy
Sarcopenia

Protein
- Inadequate protein & calories
- ↑ body fat masks sarcopenia
- Sarcopenia in NHANES
  - > 60 yrs
  - 10% women
  - 7% men

Aging of skeletal muscle
Interventions for Sarcopenia

Randomized, placebo-controlled trial
progressive resistance exercise training, multinutrient supplement, both, and neither in 100 frail NH residents over 10-wks

Nursing Home (NH) Residents

Outcomes for Resistance Training

NH Residents, Age ≈ 87 yrs
Resistance training:
- ↑ muscle strength >100%
- ↑ LE muscle size 3%
- ↑ gait velocity 12%
- ↑ mobility
- ↑ spontaneous activity
Sarcopenia and Hip Fracture Study:

- 5-yr prospective cohort study admitted to hospitals for hip fracture.
- 193 participants enrolled
- 71% were sarcopenic, 58% undernourished, and 55% vitamin D deficient.
- Poorer nutrition & walking endurance, greater pre-fracture disability and inactivity predicted ↑ length of hospital stay

Therapy for Functional Decline

- **Frail:**
  - Fails chair rise without using arms, or
  - Slow 6 meter walk (>10 seconds)
- **Intervention:** 6 mo home-based PT to improve function, balance, muscle strength, transfers and mobility vs control education program.
- **Outcome:** change in function score at 3, 7 & 12 months. Intervention significantly slowed functional decline
Exercise Reducing Disability

Systematic Review: What works?

- **Multicomponent**: endurance, flexibility, balance, strength
- **Duration**: 3, 9, 12 mos.
- **Intensity**: 2-3 supervised/week, with/without daily home program

Group-Based Exercises Reduce Fall Risk: and is maintained

- 98 women, 75-85 with low bone mass.
- Interventions: **6 mo** resistance or agility training, or general stretching
- Primary outcome = fall risk
- Fall risk at end of **12 mo**
  - 43.3% lower with resistance training
  - 40.1% lower in the agility-training
  - 37.4% lower in the general stretching group
Low-Moderate Vs High-Intensity Progressive Resistance Training in Frail Elders

- Measured dose–response to free weight resistance program in 22 NH elders
- Low-moderate (LI) & high (HI) of the knee extensor (KE) muscles

Results:
- KE strength & endurance, stair-climbing power, and chair-rising time improved in the HI and LI groups

Results (cont’d)
- 6-min walk distance improved in HI but not in the LI group
- Changes in strength were related to changes in functional outcomes
- Strong dose–response relationships between training intensity & strength gains, & between strength gains and functional improvements
Exercise Interventions

Summary:

- Muscle mass and strength ↓ with age, more so in frail
- Benefits frail people
- Improves mobility, ADL, gait, fewer falls, ↑BMD, improves well being

Pharmacotherapy: DHEA

- 280 healthy people 60-80 yrs.
- Double blind placebo controlled trial
- DHEA was restored to the range for adults 20-50 yrs.
- Measurement: handgrip strength, knee muscle strength, and thigh cross-sectional area after 12 mo.
- Results: no positive effect on muscle strength cross-sectional areas.
Pharmacotherapy: Ace-Inhibitors (AIs)

- AIs ↓ morbidity, mortality, #admissions & decline in function & exercise capacity in HF
- Population: WHI Study
- Findings: ↓ in knee extensor strength & walking speed in continuous AI users was less than in intermittent (p=0·015), & never users (p=0·001).
- **Interpretation:** ACE inhibitor Rx may halt or slow decline in muscle strength in elderly women with hypertension and without HF.

Prospective ACE Trial

- **Drug=perindopril**
- Double-blind randomized controlled trial
- Change in the 6-min walk distance over 20 wks
- 130 participants; 95 completed
- Health-related quality of life was maintained in the perindopril group.
- Improvement = to 6 mos of exercise training
Hormones NOT Recommended

- Testosterone ↑ muscle mass & strength in hypo and eugonadal men, especially with exercise
- But affects lipids, and ± prostate size.
- Hormones not recommended for frail unless clearly deficient

Vitamin D Deficiency

- Linked to weak muscles, falls & fracture
- Check levels and replace older adults & those with dark skin
- Use 700-1000 IU orally daily to achieve 25 OHD ≥30 ng/ml (75 nmol/L) to improve muscle performance & reduce risk of fall and to reduce fx
Summary

- Frailty = vulnerability which precedes disability
- **Predicts:** falls, fractures, hospitalization, mortality, institutionalization
- However, *many features may be reversible*
- SOF probably identifies many (most)
  - Wt loss ≥ 5% over 3 yrs
  - Unable to do 5 chair stands
  - “Do you feel full of energy” = no

Summary 2

Therapy may include:

- Complex Interventions
- Correcting inadequate protein & calories*
- **Aggressive Exercise** which improves mobility, ADL, gait, ↓ falls, ↑ BMD, improves well being
- Correcting Vitamin D Deficiency
New care model for older people & frailty


**TODAY**

- ‘The Frail Elderly’ (i.e. a label)
- Presentation late & in crisis (e.g. delirium, falls, immobility)
- Hospital-based: episodic, disruptive & disjointed

**TOMORROW**

- “An older person living with frailty” (i.e. a long-term condition)
- Timely identification for preventative, proactive care by supported self-management & personalised care planning
- Community-based: person-centred & co-ordinated (Health + Social + Voluntary + Mental Health)