

# **The Frailty Toolbox: What Measurement Tools are Available and How are They Utilized?**

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# Overview

- Theoretical notion of frailty
- Proliferation of frailty tools
- Most widely used tools
- Common uses of these tools
- Examples of tools used in specialties
- Summary & Recommendations

# Theories of Frailty

- Frailty as **vulnerability to stressors** (Buchner and Wagner 1992)
  - Reduced capacity to withstand stress
- Frailty as **loss of complexity** (Lipsitz 2002)
  - Complexity of homeostatic mechanisms (e.g. interconnectedness, feedback/feedforward)
- Frailty as **disuse**
  - decrease in energy flow through organism (“use it or lose it”) (Bortz 2002)
- Frailty as **homeostatic dysregulation** (Ferrucci 2005)

# Two Dominant Paradigms of Frailty


- “Contrasting viewpoints about frailty are spread along a continuum.
- At one end, frailty is viewed as **accelerated aging**.
- At the other, frailty is conceptualized as a syndrome with distinct pathophysiology.”

(Bergman, Ferrucci, et al. 2007)

# Two Dominant Paradigms of Frailty

- Frailty as **accumulation of deficits**:  
“the more things that are wrong, the more likely that person is frail”  
(Rockwood 2007)
- Frailty as a **biologic syndrome** of decreased reserve resulting from cumulative declines across multiple physiologic systems (Fried et al. 2001)

# Proliferation of Frailty Tools

- Frailty is the wild west of geriatrics
- ~75 assessment tools and rapidly 
- Due to a lack of biological understanding and lack of specificity (how is frailty distinct from aging or chronic diseases?)
- There is no agreement on how to best measure it (Manas 2012)

# Proliferation of Frailty Tools

- **Problem:** Impedes progress in biological discovery, clinical care and intervention development
- **Problem:** Often confusing to specialists interested in incorporating frailty

# Physical Frailty Phenotype (PFP)

(Fried et al 2001)

- Weight loss (more than 10lbs)
  - Weakness (grip strength)
  - Exhaustion (self-report)
  - Walking Speed (15 feet)
  - Physical Activity (Kcals/week)
- 
- Not Frail: 0
  - Intermediate: 1-2
  - Frail:  $\geq 3$



# Deficit Accumulation Index (DAI)

(Rockwood & Mitnitski 2001,2004,2006,2007a,b)

## Appendix 1: List of variables used by the Canadian Study of Health and Aging to construct the 70-item CSHA Frailty Index

- Changes in everyday activities
- Head and neck problems
- Poor muscle tone in neck
- Bradykinesia, facial
- Problems getting dressed
- Problems with bathing
- Problems carrying out personal grooming
- Urinary incontinence
- Toileting problems
- Bulk difficulties
- Rectal problems
- Gastrointestinal problems
- Problems cooking
- Sucking problems
- Problems going out alone
- Impaired mobility
- Musculoskeletal problems
- Bradykinesia of the limbs
- Poor muscle tone in limbs
- Poor limb coordination
- Poor coordination, trunk
- Poor standing posture
- Irregular gait pattern
- Falls
- Mood problems
- Feeling sad, blue, depressed
- History of depressed mood
- Tiredness all the time
- Depression (clinical impression)
- Sleep changes
- Restlessness
- Memory changes
- Short-term memory impairment
- Long-term memory impairment
- Changes in general mental functioning
- Onset of cognitive symptoms
- Clouding or delirium
- Paranoid features
- History relevant to cognitive impairment or loss
- Family history relevant to cognitive impairment or loss
- Impaired vibration
- Tremor at rest
- Postural tremor
- Intention tremor
- History of Parkinson's disease
- Family history of degenerative disease
- Seizures, partial complex
- Seizures, generalized
- Syncope or blackouts
- Headache
- Cerebrovascular problems
- History of stroke
- History of diabetes mellitus
- Arterial hypertension
- Peripheral pulses
- Cardiac problems
- Myocardial infarction
- Arrhythmia
- Congestive heart failure
- Lung problems
- Respiratory problems
- History of thyroid disease
- Thyroid problems
- Skin problems
- Malignant disease
- Breast problems
- Abdominal problems
- Presence of snout reflex
- Presence of the palmomental reflex
- Other medical history

# FRAIL Scale

(Abellan Van Kan et al 2008a; 2008b)

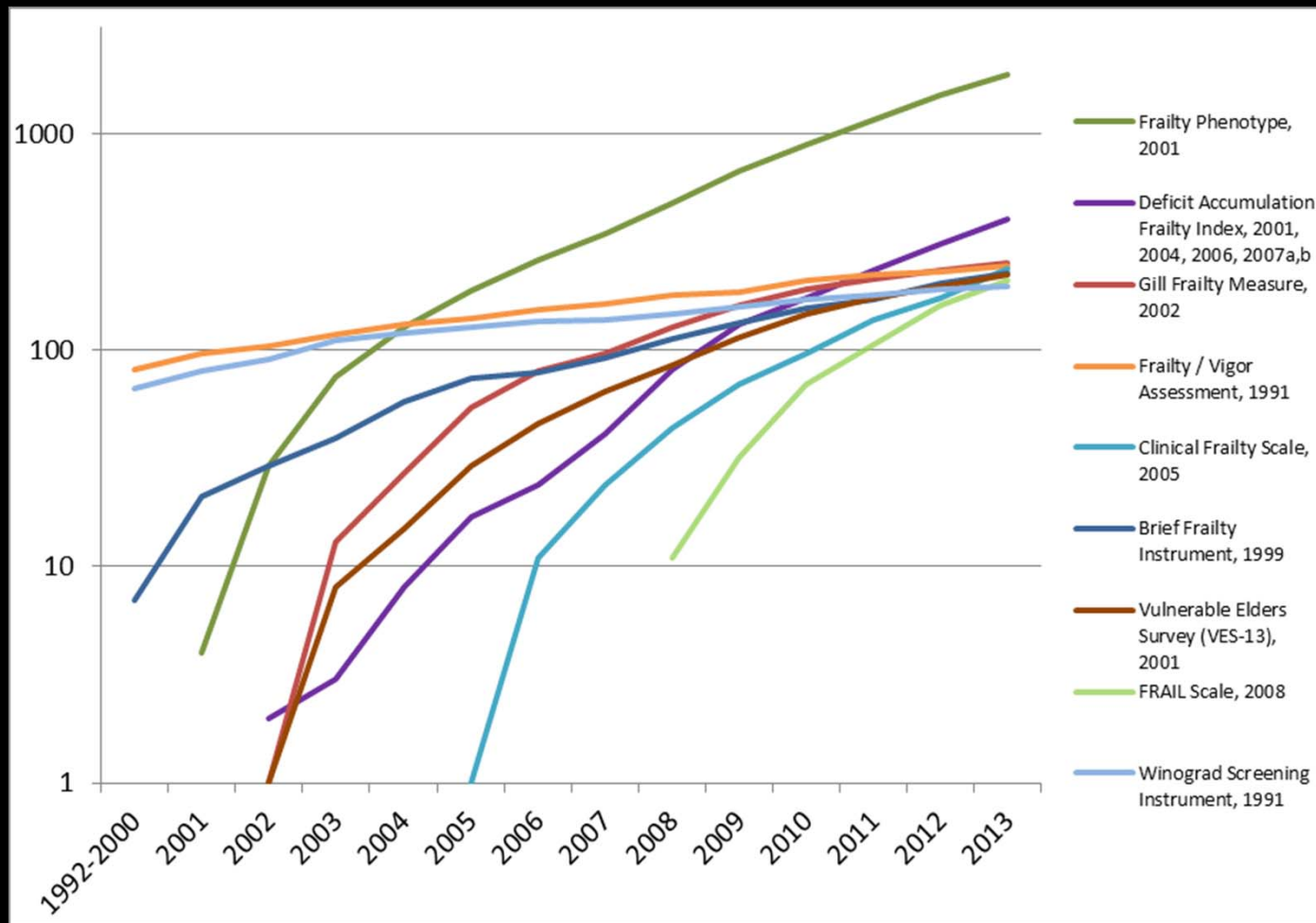
- Fatigue (are you fatigued?)
  - Resistance (can you climb a single flight of stairs?)
  - Ambulation (can you walk one block?)
  - Illnesses (more than five)
  - Loss of weight (more than 5%)
- 
- Not Frail: 0
  - Intermediate: 1-2
  - Frail:  $\geq 3$

# How Are Frailty Tools Being Used?

We conducted a study of the frailty literature to:

- characterize the different purposes for frailty assessment
- discern any patterns in the use of the assessment tools

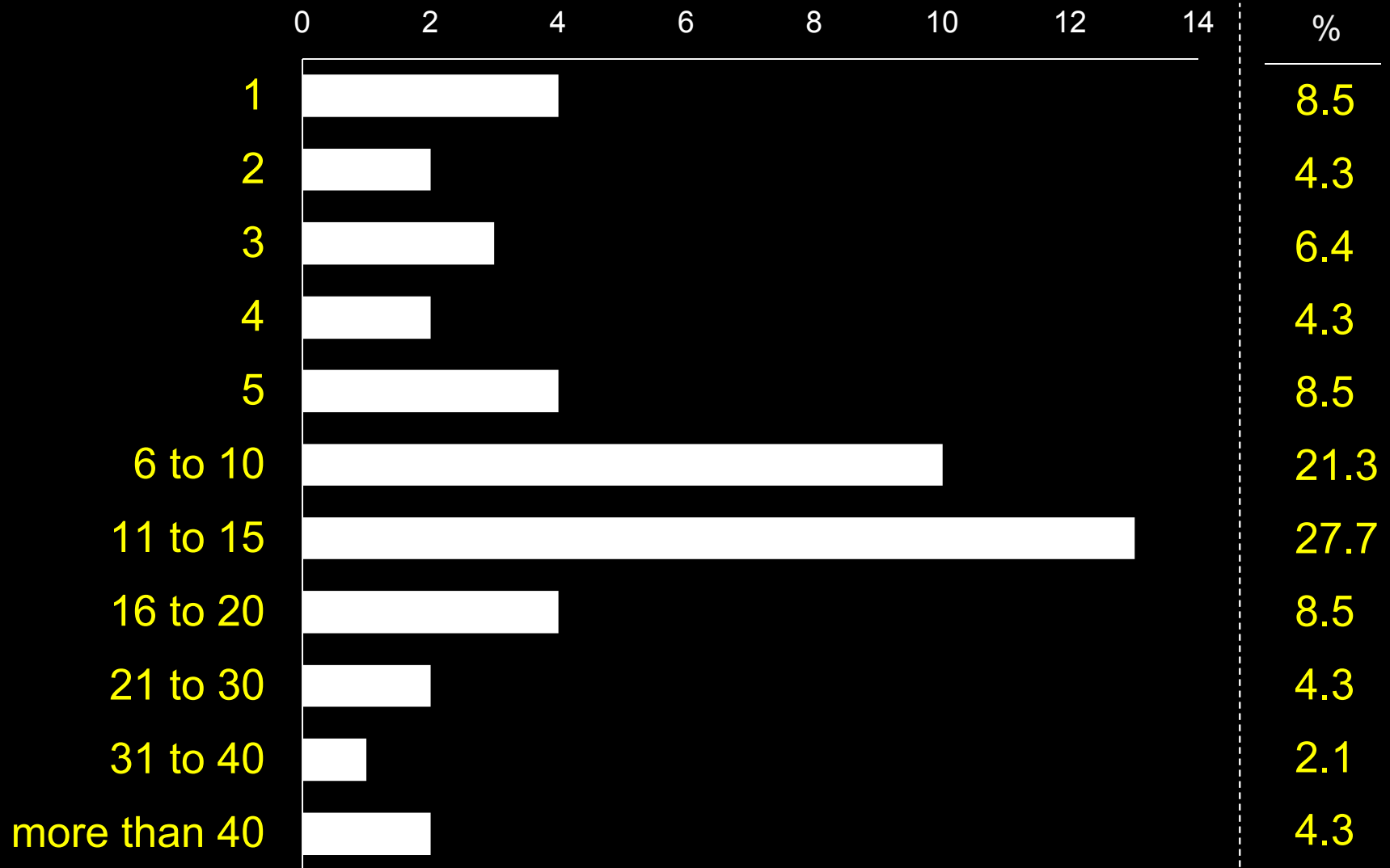
# Cumulative number of articles that cite nine highly-cited frailty tools



This figure displays the cumulative number of citations (on the Y-Axis) per year (on the X-Axis) for nine highly-cited frailty tools. The Y-axis is on a logarithmic scale.



# Items in the Frailty Instruments



# Different Tools for Different Uses?

- Are the frailty tools inter-changeable across contexts and purposes?
  - *Can an instrument that is appropriate for predicting the risk of falls be also used to study biological mechanisms underlying frailty?*
- Does it really matter?
- Are different tools needed for different purposes?

# Types of Uses of Highly Cited Frailty Tools (N=689)

## Risk Assessment (31%)

- Physical Frailty Phenotype (132 uses)
- Deficit Accumulation Index (37 uses)
- Gill Frailty Measure (12 uses)
- Clinical Frailty Scale & Vulnerable Elders Survey (11 uses each)
- Winograd Screening Instrument (10 uses)
- Brief Frailty Instrument (6 uses)

## Methodology (14%)

- Physical Frailty Phenotype (33 uses)
- Deficit Accumulation Index (32 uses)
- Brief Frailty Instrument & Vulnerable Elders Survey (11 uses each)
- FRAIL Scale (10 uses)

## Etiology of Frailty (22%)

- Physical Frailty Phenotype (121 uses)
- Deficit Accumulation Index (37 uses)

## Biomarkers (12%)

- Physical Frailty Phenotype (77 uses)
- Deficit Accumulation Index & FRAIL Scale (5 uses each)



# Types of Uses of Highly Cited Frailty Tools (N=689)

## Inclusion / Exclusion Criteria (10%)

- Physical Frailty Phenotype (22 uses)
- Vulnerable Elders Survey & Brief Frailty Instrument (11 uses each)
- Winograd Screening Instrument (10 uses)
- Deficit Accumulation Index, Frailty / Vigor Assessment, & Clinical Frailty Scale (5 uses each)

## Guide for clinical decision-making (2%)

- Physical Frailty Phenotype (11 uses)
- Vulnerable Elders Survey (5 uses)

## Estimating prevalence as primary goal (5%)

- Physical Frailty Phenotype (33 uses)
- Vulnerable Elders Survey (5 uses)

## Frailty as a target for intervention (2%)

- Physical Frailty Phenotype (11 uses)
- Clinical Frailty Scale (5 uses)

# Frailty Assessment in Clinical Specialties

How are frailty assessment tools used in clinical specialties?

# Frailty Assessment in Clinical Settings

Multiple frailty assessment tools have been used in clinical specialties including:

- **Oncology**
- **Cardiology**
- **Surgery / Transplant**
- **Trauma**

# **Oncology and Frailty Assessment**

- Frail and pre-frail cancer patients at greater risk for all-cause mortality; post operative mortality; chemotherapy intolerance; and postoperative complications (Handforth et al, Ann Oncol, 2014)
- Routine frailty and fitness assessments can help to guide cancer treatment (Handforth, 2014)

# Oncology and Frailty Assessment

- For older cancer patients, Comprehensive Geriatric Assessment (CGA) may be the best approach for determining risk and treatment plans (Hamaker 2012)
- However, CGA is time-consuming so clinicians have explored using frailty assessments to screen for patients who would most benefit from full CGA (Hamaker 2012)

# Oncology and Frailty Assessment

Frailty assessment tools in oncology:

- CGA or Physical Frailty Phenotype (PFP) are most common (Handforth, 2014)
- Other common screening tools include: VES-13 (Hamaker, 2012)
- Studies suggest that current frailty tools may lack discriminant power; recommend full CGA for older adults with cancer (Hamaker, Lancet Oncol, 2012; Smets, BMC Geriatrics, 2014)

# Oncology and Frailty Assessment

## Modified Frailty Index and Cancer Patients

(Uppal, Gynecol Oncol, 2015)

- Database study of 6,551 patients with diagnosis of gynecologic malignancy from the National Surgical Quality Improvement Program
- Frailty index calculated with 11 variables
- A higher Frailty Index score found to be predictive of increased likelihood of critical care support and 30-day mortality following surgery

**Table 1**

The 11 items of the modified frailty index (mFI).

COPD or recent pneumonia	Peripheral vascular disease or ischemic rest pain
Congestive heart failure	Impaired sensorium
Myocardial infarction	TIA or CVA
PCI, PCS, or angina	CVA with neurological deficit
Diabetes mellitus	Functional status 2
Hypertension requiring medication	

COPD, chronic obstructive pulmonary disease; PCI, percutaneous coronary intervention; PCS, prior cardiac surgery; CVA Cerebrovascular Accident; TIA Transient Ischemic Attack; Functional status measured in the 30 days prior to surgery.

# Cardiology and Frailty Assessment

- 2-fold increase in mortality for older CVD patients who are frail (Afilalo, JACC, 2014)
- Frailty has impact across stable CVD, subclinical CVD, heart failure, coronary syndromes, cardiac surgery and TAVR (Afilalo, 2014)
- Frailty prevalence among older adults with CVD: 10%-60%, depending on the frailty assessment tool (Afilalo, Am J Cardiol, 2009)



# Cardiology and Frailty Assessment

Frailty assessment tools in cardiology:

- Gait speed and PFP common in studies of CVD (Afilalo, 2014)
- Gait speed recommended among heart failure patients (Boxer, 2014)
- Clinical Frailty Scale highlighted for cardiac intervention (due to its graded scale from very fit to severely frail) (Rowe, 2014)

# Cardiology and Frailty Assessment

## Frailty and TAVI vs SAVR

(Godino et al, JACC Cardiovasc Interv., 2010)

- Instead of high risk Surgical Aortic Valve Replacement (SAVR), Transcatheter Aortic Valve Implantation (TAVI) is an alternative option for patients with symptomatic severe aortic stenosis
- Frailty phenotype one of three criteria to help determine whether patients should undergo TAVI instead of SAVR

Frailty Phenotype Assessment
Weakness: <ul style="list-style-type: none"><li>• Grip Strength</li></ul>
Slowness: <ul style="list-style-type: none"><li>• Walking Speed</li></ul>
Weight Loss
Low activity / energy expenditure
Exhaustion

# Cardiology and Frailty Assessment

## Frailty and coronary artery bypass and/or valve surgery (Afilalo et al, CCQO, 2012)

- 152 patients cardiac surgery patients; mean 75.9 years, 34% women
- Frailty measured as **5-meter gait speed  $\geq 6$  seconds** associated with increased mortality and major morbidity

5-meter gait speed test	<i>In an unobstructed area, position the patient with his/her feet behind and just touching the 0-meter start line</i>
	<i>Instruct to "Walk at your comfortable pace" until a few steps past the 5-meter mark (should not start to slow down before)</i>
	<i>Begin each trial on the word "Go"</i>
	<i>Start the timer with the <u>first footfall</u> after the 0-meter line</i>
	<i>Stop the timer with the <u>first footfall</u> after the 5-meter line</i>
	<i>Repeat 3 times and record average, allowing sufficient time for recuperation between trials</i>
<b>Frailty is defined as an average time taken to walk the 5-meter course <math>\geq 6</math> seconds</b>	

- Recommends integrative approach **combining frailty, disability and risk scores** for identifying older cardiac patients at increased risk of death and morbidity

# **Surgery and Frailty Assessment**

- Among older surgical patients, frailty is an independent risk factor for “major morbidity, mortality, protracted length of stay and institutional discharge”
- Choice of a frailty tool pre-surgery should consider its utility for “risk stratification and identification of factor for potential modification” (Partridge et al, Age Ageing, 2012)

# Surgery and Frailty Assessment

Frailty assessment tools in surgery:

- PFP; gait speed; Frailty Index and modified FI; Edmonton Frail Scale; others used preoperatively and at follow-up (Beggs et al, Can J Anesth, 2015)
- EFS highlighted for ease of use and ability to inform “preoperative optimization” (Partridge, 2012)
- Quick and easy mobility testing for post-operative assessment (Kim, Clin Interventions Aging, 2015)

# Surgery and Frailty Assessment

## Edmonton Frail Scale (EFS) and Frailty Phenotype (PFP) among surgery patients

- Among 125 older surgical patients, pre-surgical EFS frailty score associated with postoperative complications (Dasgupta et al, Arch Geron Geriatr, 2009)
- In another study, PFP score associated with postoperative complications, length of stay and unfavorable discharge (Makary, J AM Coll Surg, 2010)



### Frailty Phenotype Assessment

Frailty Score

Frailty Score: --Frail

Break Down of Frailty Score

Weight Loss: Frail

Weakness: Frail

Slowness: Not Frail

Exhaustion: Frail

Low Activity: Not Frail

# Transplantation and Frailty Assessment

## Frailty Phenotype and Kidney Transplantation

- Frail KT recipients much more likely to experience early hospital readmission (45.8% vs. 28.0), regardless of age (McAdams-Demarco et al, Am J Transplant, 2013)
- Frailty was independently associated with a 2.17-fold higher risk of death (McAdams-Demarco et al, Am J Transplant, 2015)
- Less than 10 minutes to measure frailty (McAdams-Demarco, 2015)

### Frailty Phenotype Assessment

Frailty Score  
Frailty Score: --Frail

#### Break Down of Frailty Score

Weight Loss: Frail  
Weakness: Frail  
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Exhaustion: Frail  
Low Activity: Not Frail

# Transplantation and Frailty Assessment

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### Frailty Phenotype Assessment

Frailty Score  
Frailty Score: --Frail

#### Break Down of Frailty Score

Weight Loss: Frail  
Weakness: Frail  
Slowness: Not Frail  
Exhaustion: Frail  
Low Activity: Not Frail



# Trauma Center and Frailty Assessment

## Trauma Specific Frailty Index (Joseph et al, JAMA Surg, 2014)

- Validated among 200 geriatric trauma patients
- Can be completed by patients or family members, if patient is unresponsive
- TSFI score  $>0.27$  found to be an independent predictor of unfavorable outcomes after trauma

### 15-Variable Trauma-Specific Frailty Index

#### Comorbidities:

- Cancer history
- Coronary heart disease
- Dementia

#### Daily activities:

- Help with grooming
- Help managing money
- Help doing household work
- Help toileting
- Help walking

#### Health attitude:

- Feel less useful
- Feel sad
- Feel effort to do everything
- Falls
- Feel lonely

Function, sexually active

Nutrition, albumin

## Summary

- Frailty tools are beginning to be used in oncology, cardiology, surgery, organ transplantation, and trauma
- Oncology: CGA and PFP
- Cardiology: PFP and gait speed
- Surgery: PFP, gait speed, FI, EFS
- Organ Transplant: PFP

## Tool/Measurement Issues

- Are the various frailty assessment tools inter-changeable?
- Are they all capturing the same underlying condition?
- E.g. Gait speed vs PFP vs FI

## Tool/Measurement Issues

- How does one go about choosing a frailty tool for their study?
- What is the impact of choosing one tool versus another?

## Issues Under Debate

- Trade-off between feasibility and validity
- Should we standardize frailty assessment for clinical care?
- Or, should frailty tools be tailored to each application?

# Should Cognitive Assessment be Included in Frailty Tools?

- Cognitive measures may improve ability to identify most vulnerable people
- However, may not facilitate identification of biological underpinnings, or
- May not be useful in intervention development targeting frailty per se.

## Suggestions

- Independent validation studies in different specialties may be warranted
  - Frailty as a distinct medical syndrome vs accumulation of deficits
- Such studies should assess feasibility (e.g., personnel requirement, time, interruption of workflow) and predictive ability

## Suggestions

- Single-item measures such as gait speed or grip strength should not be used to represent frailty
- Disability-related assessments should not be included in frailty tools (Manas 2014)
- Identification of clinical & laboratory biomarkers for diagnosis of frailty

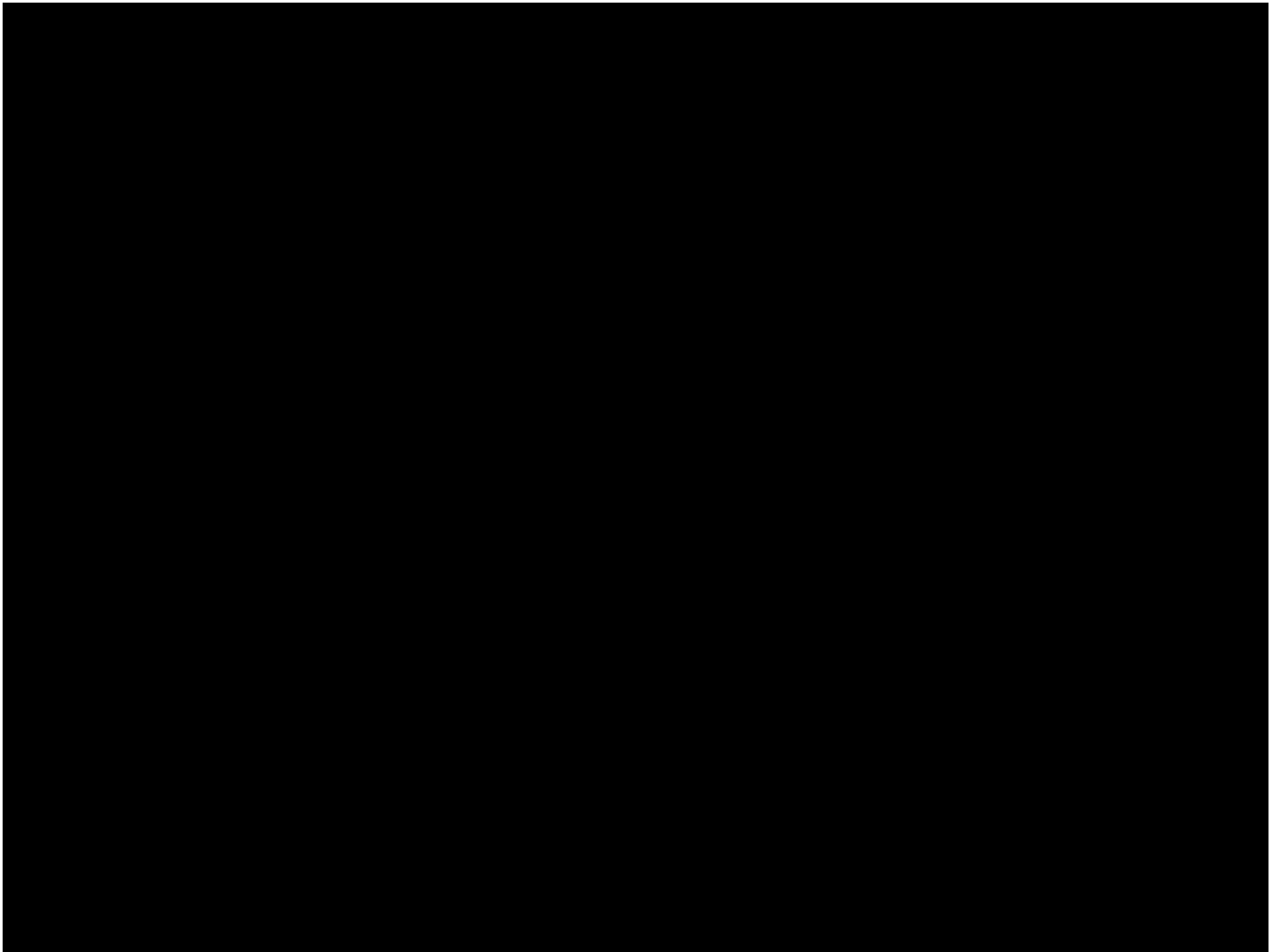


## Concluding Remarks

- Frailty as a field is vigorous!
- Infusion of energy from specialists is much welcomed!
- However, much fundamental work remains to be done:
  - theory, measurement, pathophysiology, and interventions

**THANK YOU**

**We welcome feedback!**  
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# Overall Project Aims

- **Aim 1:** To understand the **current use of** the frailty tools in the research literature (*presented here*)
- **Aim 2:** To determine the **appropriate use** of the frailty tools for different contexts and purposes (*in progress*)

## Aim 2

- To develop recommendations on the **appropriate uses** of each instrument under different contexts
  - I want to do X, under context C, which instrument should I use?

## Criteria for Aim 2

- **Current use** patterns that match the given purpose
- **Feasibility** in a given context based on ease of availability/assessment of items
- Validity, including correspondence b/w the purpose and the **underlying construct**

# Methods

- PubMed search for frailty tools to identify 28 tools
- Identified additional tools through previous reviews and in the course of this citation review
- **67 unique frailty tools total**
- Seed article(s) for each instrument determined by review of instrument development

1. Bouillon *BMC Geriatr* 2013
2. de Vries *Ageing Res Rev* 2011
3. Sternberg *JAGS* 2011

# Methods

- Each instrument was summarized and classified by:
  - Motivation
  - Domains (physical function, cognition, medical)
  - Items (self-report, performance, lab)
  - Scoring



# Methods

- For each instrument's seed article(s), we performed a citation search in the Web of Science database to determine the # of citations per seed article
- Identified tools that were cited  $\geq 100$  times
- A random sample (10%) of citing articles for the popular tools

# Methods

- 9 highly-cited tools, including:
  - **Physical Frailty Phenotype (Fried)**
  - **Deficit Accumulation Frailty Index (Rockwood & Mitnitski)**
  - **FRAIL Scale (Abellan Van Kan)**
  - **VES-13 (Saliba)**
- Developed a stepwise approach to catalog each citing article and to learn if and how the frailty instrument was applied

# Cardiology and Frailty Assessment

Frailty assessment tools in cardiology (cont):

- While instrument choice varies, a recent study of cardiac patients concluded that a quick, foot-of-the-bed clinical judgment, was not a reliable way to determine frailty status (compared to the Edmonton Frail Scale) (Hii, Heart, Lung, Circ, 2014)

# Is Frailty Different from Comorbidity and Disability?

Yes

“These three terms, frailty, comorbidity, and disability, are often used interchangeably to identify the physically vulnerable subset of older adults requiring enhanced care. However, recent research supports geriatricians’ perceptions that these are distinct clinical entities, although interrelated, and that clinical management of each of these has its own unique content and challenges.” (Fried JGMS 2004)

# Comorbidity, Disability and Frailty (Fried JGMS2004)

