

Chapter 1

Understanding frailty and sarcopenia

Content

- What is healthy ageing?
- What is frailty?
- How to identify frailty?
- What is sarcopenia?
- How to diagnose sarcopenia?
- Interventions for frailty and sarcopenia

What is Healthy Ageing?

- Process of developing and maintaining functional ability that enables well being of older age (WHO, 2020)

- The HIGHLIGHT ---- Focus on Functioning

ie. Interactions between individual (intrinsic capacity) and the environment (including physical environment and supporting systems)

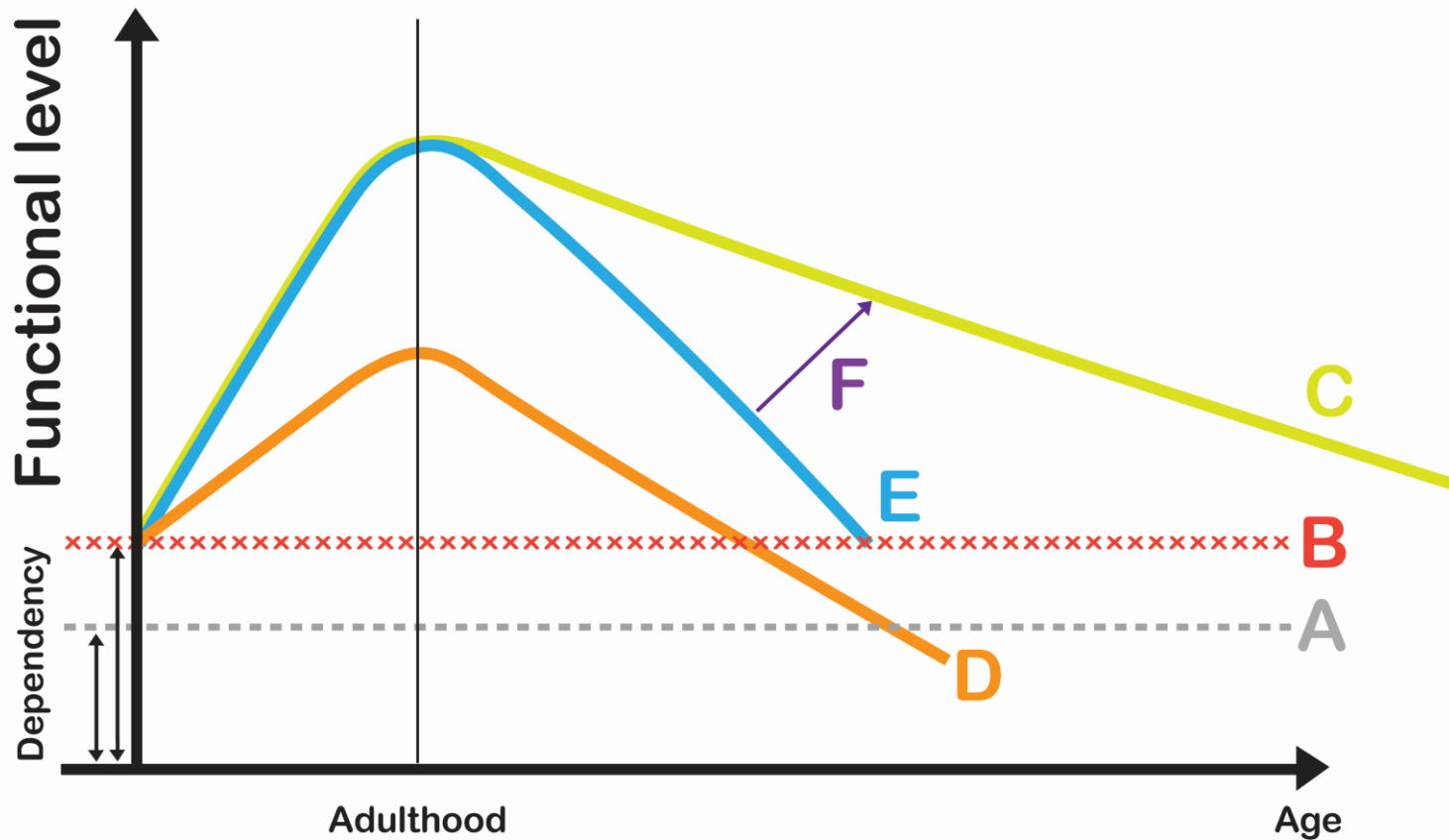


Image source from : <https://www.futuregen.solutions/2016/08/16/the-shameful-case-of-elder-abuse-in-society/> & <https://thediomat.com/2019/11/how-does-japans-aging-society-affect-its-economy/>

**“Environment” depends societal factors and
is beyond scope of current module**

Let’s focus on intrinsic capacity

Intrinsic capacity and function



A-B: denotes impact of environmental factors

C-D: higher baseline level allows more reserve to lose before requiring assistance

E: Accelerated decline because unfavourable lifestyle or disease state

F: restoration / reversal attempts

Healthy Ageing:

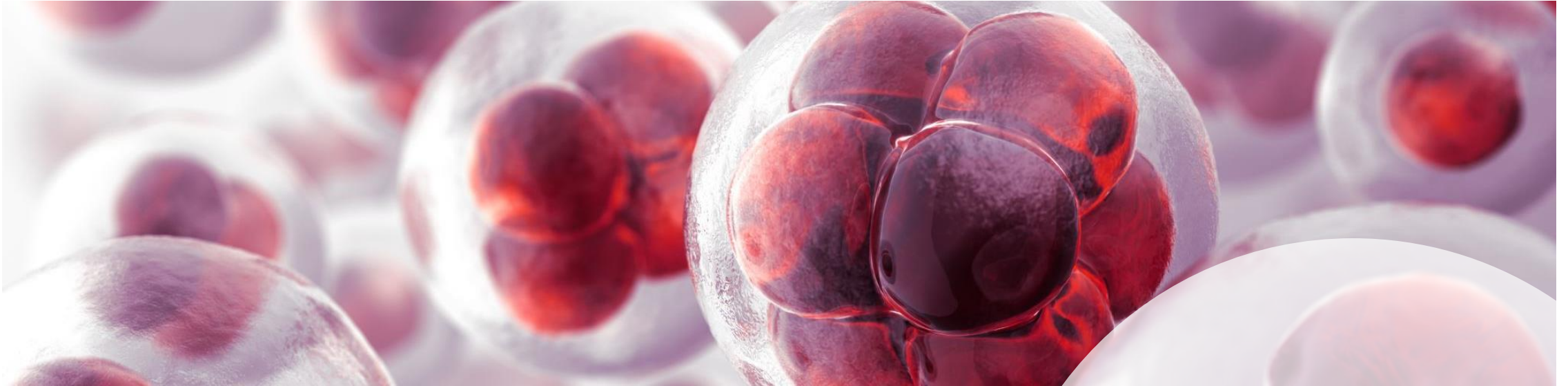
Building up intrinsic capacity / slow down decline

Modifiable factors

- Healthy dieting and good nutrition (cross ref to Chapter 2)
- Regular exercise / physical activities (cross ref to Chapter 3)
- Maintain mental health
- Disease prevention / good disease control
- Active life engagement with others and society

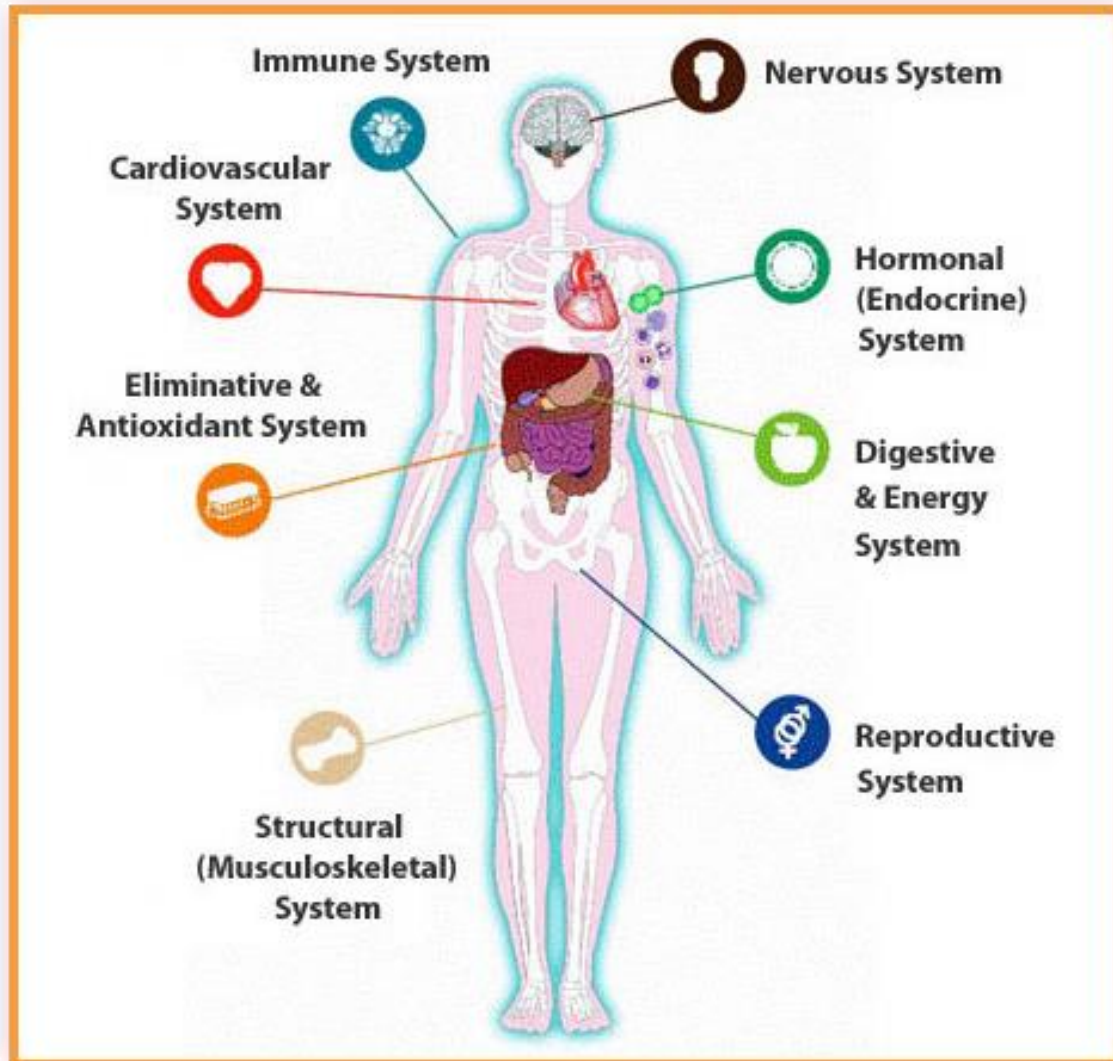
Non-modifiable factors

- Genetic composition
- Sex
- Chronological age



From Healthy Ageing to Frailty

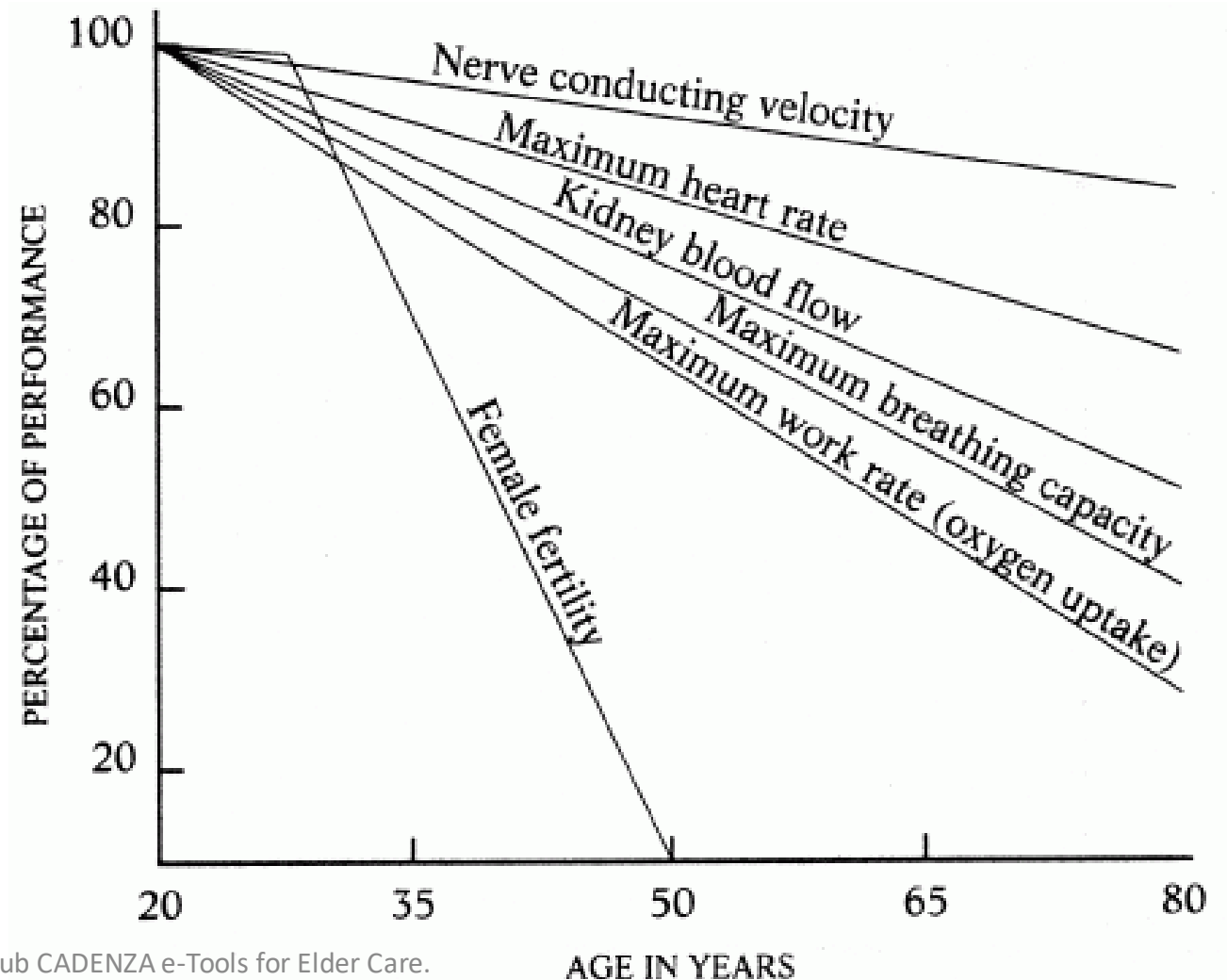
Convention scientific approach



- Individual system
- Individual disease
- One man, one disease model
- Linear model (A → B)
- Individual disease management

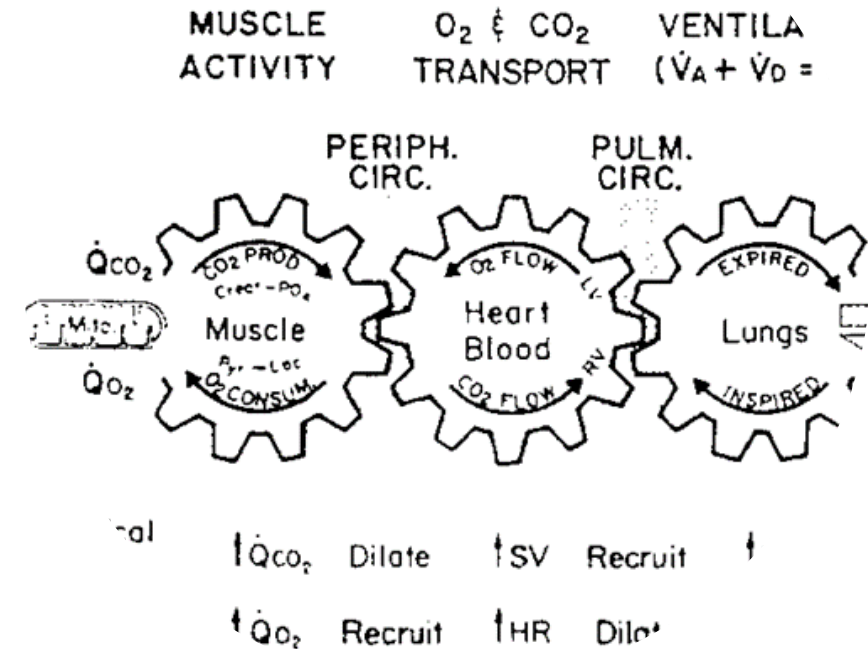
Limitations on use of conventional approach to older adults (1)

- No tissue /system is free from ageing (though varies between individual, and among organs of same individual)
- With age, increase in **multi-system** (instead of single disease / system) involvement leading to → function limitation



Limitations on use of conventional approach to older adults (2)

- Proper functioning (*remember: WHO defines health in term of functioning*) depends on multiple systems interacting together
- A person may have reduced exercise capacity because of heart problem, lung problem, joint problem, muscle problem, mood problem, or any combinations of each of the problems in variable degree
- Conventional single disease model has great limitation in older adults



Knowledge from animal studies

- Caloric Restriction in mice
 - Extended life span by 50%
 - Die without apparent diseases
- Measurement on number of dysfunctions (irrespective of which) predictive of death

Observations in human being

- Physique and bodily function among individuals vary with age
- Many a time, multiple components of which each alone with little impact, contribute to the impairment
- More commonly observe in older adults, yet not exclusive (I.e. above can be observed in younger population)

→ (development of) **FRAILTY SYNDROME**

Frailty Syndrome

A clinical state of increased vulnerability,

resulting from ageing associated decline in reserve (*intrinsic capacity*) and function

across multiple physiological systems such that

the ability to cope with everyday or acute stressors is compromised

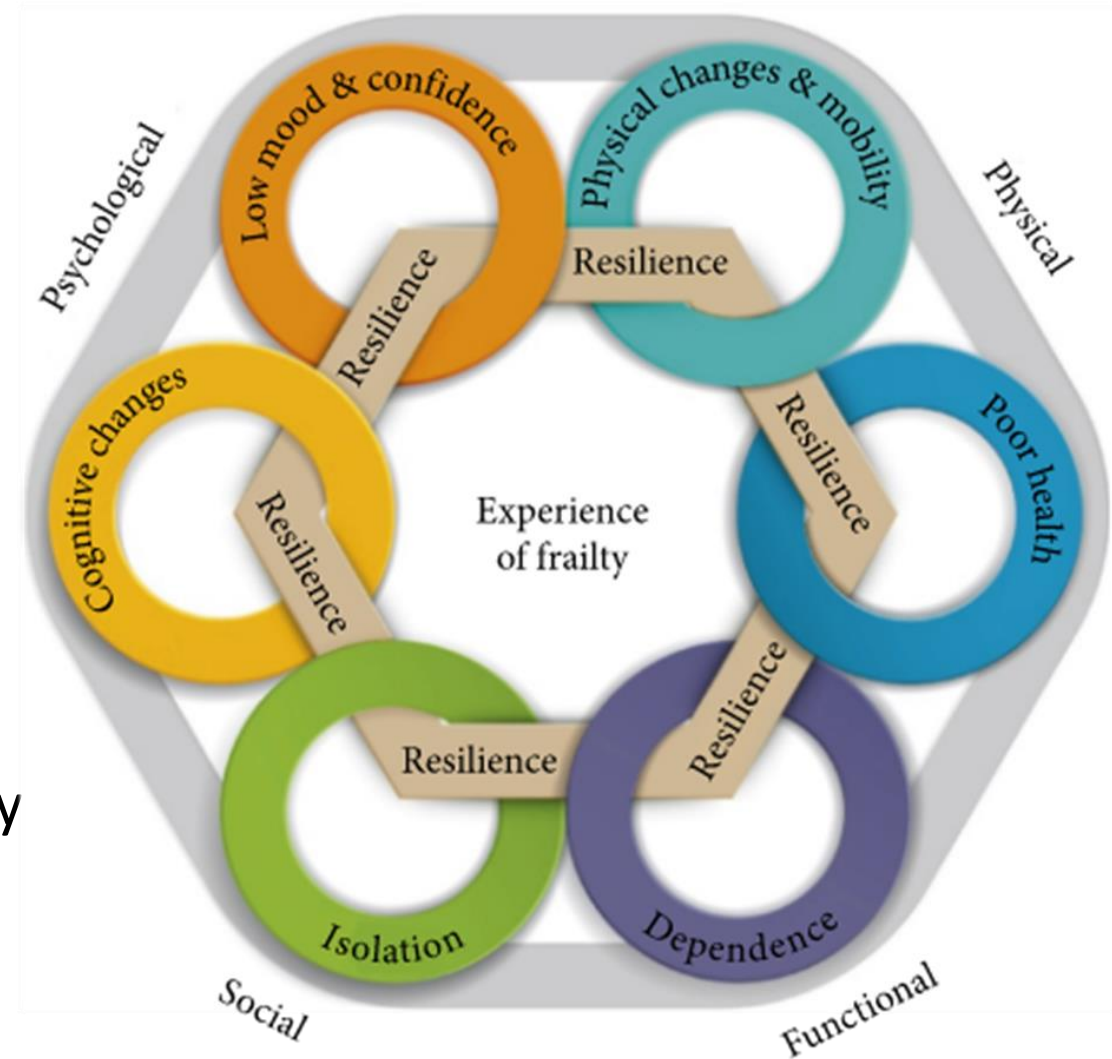
(Xue, 2011)

Frailty represented by two ways

- Phenotypic frailty (Fried et al., 2001)
 - Unintentional weight loss
 - Self reported exhaustion
 - Weakness (Grip strength)
 - Slow walking speed
 - Low physical activity
- Culminative deficits (Rockwood & Mitnitski, 2007)
 - Deficit accumulation of multiple etiologies
 - Reduced reserved (intrinsic capacity)
 - Increased vulnerability to stress

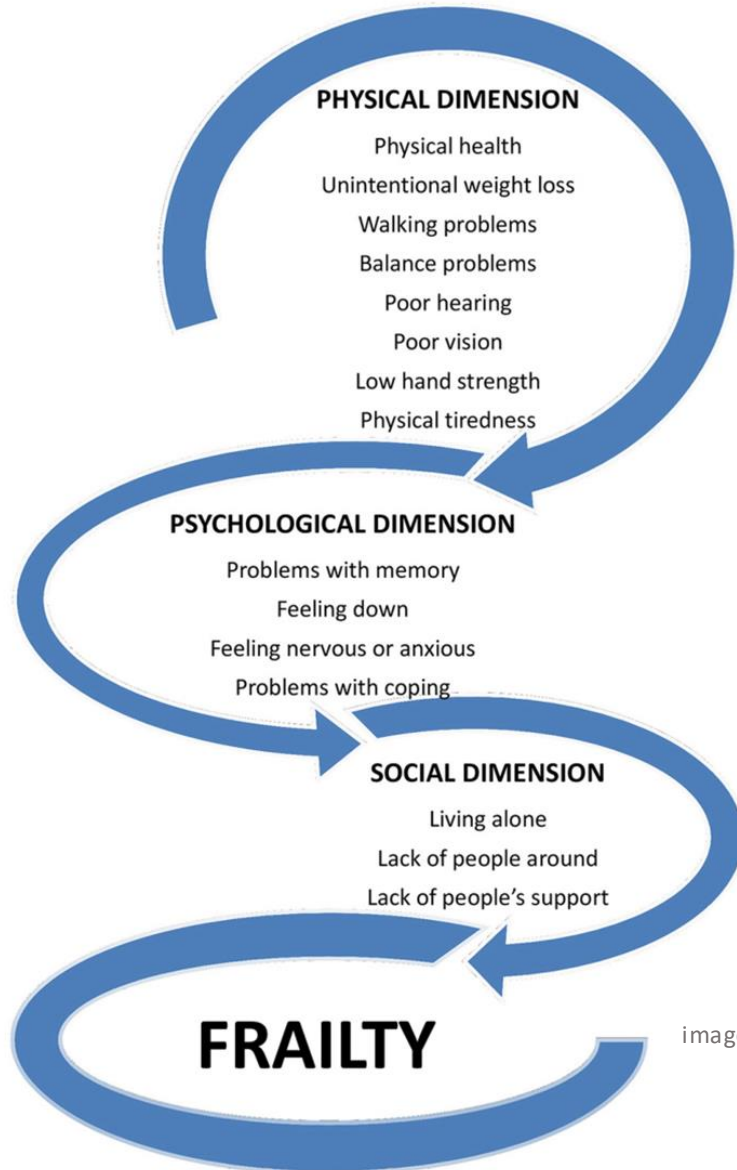
Ageing and Frailty

- Multi- dimensional aspect of health
- Gradual decline over time
- High intrinsic capacity / resilience
 - ➔ protect from frailty
 - ➔ healthy aging
- Any breakdown
 - ➔ accelerated decline and dependency



Key concepts in Frailty

(multiple physiological systems)

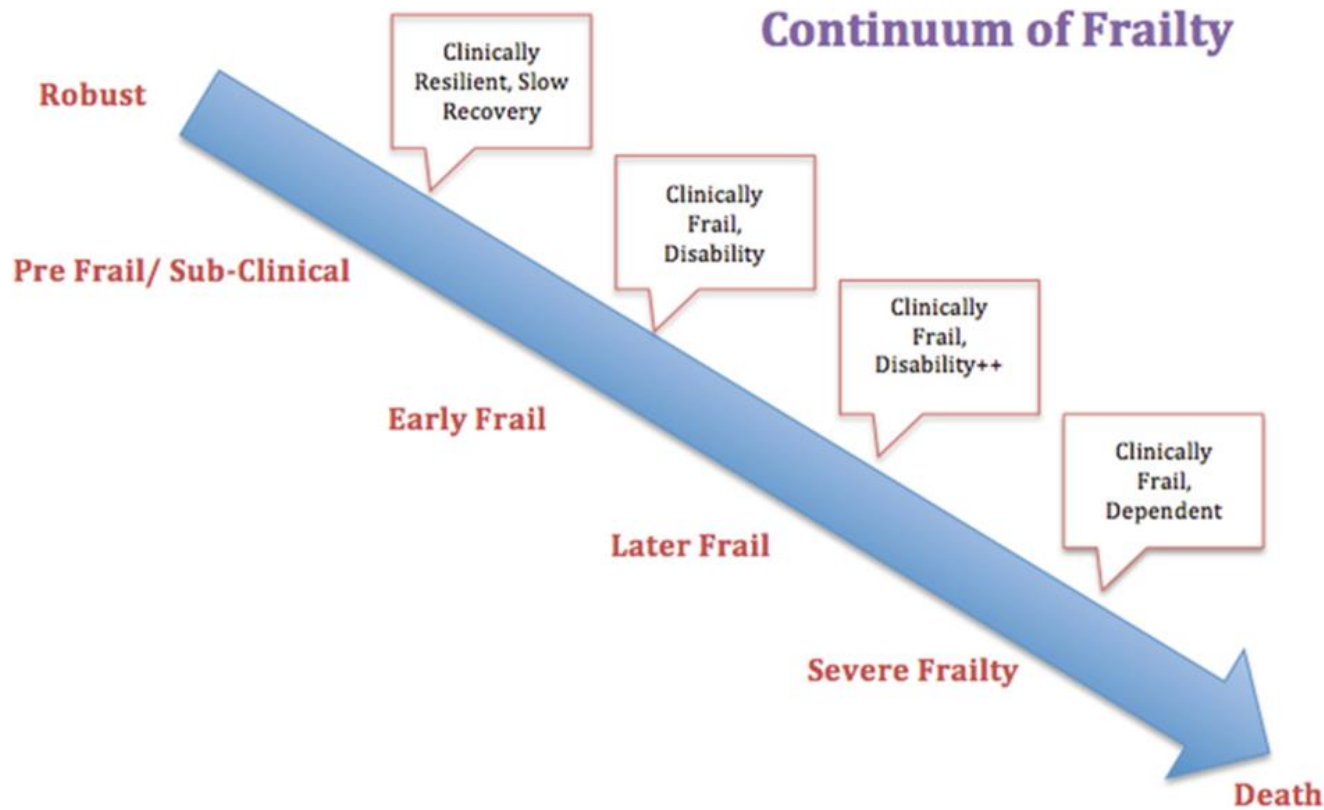


- Though it may manifest as a physical dimension (e.g. walking problems), underlying issues are multi-dimension and can go across cognitive and social dimension
- For research purposes, some authors would like to classify Frailty into
 - Physical frailty
 - Cognitive frailty
 - Social frailty

(Let's focus on healthcare related aspects of frailty)

image source from : https://www.researchgate.net/figure/fig1_318351153

Key Concepts (*decline in reserve*)



- A decline in intrinsic capacity (reserve) over time (see previous slide 10)
- Implication
 - There exists “sub-clinical” (“Pre-frail”) with diminishing reserve yet not manifested
 - ➔ allow window time to detect and reverse

Image source from : https://link.springer.com/chapter/10.1007/978-981-13-8938-2_1

Key Concepts in Frailty

(Biological but not chronological age)

- Although frailty will ultimately set in (unless one dies early), it **can be delayed** with healthy ageing activities till very old *(see previous slide 7)*
- Biological age is more important than chronologic age

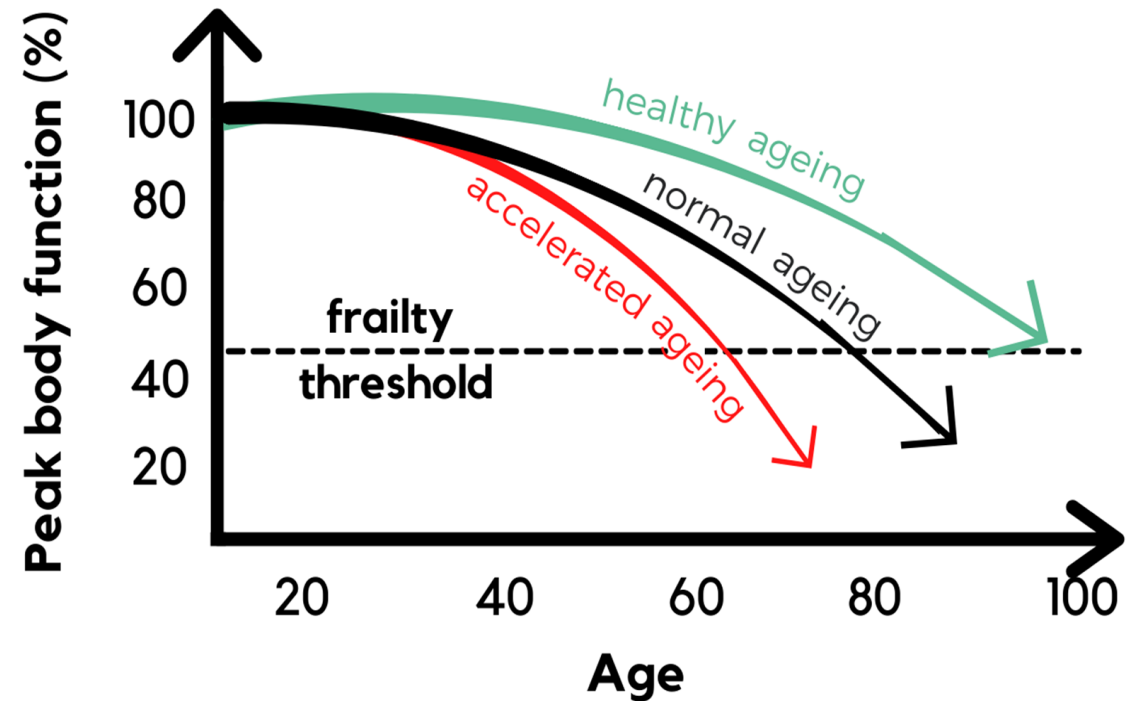
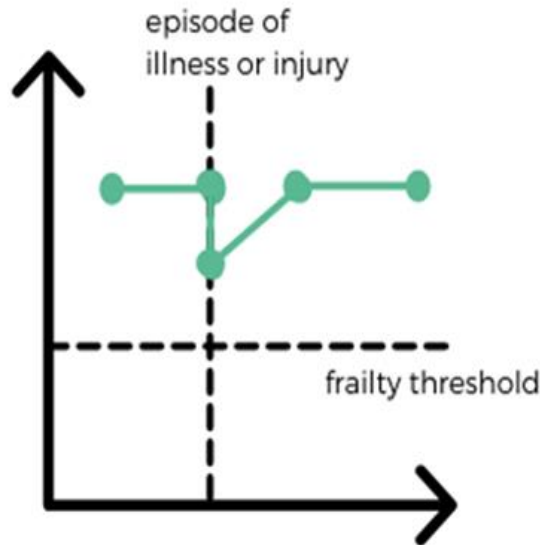


Image source from : <https://vee-uye.com/>

Impacts of Frailty

Robust (non-frail)



Frail person

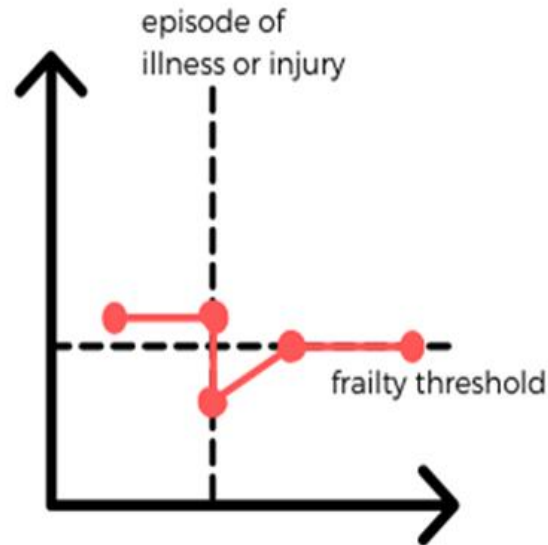


Image source from : <https://vee-uye.com/>

- It is associated with adverse outcome
 - Slower recovery rate
 - May not recover to as before
 - Excess mortality
- Precipitation of geriatric syndrome
 - Delirium
 - Falls
 - Failure to thrive
 - Immobility, not coping / dependency
- Importance on early identification for
 - Preventing complications
 - Optimize management plan
(to be discussed later)

Key concept in Frailty

(frailty and functioning)

Frailty as “A clinical state of decline in reserve and *function* across multiple physiological systems”

NOT to be confused with

- Disability / limitation in self care
- Sarcopenia (loss of muscle and loss of function) (to be discussed later)

Disability and Frailty

.... Imagine two persons
who cannot walk without aids

Person A

- Baseline: independent
- Road traffic accident with below knee amputation (BKA)
- Disability in ambulation: Walks with prosthesis or hop with elbow crutches

Person B

- Baseline: osteoarthritis right knee, used to walk slowly
- Now has a cerebrovascular accident with right side lower limb power 4/5
- Sustain fracture hip during acute CVA with leg length discrepancy
- Disability in ambulation: walks with frame

Both cannot walk without aids (similar disability)

- Are the mechanisms leading to the disability similar?

Disability and Frailty...

For A

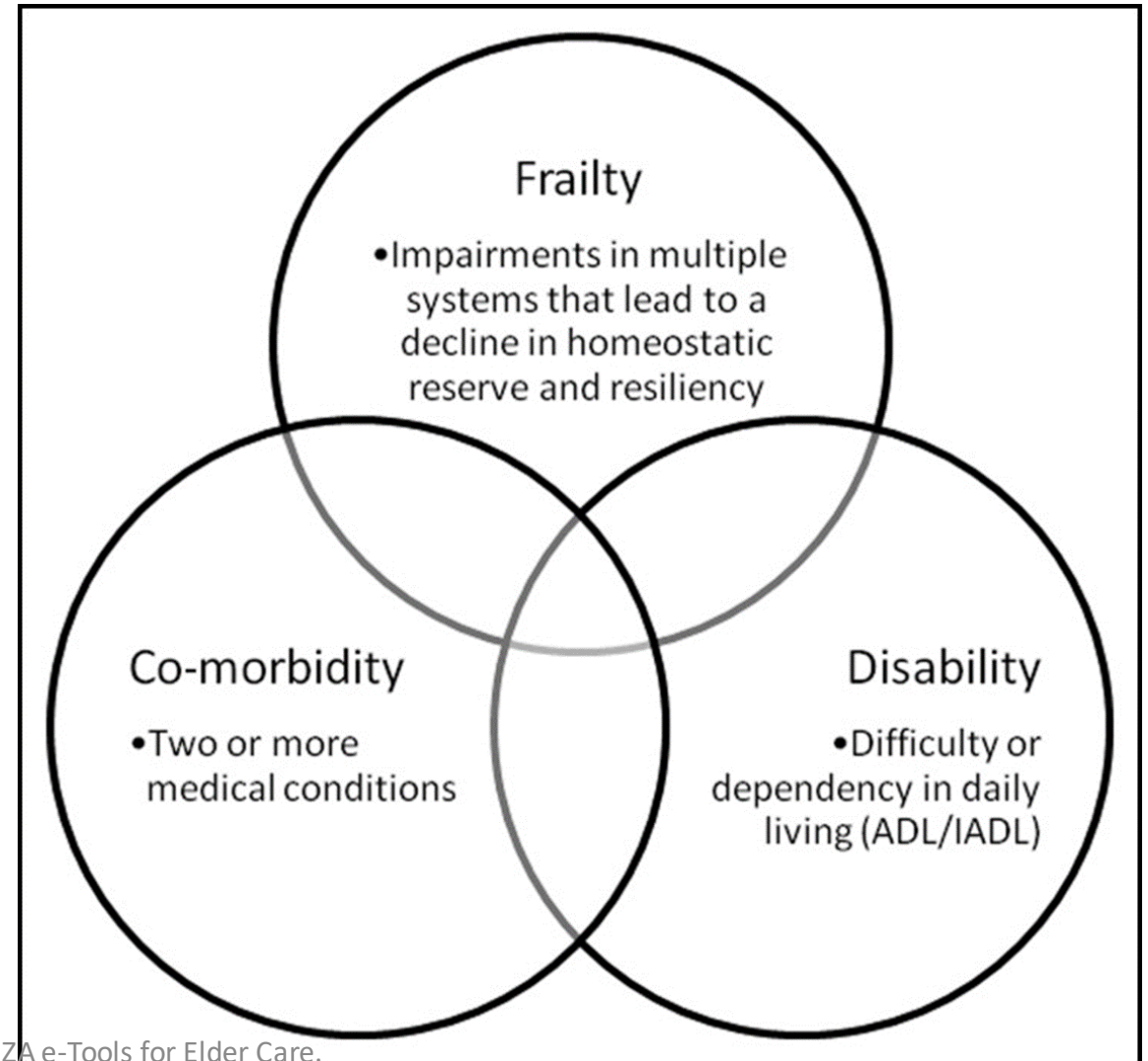
- Is NOT frail though loss of ambulation (self care limitation, disability) because of single factor involvement (loss of leg as support)

For B

- For each of the risk factor alone (OA knee, CVA, leg length discrepancy) , B may still manage to walk with compensatory mechanism
- Yet, the multiple little impairment in each aspect contribute to the inability to walk (ie. loss of reciprocal compensation)
- B has frailty because **lack of reserve** and function **across multiple physiological system**

Key Concepts (*frailty* ≠ *disabilities*)

There are overlaps between disability and frailty, yet they are **NOT** the same



How common is Frailty?

- Depends on criteria, setting and groups of subjects chosen

- US 9.9%
(Fried et al., 2012)
- Asia Pacific region 3.5 – 27%
- Hong Kong 12.5%
(Woo et al., 2015)
- Singapore 6%
(Chong et al., 2017)

	65-69	70-74	≥75	Overall
Robust	50%	48.1%	25.4%	35.1%
Prefrail	44.9%	44.2%	57.8%	52.4%
Frail	5.1%	7.7%	16.8%	12.5%

*Robust = FRAIL score 0, Prefrail = FRAIL score 1-2 Frail = FRAIL score 3-5
FRAIL score to be discussed at later slides
(Woo et al., 2015)*



Screening for frailty – Who and How?

The “How”?

- Multiple Screening tools – some examples
 - Frailty phenotype (*Fried*)
 - Frailty Index (*Rockwood*)
 - Clinical Frailty Scale (*Rockwood*)
 - “FRAIL” scale (*Moley*)
 - Edmonton Frail Scale (*Rolfson*)
 - Tilburg frailty indicator (*Gobbens*)



Frailty phenotype (Fried et al., 2001)

Weak grip strength	Cut off points for grip strength of the dominant hand is as following, = 17 kg for BMI = 23 = 17.3 kg for BMI 23 < BMI 26 = 18 kg for BMI 26 < BMI 29 = 21 kg for BMI > 29
Slow gait speed	The subject could use a walking aid, but not the aid of another person. Walking 4m (speed) in: = 0.65 m/s for height = 159cm = 0.76 m/s for height > 159 cm
Low physical activity level	Global Physical Activity Questionnaire (GPAQ) according to WHO (2012) recommendation was used to determine the physical activity level.
Self-reported exhaustion	Indicative positive response of any one out of three questions. a. Felt unusually tired in the previous month? (low energy level < 3 {on of scale of 0-10}) b. Felt unusually weak in the previous month? c. Had an unusually low energy level? (For b. and c., most or all the time {where, rarely [< 1day], some or little of the time [1-2 days], most of the time [3-4 days] and all the time})
Low weight	BMI < 18.5 kg/m ² , which is the lowest category WHO BMI classification.

Frailty Index (Rockwood et al., 2005)

- Based on accumulation of deficits model
- $FI = \frac{\text{Number of deficit}}{\text{Total number of item}}$
- Items measured
 - At least 30-40 items
- Criteria for items to be included
 - Associated with health
 - In general, the deficit should increase with age
 - Deficit should not be saturated too early
 - Cover a range of conditions
- Can be symptom (e.g. easy fatigue), sign, laboratory result (e.g. DM) , disability (e.g. manage finance) , disease (e.g. CVA)

Clinical Frailty Scale (Rockwood et al., 2005)

Clinical Frailty Scale*



1 Very Fit – People who are robust, active, energetic and motivated. These 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 IADLs** (finances, transportation, heavy housework, medications). Typically, mild frailty 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 (e.g. standby) 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.

* 1. Canadian Study on Health & Aging, Revised 2008.
2. K. Rockwood et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005; 173:489-495.

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CFS in practice (Chong et al., 2021)

FRAILTY QUESTIONNAIRE


For each question, please select **all** of the options that apply to you.

Two weeks **BEFORE** your current illness...


Q1. Did you need help with any of the following personal care?




Using the toilet



Getting dressed




Bathing/Showering




Walking

*Stop here if you have selected **any** of the options above.


Q2. Did you need help with any of the following activities?



Going outside




Handling Money




Taking Medications

*Stop here if you have selected **any** of the options above.

Q3. Did you feel constantly tired throughout the day?




Yes




No

Q4. Did you feel that you were walking slower than usual?



Yes



No

CLINICAL FRAILTY SCALE

Quick guide to scoring the CFS after completion of questionnaire

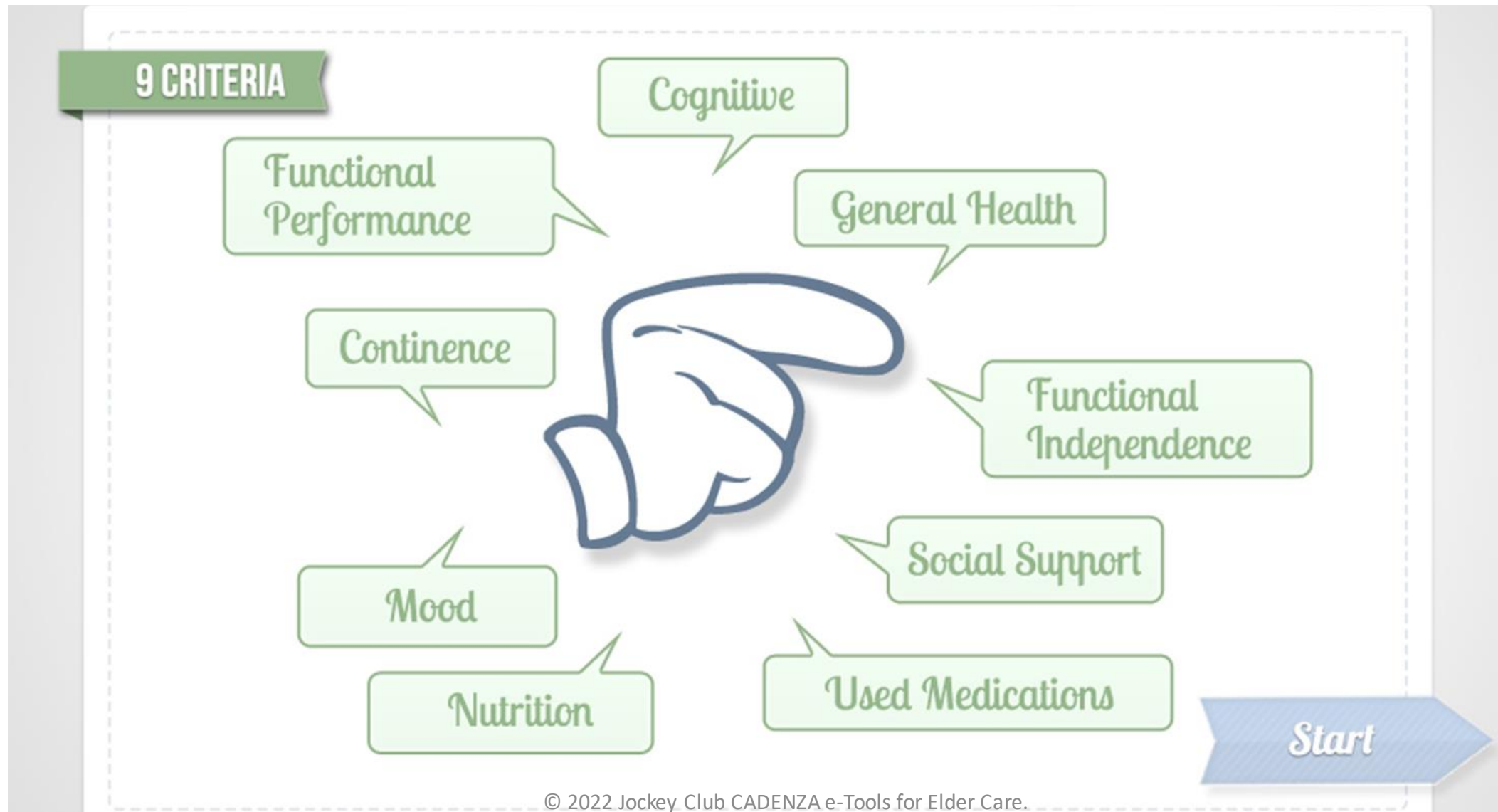
QUESTIONS	CLINICAL FRAILTY SCALE	
Q1	ALL 4 ticked →	CFS 7-8 Severely Frail
	1-3 ticked →	CFS 6 Moderately Frail
Q2	ANY ticked →	CFS 5 Mildly Frail
Q3 Q4	YES for either →	CFS 4 Pre-Frail
	NO →	CFS 1-3 Robust

Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. CMAJ. 2005;173(5):489-495. doi:10.1503/cmaj.050051.

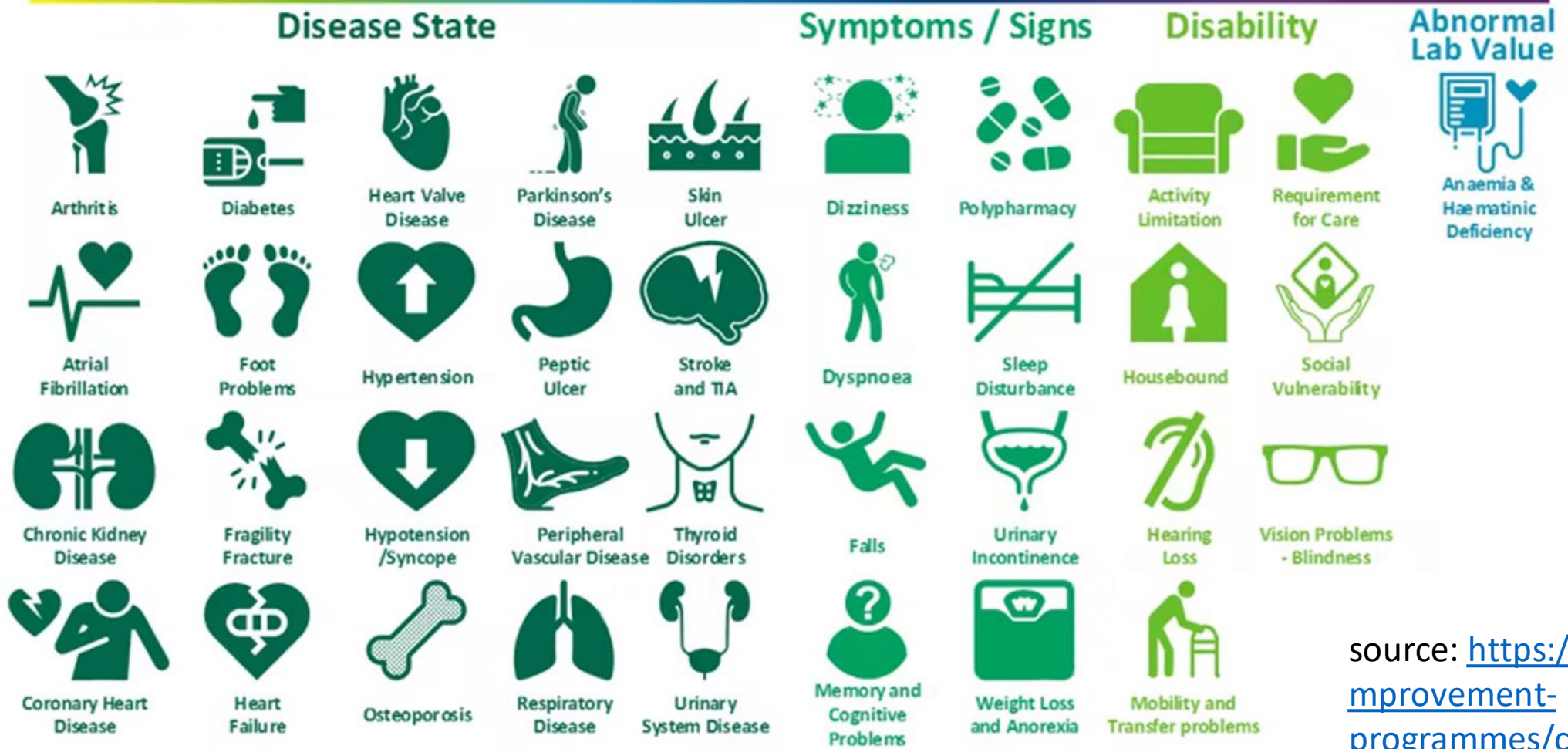
FRAIL scale *(Morley)*

Item	Question
Fatigue	Are you tired to exercise?
Resistance	Can you climb one flight of stair without assistance
Aerobic	Can you walk one block without assistance?
Illnesses	Five or more illnesses
Loss of weight	>5% weight loss over last one year
Score: 0 = Robust 1-2 = Pre-frail 3-5 = Frail	

Edmonton frail scale



Electronic frailty index



source: <https://ihub.scot/improvement-programmes/community-care/electronic-frailty-index-efi/>

How to choose among different tools?

Tool	Setting / Sample	Remark
Frail phenotype	Community base	Requires local data to define cutoff for each item
FRAIL scale	Community base	By proxy. Useful for population or opportunistic screening
Clinical Frailty Scale (CFS)	Outpatient / Long Term Care / Hospital	Classification largely biased by disability level that can be due to single condition (e.g. CVA)
Edmonton Frailty Scale (EFS)	Hospital / Emergency Department	Multiple dimension. Identify areas that need review / intervention / support / supportive discharge from emergency department
Electronic Frailty Index (eFI)	Healthcare facilities	Adopt Cumulative Deficit approach Bio-physical model mainly Social frailty underweighted
Cumulative Deficit model	Healthcare facilities	Requires full healthcare record with comprehensive geriatric assessment Higher predictive power on health treated outcomes

Who to be screened?

- Primary Care setting
 - All people age >70
 - Those with multiple chronic illnesses
 - Those who have weight loss over 5kg in past one year
 - (FRAIL scale most applicable)

(Dent et al., 2017)

- Opportunistic screening among age >65
- Use of validated tool of your setting
 - CFS, eFI, EFS, Culminative Deficit Score of your setting

(Dent et al., 2019)

Why screen for Frailty?

Restoration

- Frailty is reversible (*Lee et al., 2014*)
 - ➔ Screening for intervention and restoration (How? to be discussed later)

Frailty status at Baseline	Frailty status at Follow up in 2 years, N (%)		
	Robust	Pre-frail	Frail
Male	657	727	135
Robust	456 (57.8)	266 (33.7)	14 (1.8)
Prefrail	199 (23.4)	426 (50.1)	94 (11.1)
Frail	2 (1.9)	35 (33.0)	27(25.5)
Female	622	773	104
Robust	381 (60.2)	199 (31.4)	6 (1.0)
Prefrail	235 (26.6)	496 (56.1)	58 (6.6)
Frail	6 (3.6)	78 (47.3)	40 (24.2)

Prevention of complication at stress

- Precipitation of geriatric syndrome
 - Delirium
 - Falls
 - Failure to thrive malnourishment
 - Immobility, not coping / dependency
- ➔ hospital related complication
- ➔ prolonged recovery time
- ➔ prolonged hospital stay

- Early identification
 - ➔ Action for prevention

Why screen for frailty?

Optimize management plan



Robust person

longer quality life years
→ More benefit to Rx
More resilient to stress
→ Less risk to Rx



Frail person

Shorter quality life year
→ Less benefit to Rx
Less resilient to stress
→ Higher risk to Rx

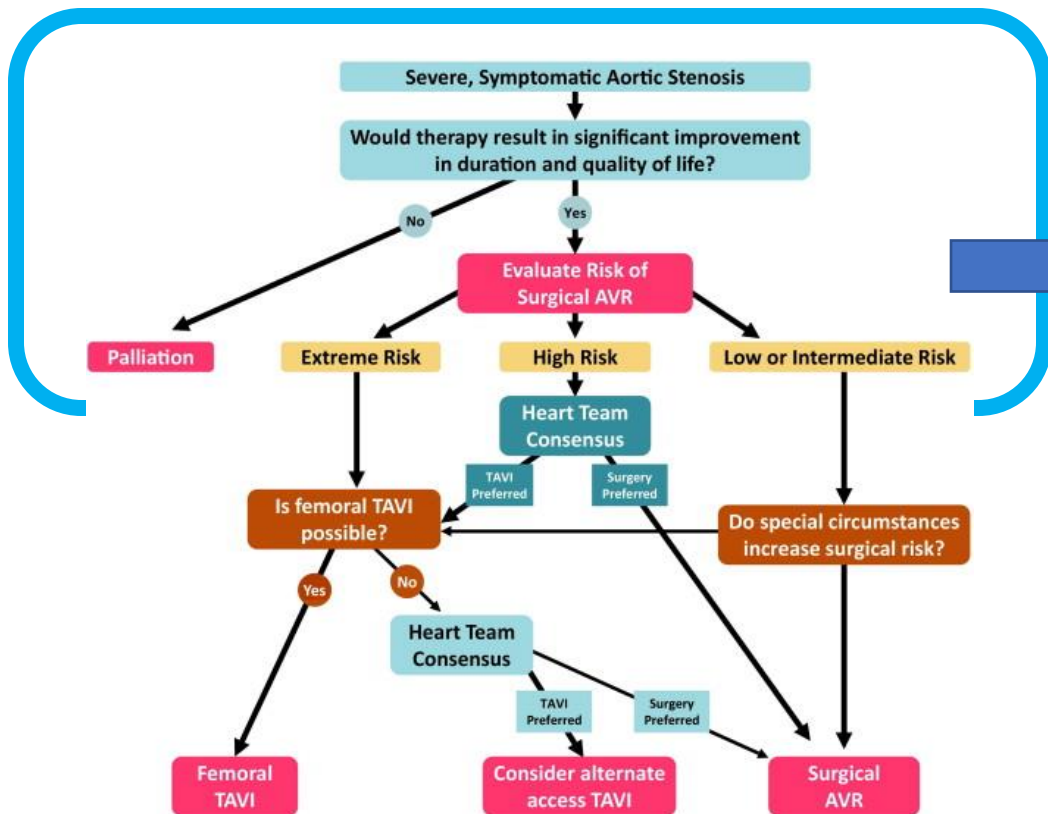


For same condition

More acceptable to subject a robust person to Rx that have higher efficacy though may have higher procedure / Rx risk
More acceptable to subject a frail person to Rx that is of lesser risk though lesser efficacy




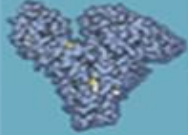
Optimize management plan (Example)

- Benefit / risk assessment for management of severe aortic stenosis



(Asgar et al., 2019)

CENTRAL ILLUSTRATION: Essential Frailty Toolset in Older Adults Undergoing Aortic Valve Replacement

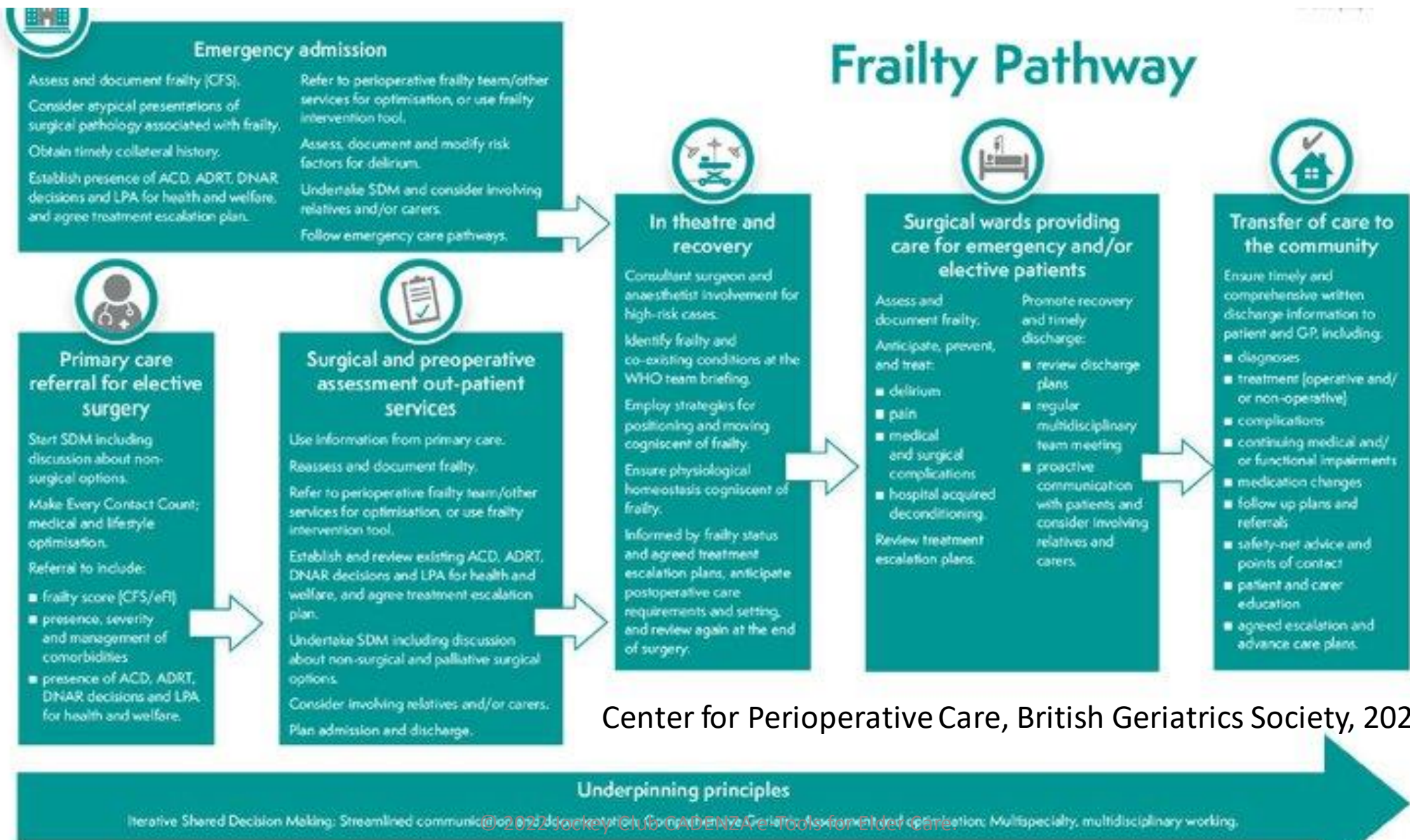
	Five chair rises <15 seconds	0 Points
	Five chair rises ≥15 seconds	1 Point
	Unable to complete	2 Points
	No cognitive impairment	0 Points
	Cognitive impairment	1 Point
	Hemoglobin ≥13.0 g/dL ♂ ≥12.0 g/dL ♀	0 Points
	Hemoglobin <13.0 g/dL ♂ <12.0 g/dL ♀	1 Point
	Serum albumin ≥3.5 g/dL	0 Points
	Serum albumin <3.5 g/dL	1 Point

EFT Score	1-Year Mortality	
	TAVR	SAVR
0-1	6%	3%
2	15%	7%
3	28%	16%
4	30%	38%
5	65%	50%

EFT Points: _____

Afilalo, J, et al. J Am Coll Cardiol. 2017;70(6):689-700.

Optimize management plan

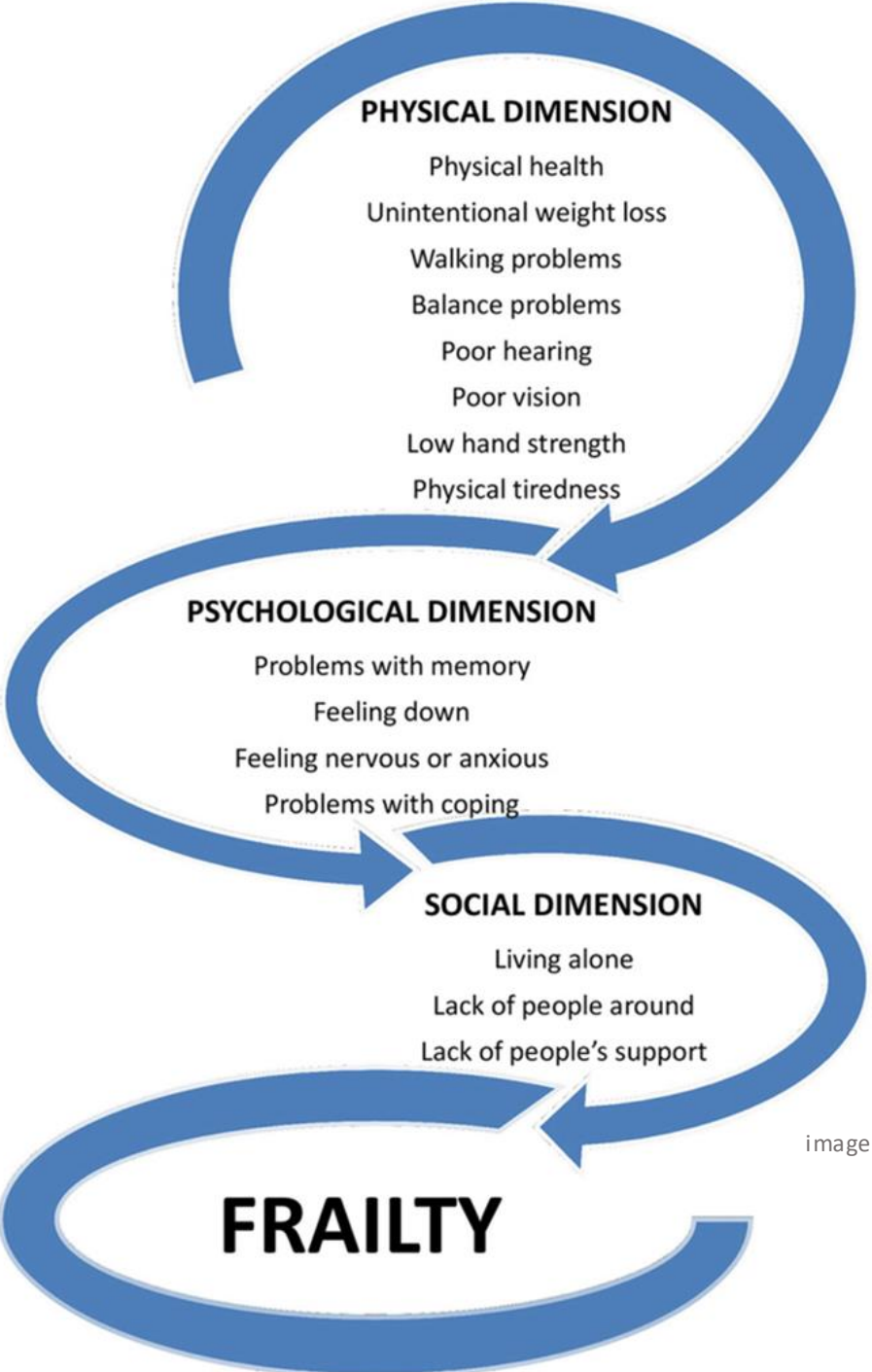


Center for Perioperative Care, British Geriatrics Society, 2021

Why screen for frailty?

Optimize management

- Pre-operative
 - Optimize background condition
 - Medication review
 - Nutrition augmentation
 - Rehabilitation
- Enhance postoperative care
 - Pressure sore prevention
 - Delirium prevention
 - Attention to hydration, nutrition
 - Early mobilization

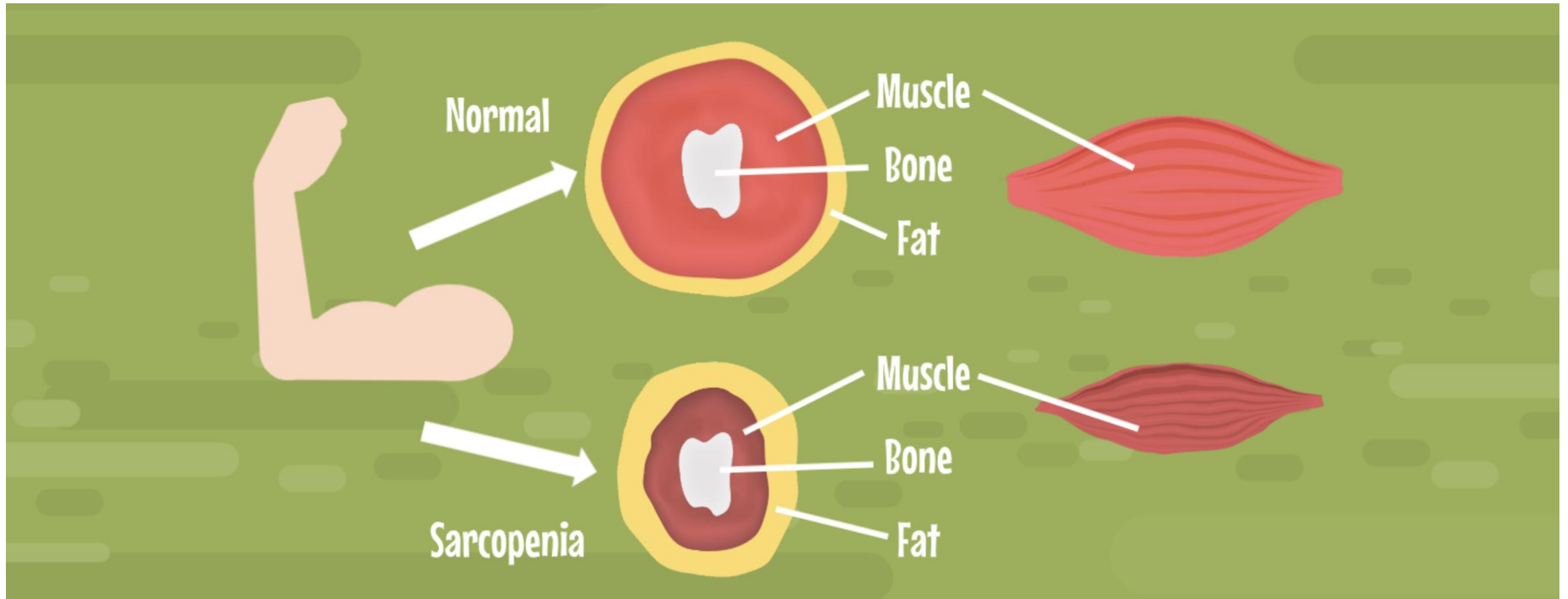


Why screen for frailty? Optimize management

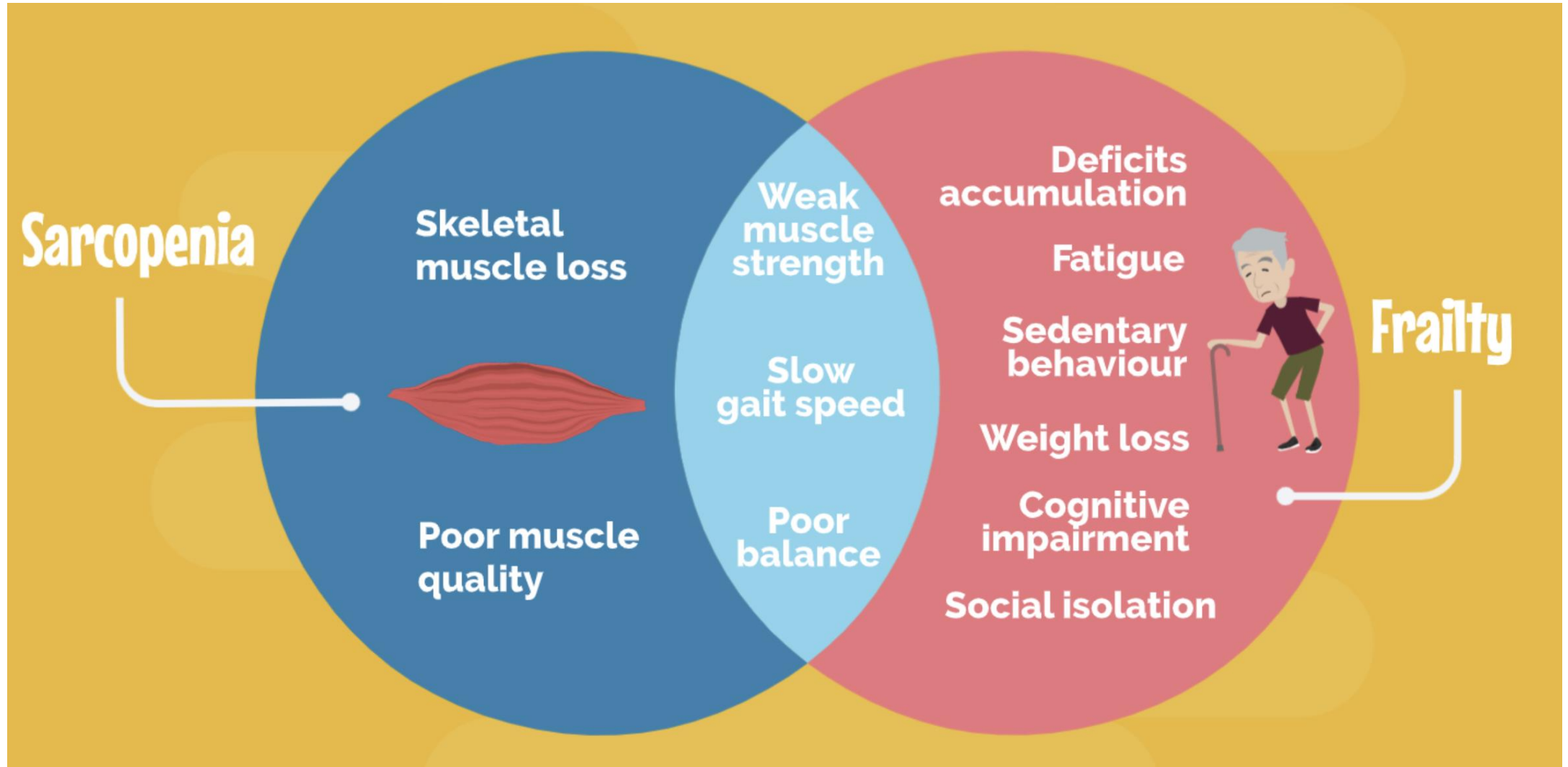
- Identify (multi-dimensional) support care needs for ageing in place

image source from : https://www.researchgate.net/figure/fig1_318351153

Let's move to sarcopenia for time being



Sarcopenia and frailty



Though frailty and sarcopenia share similar manifestation,
they are not equivalent

Definition of sarcopenia

- A syndrome characterized by
 - Low muscle strength
 - Low muscle quality and / or quantity

(Cruz-Jentoft et al., 2019)

- “Probable” sarcopenia
 - Low muscle strength alone
- Severe sarcopenia
 - Physical performance
- Implication
 - Risk of adverse outcomes such as physical disability, poor quality of life and mortality

“Accelerated loss of skeletal muscle mass associated with decreased functional capacity”

Definition of sarcopenia

- Age-related loss of skeletal muscle **mass**

Plus

- Loss of skeletal **strength**

And / Or

- Reduced **performance**

Severe sarcopenia = **reduced** loss of mass + strength + performance

(Chen et al., 2020)

How common is sarcopenia?

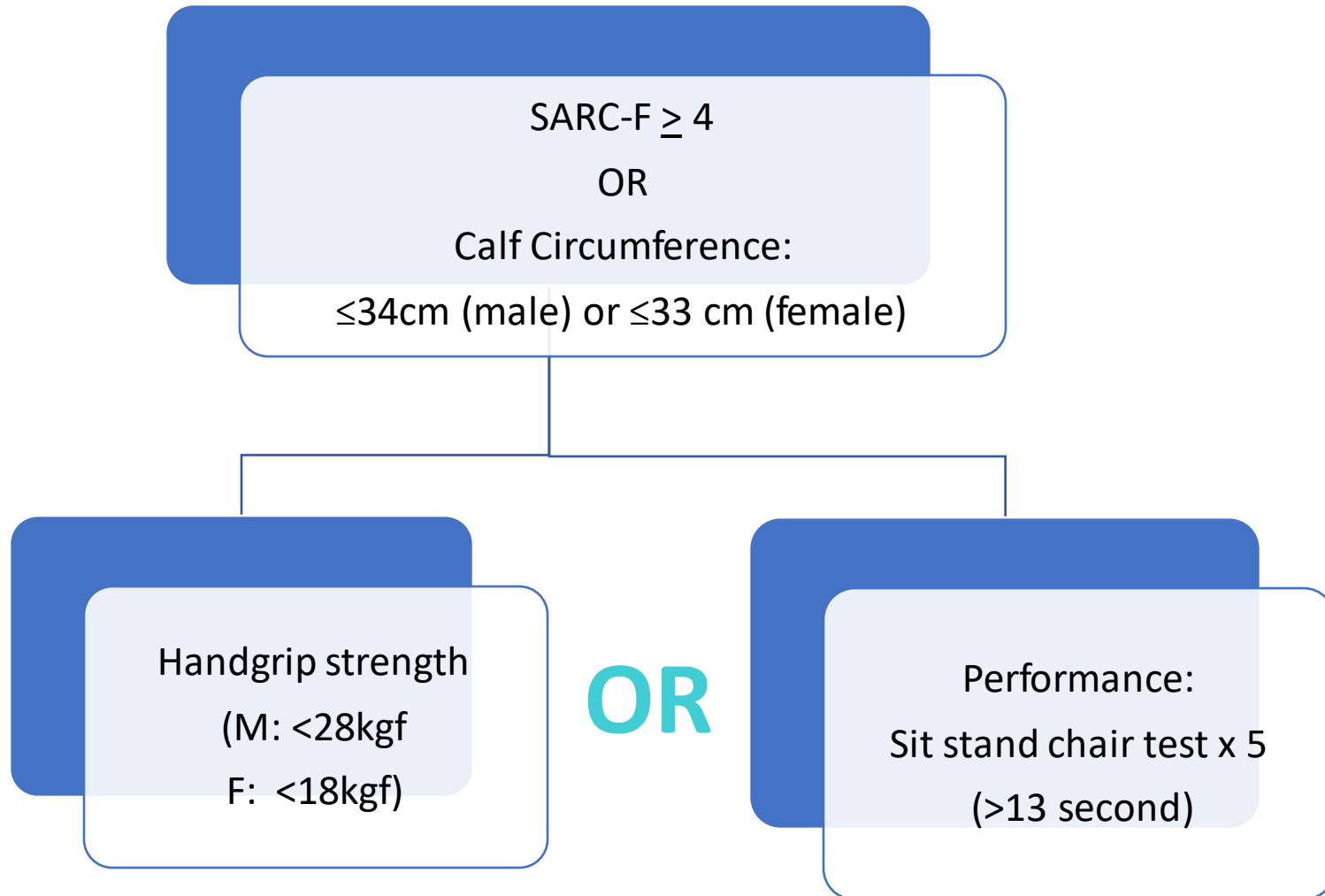
(community living seniors)

	65-60	70-74	<u>≥</u> 75
SARC-F Score	N=89	N=81	N=359
0-3	64 (71.9%)	58 (71.6%)	182 (50.7%)
<u>≥</u> 4	25 (28.1%)	23 (28.4%)	177 (49.3%)
SARC-F (0=10): <u>≥</u> 4 denote sarcopenia (<i>Woo et al., 2015</i>)			

SARC-F for screening of sarcopenia (community setting)

Component	Question	Score
Strength	How difficult do you have in lifting and carrying 10 pounds	0 = None 1 = Some 2 = A lot of trouble
Assistance in walking	How much difficult do you have walking across a room?	0 = None 1 = Some 2 = A lot, use aids, or unable
Rise for a chair	How much difficulty do you have transferring from a chair or bed?	0 = None 1 = Some 2 = A lot or unable without help
Climb stairs	How much difficulty do you have climbing a flight of 10 stairs	0 = None 1 = Some 2 = A lot or unable
Falls	How many times have you fallen in the last year?	0 = None 1 = 1-3 falls 2 = 4 or more falls
If screen +ve (Total score >4) → further assessment		

Community Screening for sarcopenia (Flow)



Remarks:

- (1) Definite diagnosis requires measure of appendicular skeletal muscle by DEXA
- (2) Possible sarcopenia
 - Either one of Handgrip / Performance +ve :
- (3) Likely severe sarcopenia
 - Both handgrip and performance +ve
- (4) Benefit for intervention once possible sarcopenia is established

(Chen et al., 2020)

Triggers for screening in clinical settings

- Presence of
 - Functional decline or limitation, unintentional weight loss, depressive mood, cognitive impairment, repeated falls, malnutrition
 - Chronic conditions (heart failure, diabetes mellitus, chronic obstructive pulmonary disease, chronic kidney disease etc.)

(Chen et al., 2020)

What to do after diagnosis of Sarcopenia / Frailty

A recap on their relationship

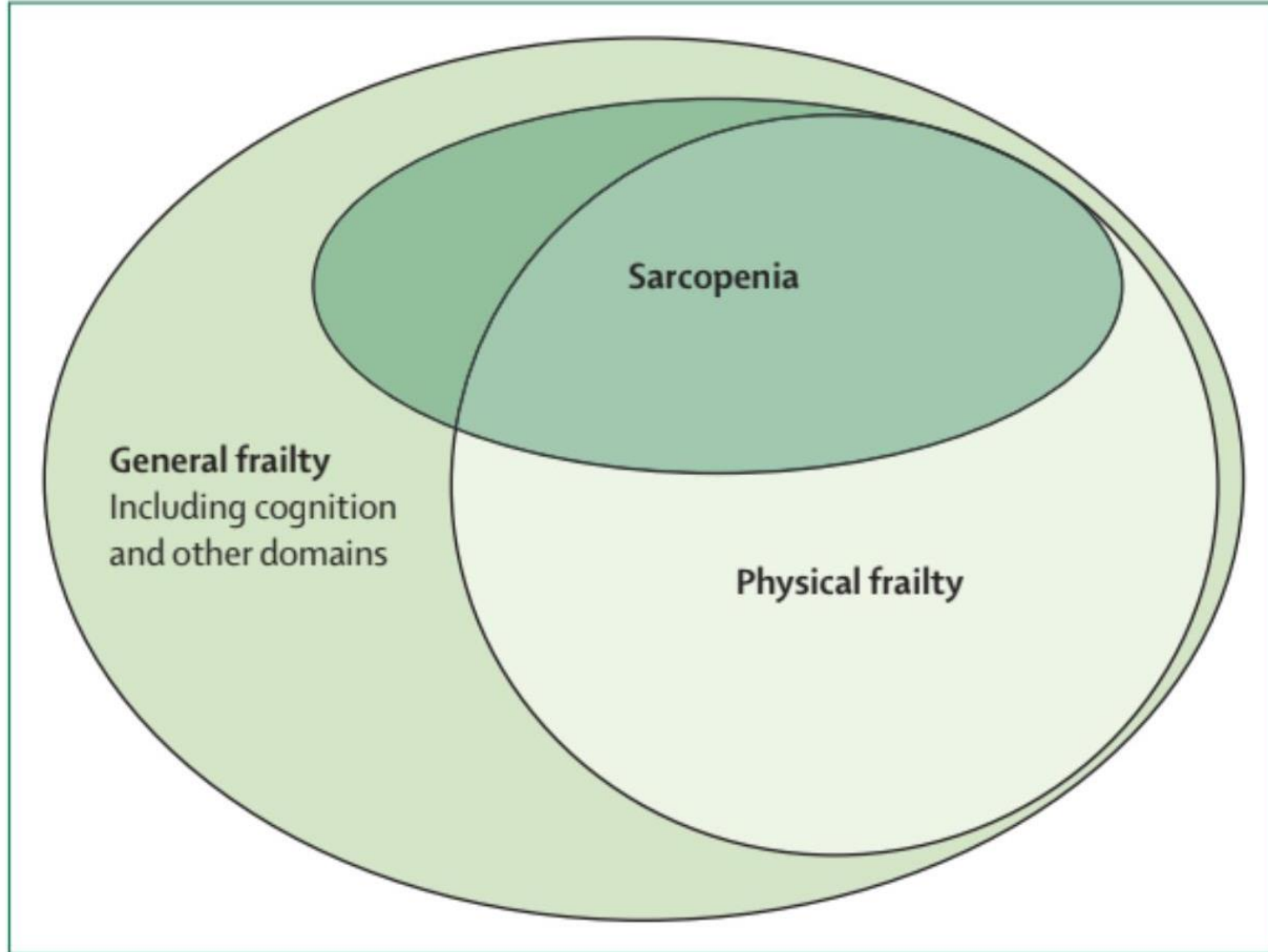
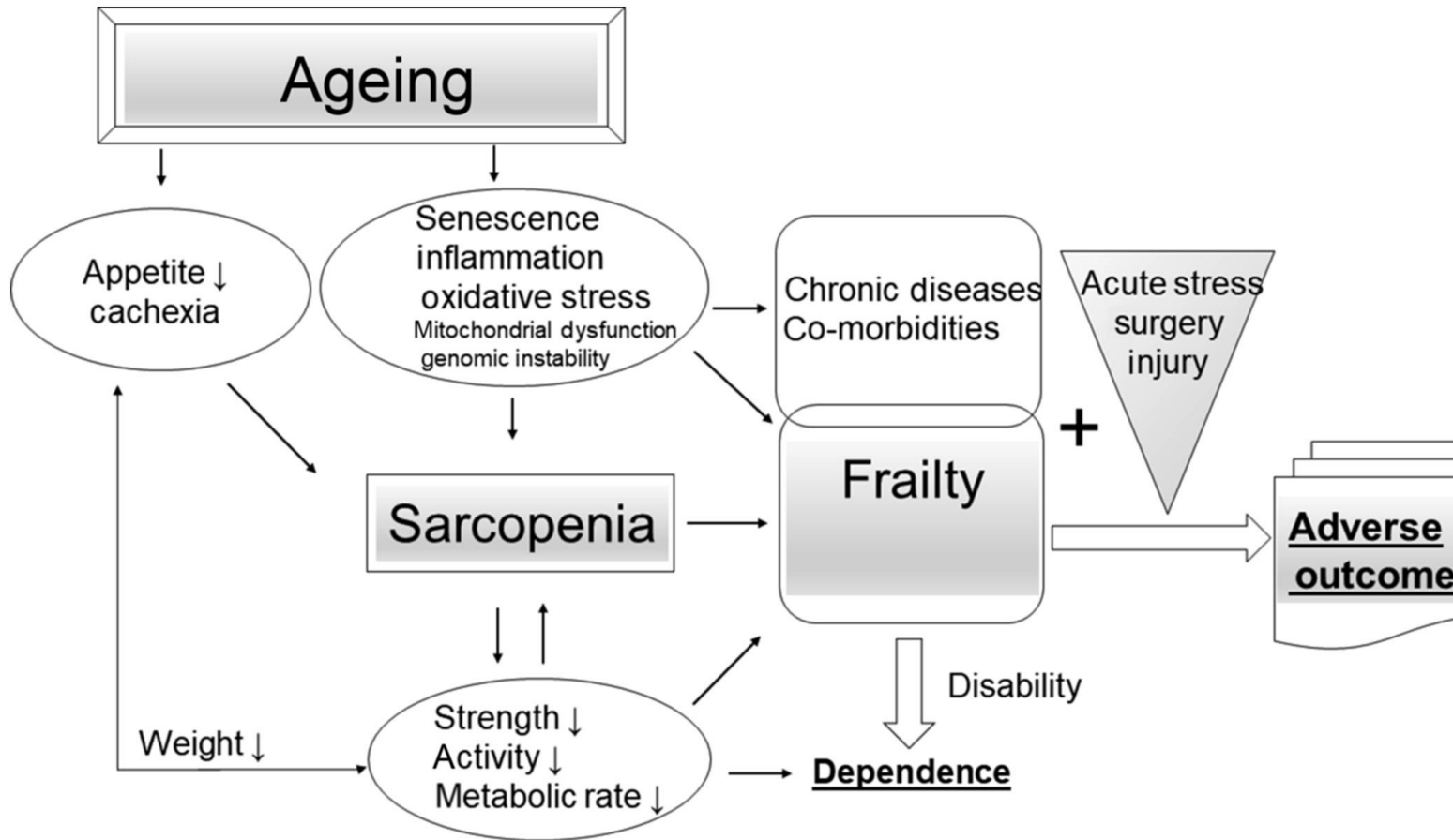


Figure 3: Schematic diagram showing the diagnostic overlap between sarcopenia and physical or general frailty

A recap on their relationship



Both are closely related

- Share mechanism
- Commonly associated conditions
- Adverse outcomes

➔ Share management approach

(Bentov et al., 2019)

What to do after diagnosis of sarcopenia and / or frailty?

- Review for possible secondary causes
 - Intentional weight loss / dietary restriction
 - Review intake and contribution factor (e.g. social isolation with malnutrition, poor denture)
 - Review control of medical conditions (e.g. DM)
 - Review medication list to avoid iatrogenesis (e.g. hypotension)
- Review lifestyle
 - sedentary lifestyle predisposed to accelerated muscle loss
 - fatigue from disease (e.g. anemia, hypothyroid, depression)



- **STRONG** Recommendations for primary sarcopenia / frailty
 - (Graded) Resistive exercise to improve muscle mass and strength (e.g. Vivifrail exercise)
 - Protein / caloric supplementation with high protein diet
 - To couple with resistive exercise
 - Up to 1.2gm/kg/day
 - Vitamin D supplement if Vitamin D deficit

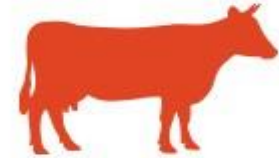
1,5g
CA-HMB
PER SERVING

=



~50
EGGS

OR



~1,3KG
BEEF



190 ml
WATER

+



6
SCOOPS
ONS
POWDER

=



=



~3000
AVOCADOS

OR

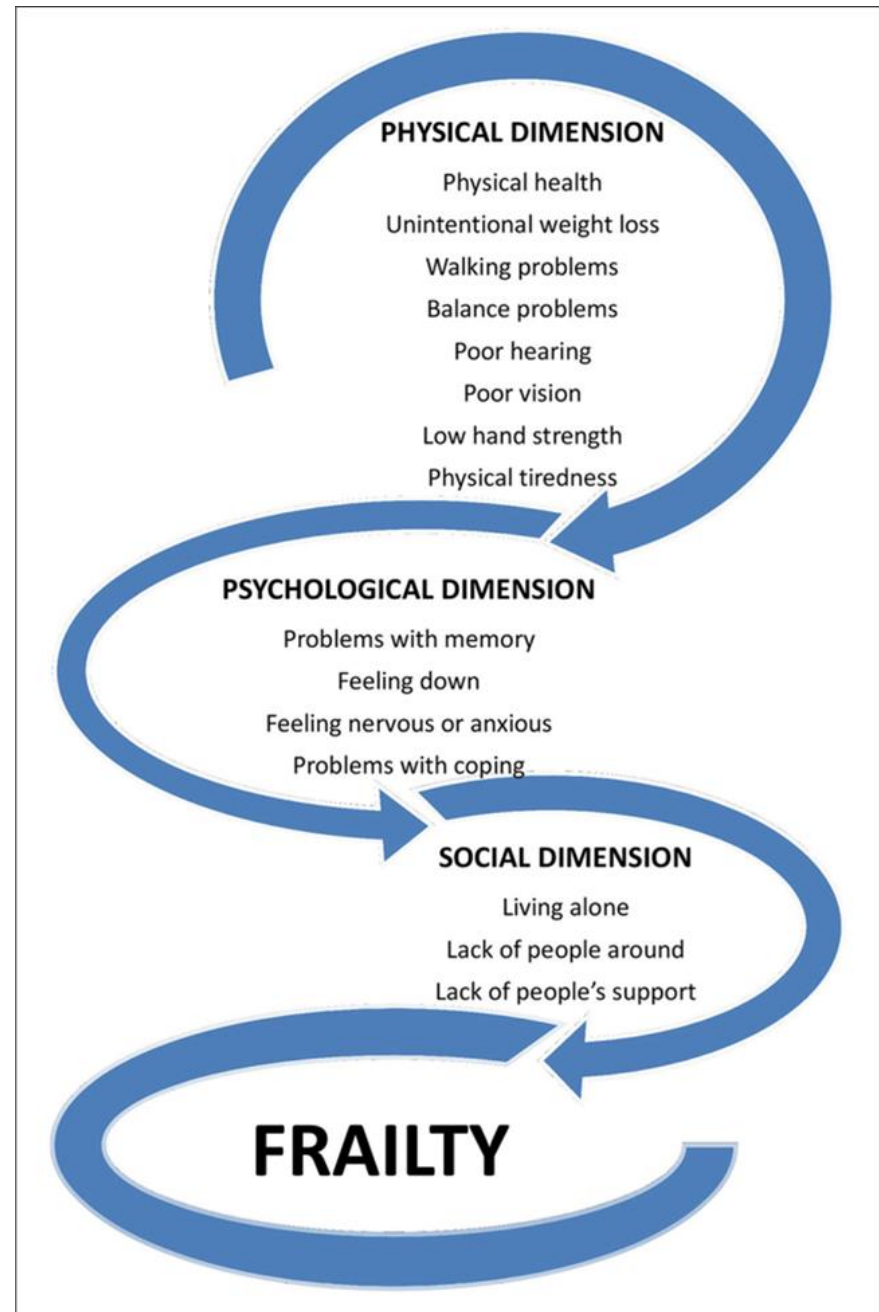


~4000KG
BROCCOLI

- **Conditional recommendation** (preliminary data available but need further studies) on individual nutrient supplements
 - Vitamin D if not at deficit state
 - B-hydroxy B-methylbutyrate (HMB) (an essential amino acid)
 - Whey protein after resistive exercise

Refer to next 2 chapters for nutrition and exercise interventions.

- The above resistive exercise and high protein diet tackles physical frailty
- Psychological frailty, and social frailty need to be addressed



Psychological Frailty

- Refers to impairments in various areas, such as mood, cognition and motivational components
- A consequence of age-altered brain function
- Reduction in cognitive reserve>>>cognitive frailty
- Loss of resilience and adaptability in the domain of brain function
- Physical frailty has implication in cognitive function
>>> health outcomes ↓

(Fitten, 2015)

Cognitive Frailty

The concept of cognitive frailty

- linked to a reduction in cognitive 'reserve';
- characterized by the coexistence of physical frailty and cognitive impairment (Clinical Dementia Rating [CDR] = 0.5);
- and exclusion of concurrent Alzheimer's disease or other dementias (Kelaiditi et al., 2013)

Social Frailty

- A state of being at risk of losing (or having already lost) resources that are essential for meeting one or more basic social demands.
- Living alone, not having a friend and family support, socially isolated could have a severe impact on psychological well-being.

Interventions

- Aim to improve psychosocial wellbeing concerning emotion, social, mental and spiritual domains
- Long term community-based with multidimensional training activities
- Cognitive Training
 - Enhance attention and information processing, stimulate short-term memory, reasoning and problem-solving abilities
 - Gerontechnology e.g. computer games, VR programme etc.

Click [here](#) for more information

- Age-friendly community
 - Create supportive environment
 - Community resources
- Social inclusion and participation
 - Paid or unpaid work
 - Enhance social connections
- Social campaigns
 - Arouse public awareness of age-related frailty and pre-frailty
 - Early identification and intervention
- Improve resilience
 - Increase intrinsic capabilities to cope with stressors
- Suggest healthy lifestyle to avoid or delay decline

Better still ... to improve resilience





**The Frail Elderly
(a label at
hospital)**

Present late (e.g. Fall)

Hospital-based: episodic,
fragmented and
disjointed

**At risk elderly
(community)**

Timely identification for
preventive, proactive care
and shared decision
making

Coordinated Person-
centered care

Suggested reading

Professional training materials of Cadenza Training programme

- CTP002: Promoting Psychosocial and Spiritual Well-being of Older People

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