Gains Galore: Why Exercise is Critical in the Oncology Population

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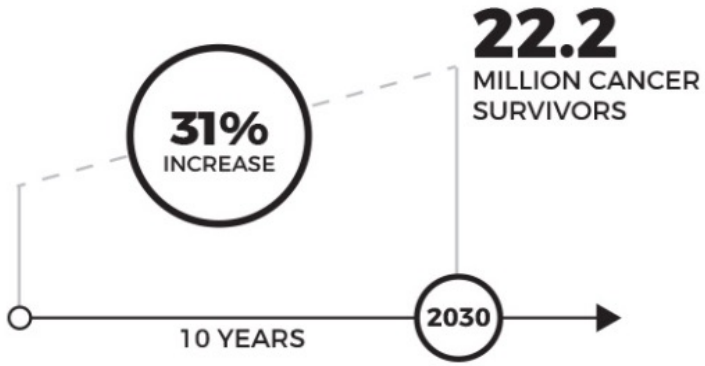
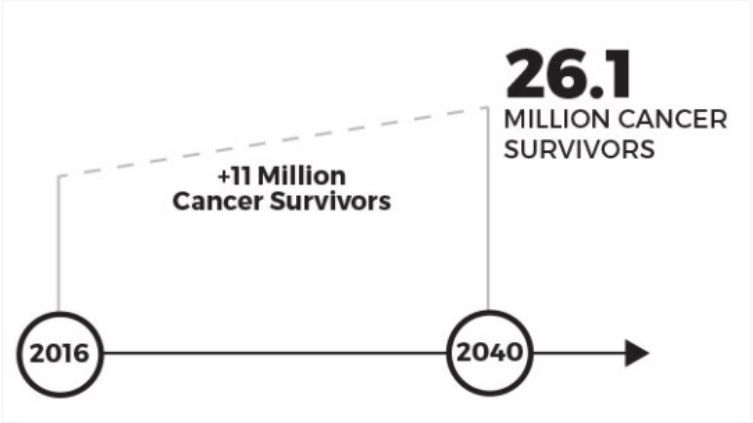
Intended Learning Outcomes

- Review important statistics in the oncology population and differentiate three key definitions
- Inform on the importance of exercise and physical activity at the molecular level
- Review principles of exercise programming
- Discuss common shortcomings within exercise programming in the exercise oncology population



The number of cancer survivors is projected to increase by 31.4%, to 22.2 million, by 2030.[1]



The number of cancer survivors is projected to grow to 26.1 million by 2040.[1]

1 American Cancer Society. *Cancer Treatment & Survivorship Facts & Figures 2019-2021.* Atlanta: American Cancer Society; 2019.

Statistics[2-4]

- Only ~1/3 of persons living with & beyond cancer are meeting exercise recommendations
  - Number drops to about 10% of persons actively going through tx
  - Up to 34% report NO leisure time physical activity or exercise
- Multitude of reasons why this number is so low
  - Understanding of exercise & PA (Both physician and patient)
  - Fear (Both physician and patient)
  - Access
  - Time
  - Financial challenges

ADLs – Physical Activity – Exercise 5-8

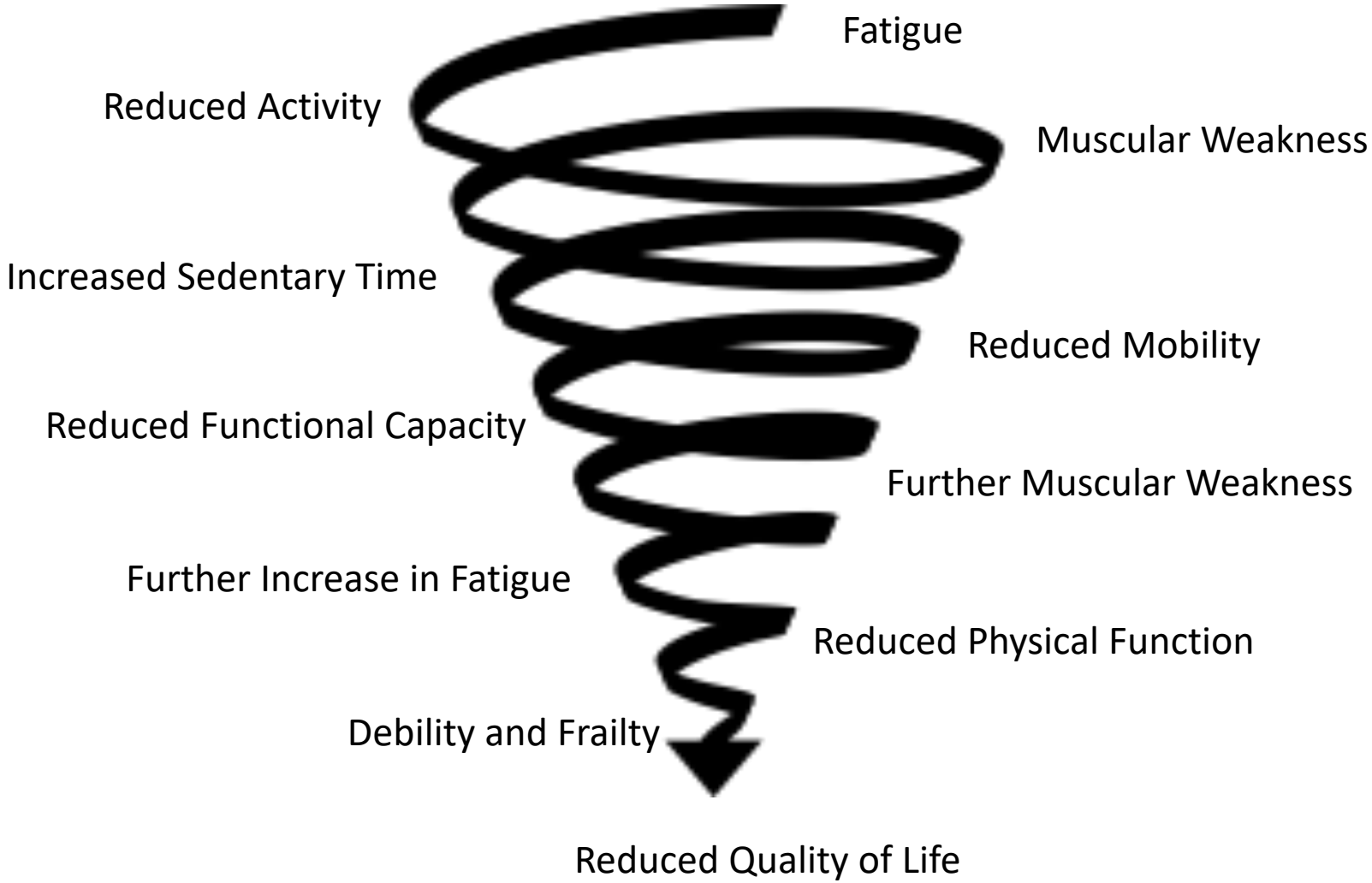
- **Activities of Daily Living:** getting out of bed, bathing, eating, Transfers, dressing
- **Physical Activity:** any bodily movement produced by skeletal muscles that requires energy expenditure (i.e. gardening, house cleaning, playing with children or grandchildren, kayaking, pickleball…)
- **Exercise:** a subset of physical activity that is planned, structured, & repetitive & has as a final or an intermediate objective - the improvement or maintenance of physical fitness (i.e., aerobic capacity, muscle strength power & endurance, balance, coordination, & flexibility)

Why *Appropriate* Exercise is Critical

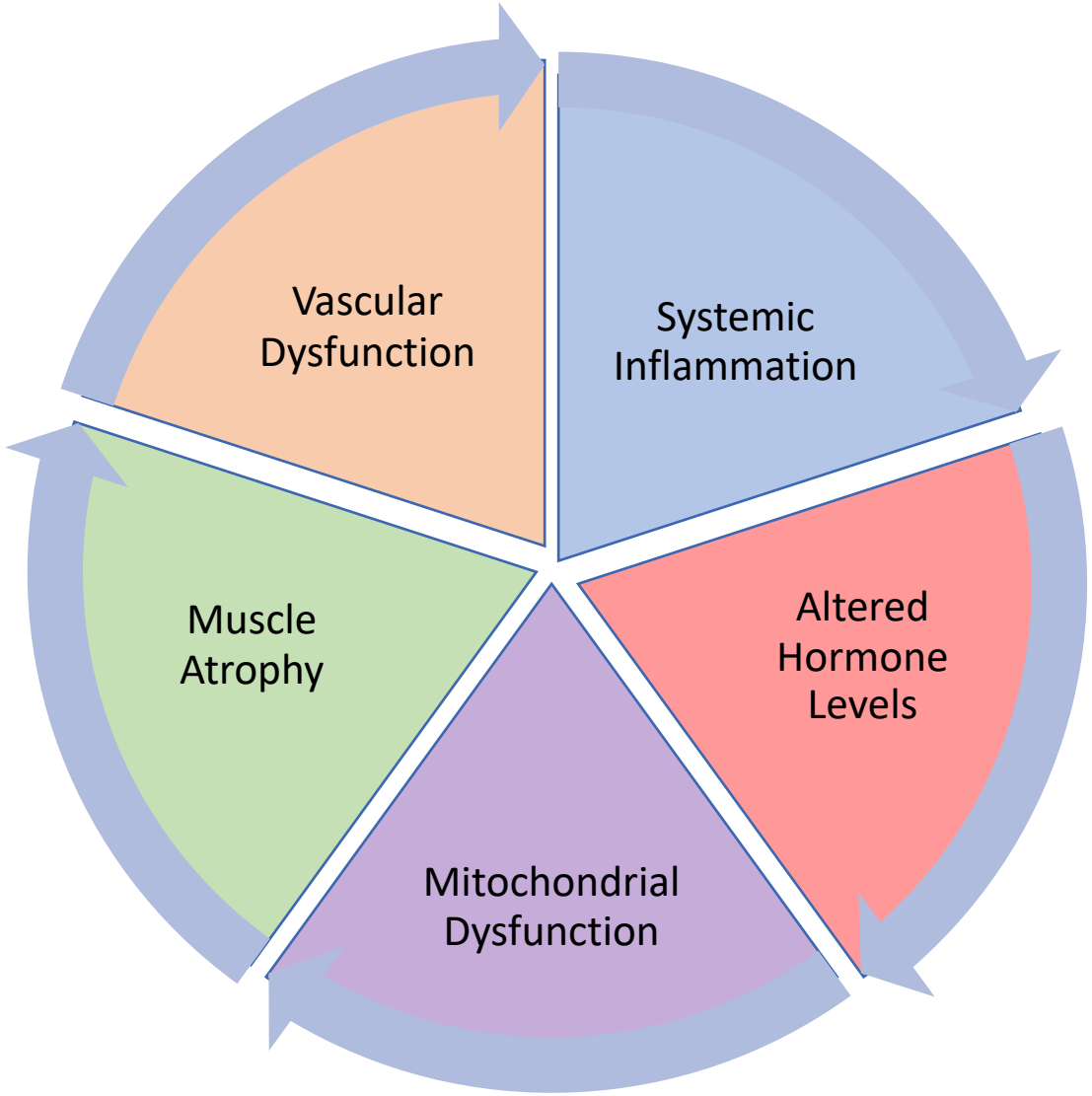
Adverse Effects of Cancer &Treatment [9,10]

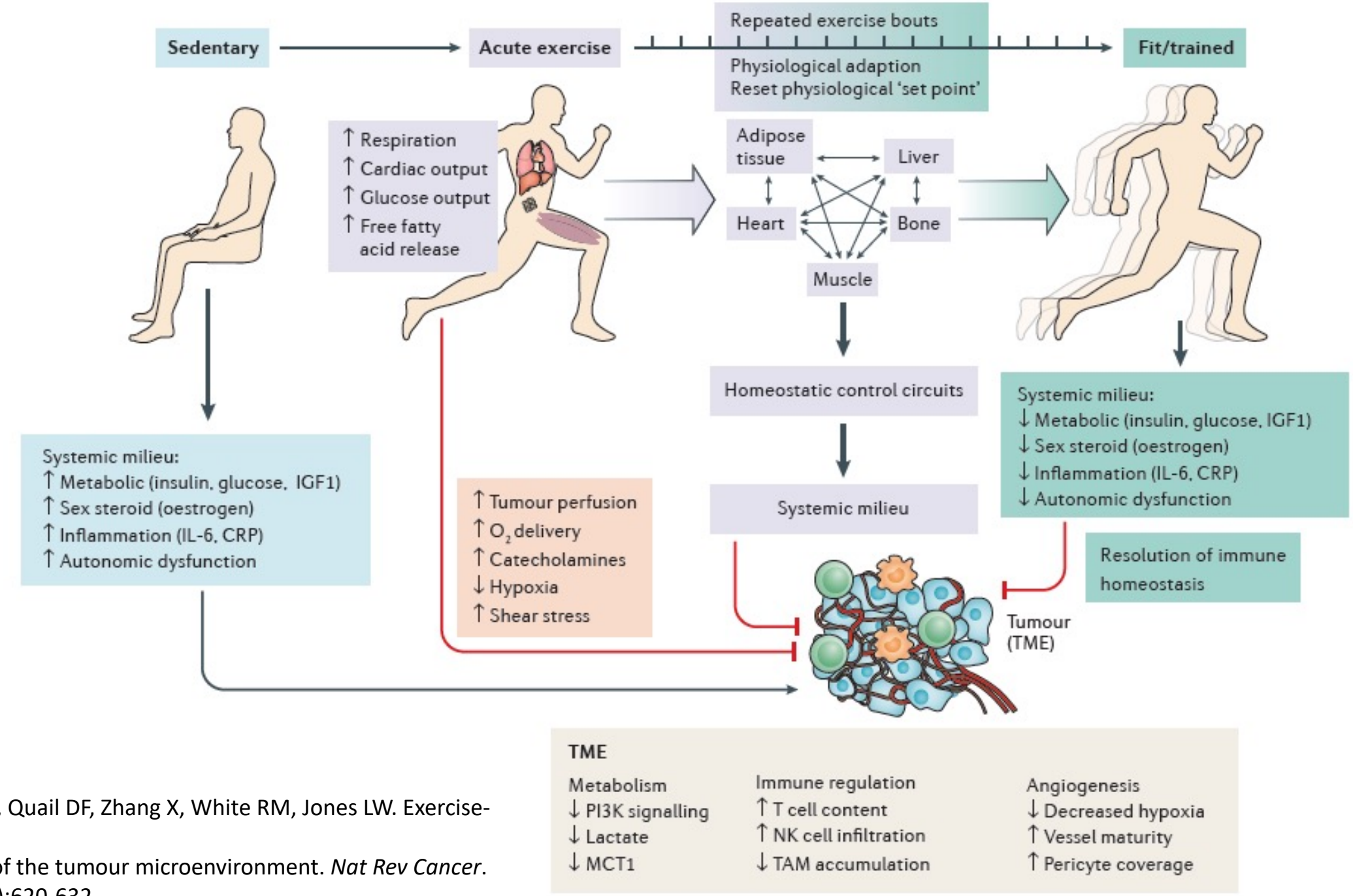
- Fatigue
- Loss in muscle mass
- Reductions in muscle strength/power
- Decrease joint mobility
- Cardiotoxicity
- Impaired cognition
- Myelosuppression
- Bone loss
- Impaired functional capacity/ VO_2max
- Chemotherapy Induced polyneuropathy
- Pain
- Inflammation
- Altered nutrition
- Insulin resistance
- Depression/Anxiety

Adverse Effects on Quality of Life [11]



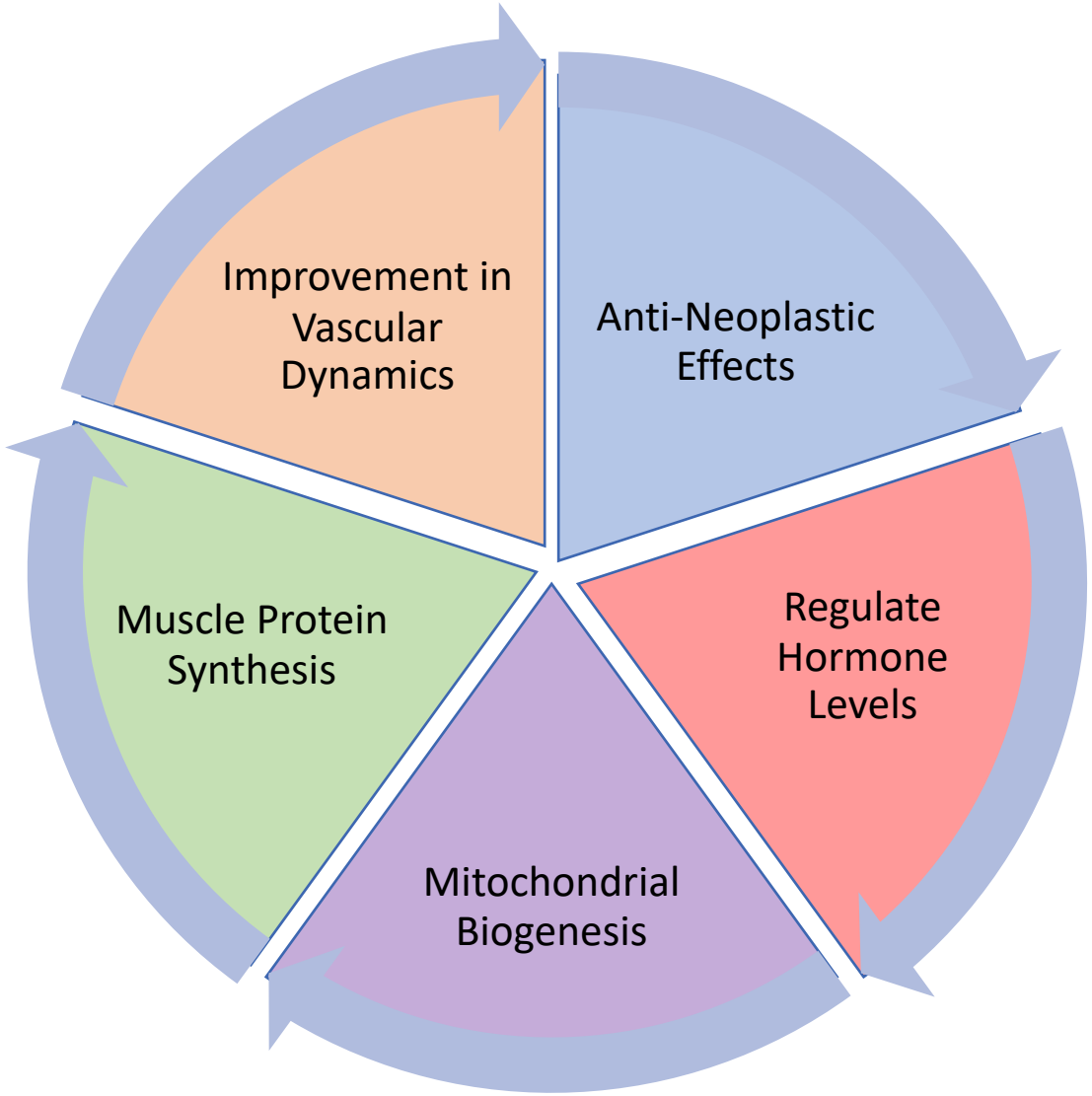
Molecular Effects of Cancer & Treatment 12-20





Koelwyn GJ, Quail DF, Zhang X, White RM, Jones LW. Exercise-dependent regulation of the tumour microenvironment. *Nat Rev Cancer*. 2017;17(10):620-632.

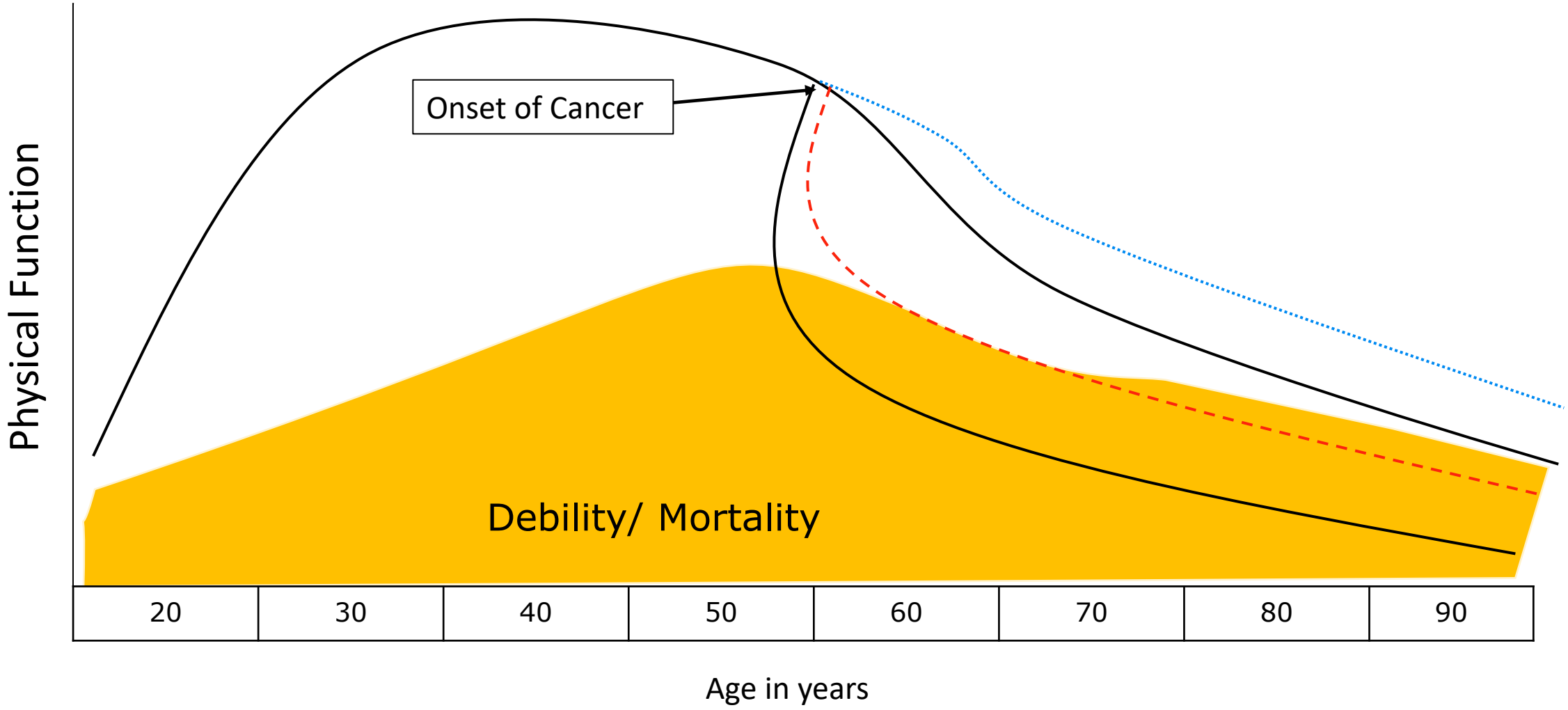
Why Exercise Matters on a Molecular Level [22,23]



Potential Benefits of Exercise Oncology [24]

- **Strong Evidence**
  - Anxiety
  - Fatigue
  - Health Related QoL
  - Lymphedema
  - Physical Function
- **Moderate Evidence**
  - Bone Health
  - Sleep
- **Insufficient Evidence**
  - Cardiotoxicity
  - CIPN
  - Cognitive Function
  - Falls
  - Pain
  - Tx Tolerance
  - Nausea

Effects of Aging on Physical Function 25



ExRX in Individuals with Cancer [24,26]

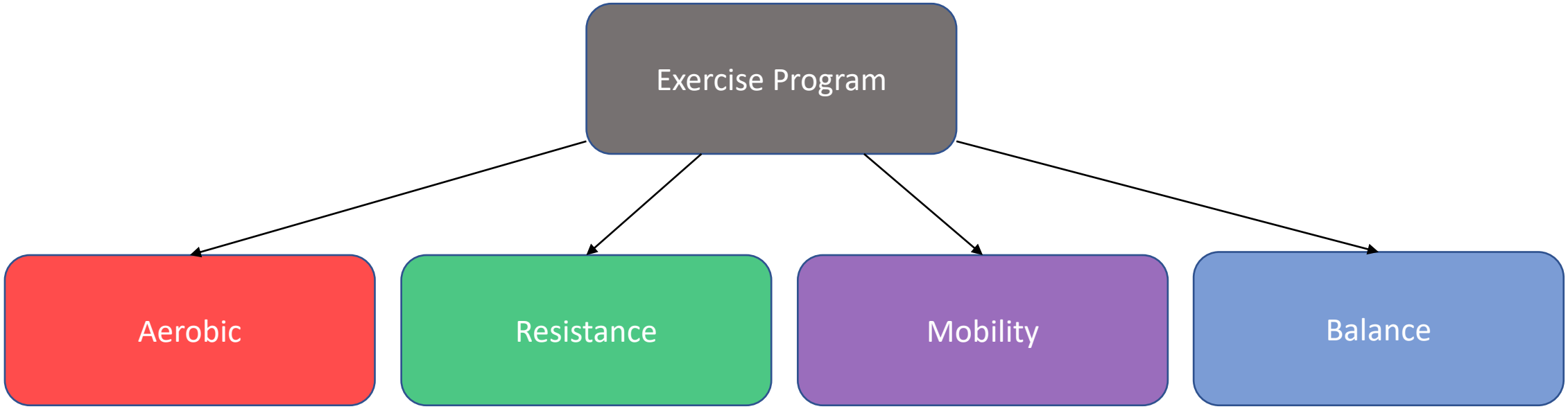
- Minimum recommendations by *ACSM*:
  - 30 minutes of aerobic exercise 3x per week
    - Resistance training 2x per week focusing on large muscle groups
      - 2 sets of 12-15 repetitions
    - However, individuals with cancer should attempt to be active everyday 3x for at least 10 minutes
- Should aim to meet the *ACSM/WHO* minimum requirements of 150 minutes of moderate & or 75 minutes of vigorous exercise per week.
- Due to the importance of exercise in the oncology population it should be considered a **vital sign** much like blood pressure, pain, heart rate, etc.
  - This is where we should regularly assess and advise about exercise

Assessing for Physical Activity/Exercise

- Regularly assess physical activity/ exercise participation across multiple time points.
  - Prospective surveillance model
    - At time of diagnosis
    - As the person is moving through treatment
    - At the end of treatment
    - Into survivorship
- Integrate within the health system, Multi-D clinics, Community, etc.
  - Provide information on becoming physically active & refer if necessary & willing
    - Physicians have reported that they don’t feel confident in educating on exercise or don’t have the time to

Foundations of an Exercise Program

It Shouldn’t be a Siloed Approach



Principles of Exercise Program (ACSM)[29]

- Frequency
- Intensity
- Type
- Time
- Specificity
- Volume
- Progressive Loading

Aerobic Training 30

Frequency

- 3-5x per week

Intensity

- 40-90% of VO_2max or HRR
- METs:
  - Moderate – 3 to 6 METs (walking 3.0 mph, stationary bicycling at 100 watts with light effort, light effort calisthenics)
  - Vigorous - >6 METs (jogging, jumping rope, heavy effort calisthenics)
- RPE:
  - Moderate 11-13/20 or 4-6/10
  - Vigorous: 14-17/20 or 7-9/10

Type

- Can really be any type of movement that allows for appropriate intensity though at times a stationary bike or NuStep may be the most appropriate if there are balance concerns.

Resistance Training 30-32

Frequency

- 2-3x per week on non-consecutive days

Volume (Sets x Reps x Resistance)

- Often 60-70% or 1RM is often considered the baseline for improving strength
- Resistance as low as 30% of 1RM may promote improvement in physical function as long as volume is appropriate.
- **10-20 sets per week per muscle**
- Overall volume may be the biggest factor to improving strength/muscle mass/physical function when the resistance is at appropriate level

Type

- Can be free weights, machines, resistance bands, or bodyweight.*
- Focus on large muscle groups with supplementary exercises for smaller muscle groups.

Rate of Perceived Exertion (RPE) scale [33]

Borg RPE Scale	Modified Borg (CR-10) RPE Scale	Perceived Effort
6		Very, Very Light Effort
7		
8		
9	0	Very Light Effort
10	1	Light Effort
11	2	
12	3	Moderate Effort
13	4	Somewhat Hard Effort
14		
15	5	Hard Effort
16	6	
17	7	Vigorous Effort
18	8	
19	9	Maximum Effort
20	10	

Adapted from Haddad et al. 2017

Repetitions in Reserve

Rating	Perceived Effort with Reps Remaining
10	Max Effort
9	1 rep remaining
8	2 reps remaining
7	3 reps remaining
6	4 reps remaining
5	6 reps remaining
3-4	Little Effort – 10+ reps remaining
1-2	No Effort
Adapted from Helms et al 2016	

Designing an Exercise Program

Designing an Exercise Program

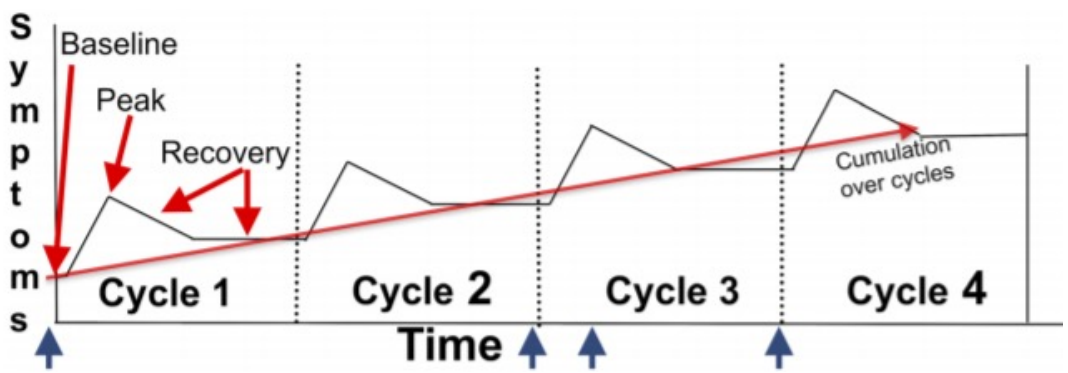
- **Assess**
  - Medical Background
    - Primary Diagnosis
    - Comorbidities
    - Lab Values
    - Cognition
    - Nutrition
  - Perceptions and Beliefs of Exercise
  - Goals and Main Concerns
  - Mobility and Physical Function

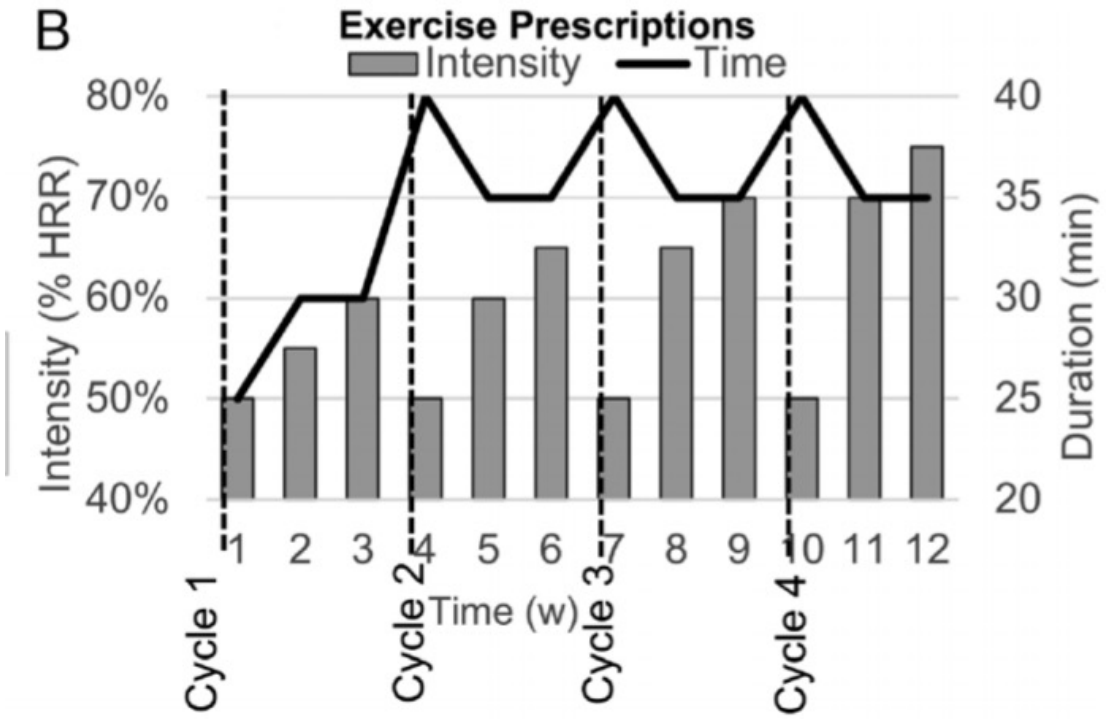
- Then we **synthesize** all of it to build an individualized exercise program

- Routinely **reassess** the to ensure progress with mobility and physical function

Performance Potential

- Performance may vary day to day & between sessions based on numerous intrinsic factors:
    - Fatigue
    - Sleep
    - Soreness
    - Pain
    - Anxiety
    - Lab Values
- Same weight/volume may not “feel” the same each session
    - 185 lb leg press 4x4 may be an RPE of 7 on Monday but on Thursday may be RPE of 10 which then could result in greater fatigue down the line.





43 Kirkham AA, Bland KA, Zucker DS, et al. "Chemotherapy-periodized" Exercise to Accommodate for Cyclical Variation in Fatigue. *Med Sci Sports Exerc*. 2020;52(2):278-286. doi:10.1249/MSS.0000000000002151

Pain vs. Soreness 37

Soreness	Pain
• Dull, tight, & achy feeling • Burning like feeling when exercising	• Sharp pain (stabbing, throbbing, aching) at rest or with activity
• May experience symptoms during exercise or within 24 hrs after & last 48-72 hrs	• During exercise or within 24 hrs after exercise/ activity • May linger & get worse with each bout of exercise or activity
• <u>Mobility, movement, rest, & recovery may improve symptoms</u>	• Targeted exercises, recovery, mobility, & <u>rest may improve pain</u>

Pain vs. Soreness [37,38]

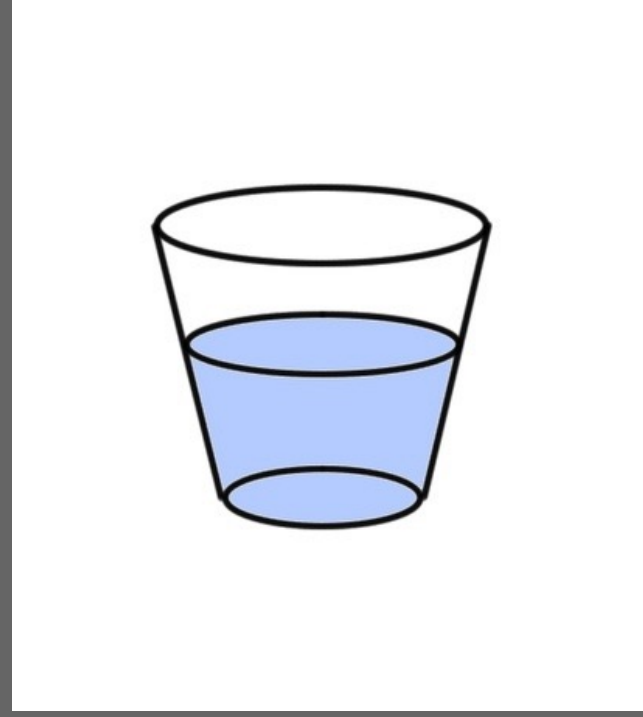
- If the person reports increased soreness from previous session(s) or pain with a specific movement may need to modify the session or movement.
- Before removing an exercise completely should attempt to modify
  - Modify the range of motion
  - Reduce the load or volume
  - Change the tempo
  - Break the movement into parts
  - Focus on either concentric or eccentric only
- Want to avoid promoting fear of movement and kinesiophobia
  - Resistance training has strong potential to reduce pain

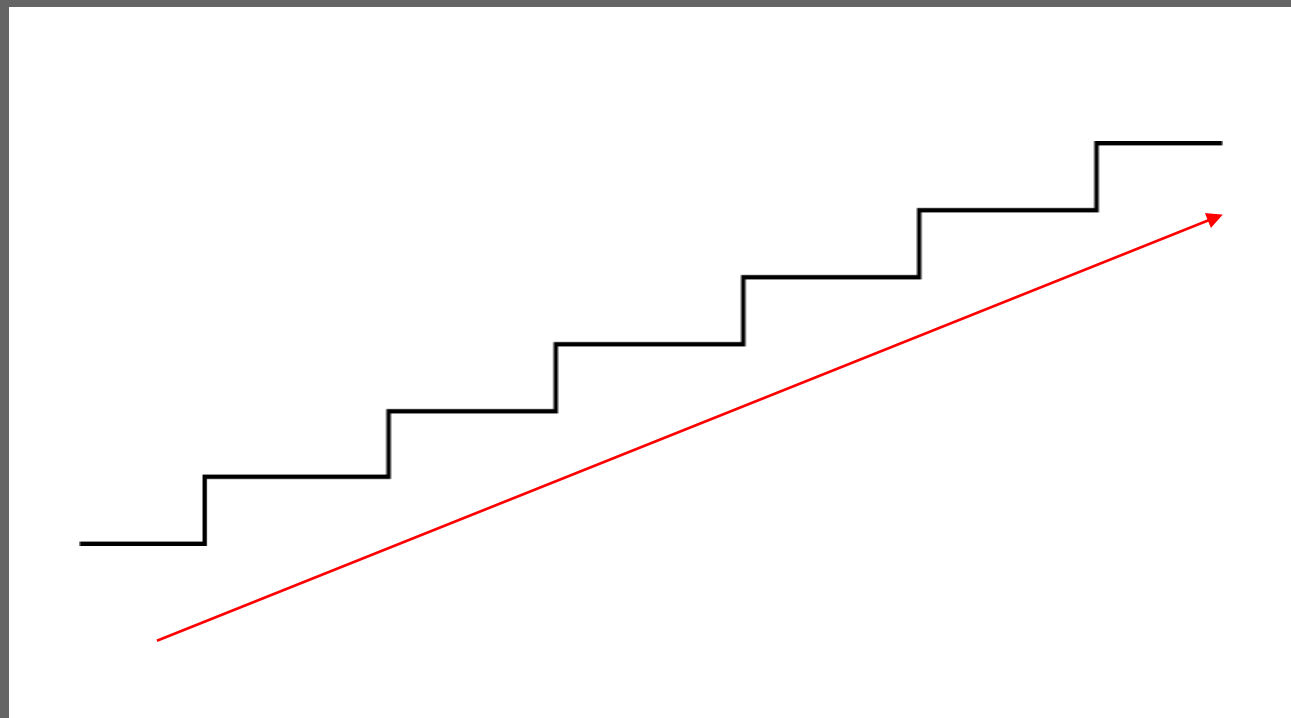
Where Exercise Programs Fall Short

The Pitfalls in an Exercise Program

39,40

- Often the exercise program is insufficient in:
  - Specificity
  - Volume
  - Progressive Loading to Adaptation





The Pitfalls [39,40]

1. **Specificity**: Exercise program needs to be specific to the goals
   - If the goals are to improve strength, then the program needs to reflect that
     - A walking program won't improve strength

2. **Volume**: Needs to be sufficient volume to the program to promote the required gains
   - Depending on the intensity (% of max, RPE, RIR) the volume may differ but percentages as low as 30% have shown to promote gains
   - Total Time Under Tension (TUT) per session or week

3. **Progressive Loading:** To get positive adaptations there needs to be progressive loading & to get progressive loading there needs to be positive adaptations
   - Moving away from the progressive overload where the thought is to just keep putting weight on the bar or machine

Specificity 41-43

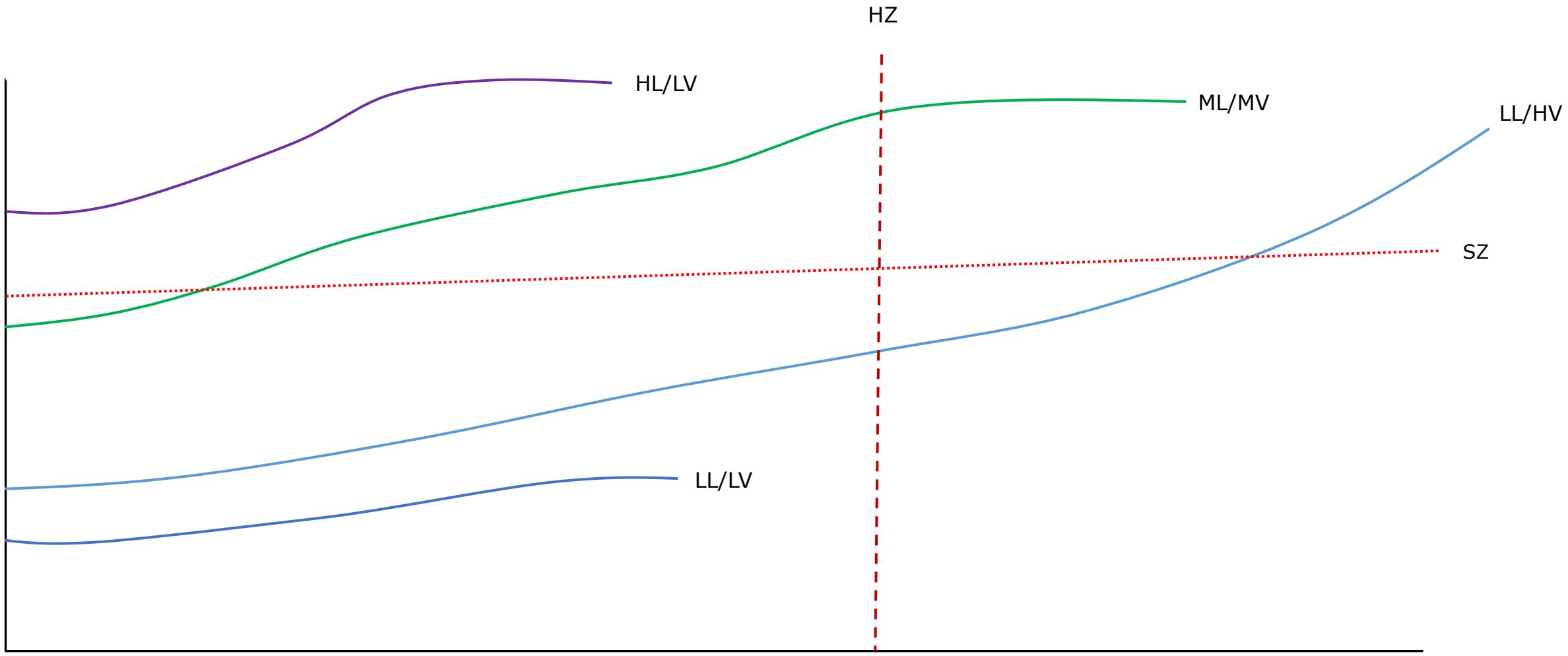
- Making the case for Reps over Steps
  - Often strength/power is significantly lacking in this population
    - Muscle Weakness is routinely seen before Muscle Atrophy
    - Type IIa/IIx atrophy is escalated due to sedentary nature
  - A walking program is beneficial to promote activity but isn't specific in this case
    - **<u>If they're weak, can they even walk a meaningful distance to promote physical function?</u>**
  - Further looking at mortality and overall survival there is a correlation with muscle strength/mass and improved outcomes
- There is the thought of repetition range for producing strength, hypertrophy, or endurance
  - If strength increases hypertrophy will most likely occur and vice versa
  - First → Neuromuscular adaptations: Then → Structural Changes

Volume

- Volume (load x sets x reps) is often the critical factor in eliciting positive adaptations
  - Often what is lacking in the oncology population for exercise programs
- Don’t want to just pick a resistance but want to progressively load within the exercise program
  - This is where initial and then continual assessment of function and performance potential is important
- When volume is sub-threshold there will either be null or blunted positive adaptations & improvement in physical function

Food for Thought [44, 45]

- Heavy resistance isn't the end all for promoting strength/hypertrophy
  - Higher loads will = greater strength gains (some hypertrophic adaptations)
  - Lighter loads will = strength/hypertrophic adaptions (to an extent)
- Load management is intricately intertwined with overall sets and repetitions (Volume)
  - Need to sufficiently stimulate motor units to promote strength/hypertrophic gains
    - Whether it be with low/moderate/high loads
    - May easily miss the mark for strength/hypertrophic gains depending on chosen load and/or volume
- Movement of exercise also has important neuromuscular adaptations that can be critical for overall physical function in the oncology population



HZ – Hypertrophy Zone; SZ – Strength Zone
HL/LV – High Load/ Low Volume
ML/MV – Moderate Load/Moderate Volume
LL/HV – Low Low/High Volume
LL/LV – Low Load/ Low Volume

Progressive Loading

- There are almost an infinite number of ways to alter/modify an exercise program
  - Rest
  - Sets
  - Reps
  - Resistance
  - Routine
  - Sequencing
- There is a high likelihood to see significant variations across sessions with exercise prescription.
- To ensure adequate volume and progressive adaptations there needs to be some consistency with exercise selection across sessions
  - Can mix it up between sessions but can’t have completely new exercise(s) every session

Progressive Loading 46

- So how do we progressively load or progress an exercise program?
  - Consider Performance Potential
  - Shouldn't just arbitrarily select a weight and/or exercise(s)
    - Consistency is key
  - Use of Rating of Perceived Exertion (RPE) & Reps in Reserve (RIR) - best option
    - Allows for autoregulation from a session to session/ week to week basis
- Don't have to only manipulate exercise volume, intensity, & duration to progressively load
  - Lying/sitting → Standing
  - Uni-planar or one-dimensional → Multi-planar or three-dimensional
  - Stable → Unstable
  - Without visual deprivation → With visual deprivation
  - Bilateral → Unilateral
  - Single task → Double task

Exercise Periodization

- **Macrocycle:** Traditionally thought of a full season or year
- **Meso- & Microcycles** can be broken into weeks or sessions to allow for optimal programming
  - Allows for considerations of chemotherapy, radiation therapy, surgery, functional performance status
- **Linear**
  - Incremental increase in volume & load
  - In traditional setting of S&C for an athlete: Hypertrophy → Strength → Power
  - May not necessarily conform to the rehab/wellness settings
- **Undulating**
  - Varying volume & load from week to week
    - Strength → Deload → Maintain → Strength→ Hypertrophy
    - Fitting for the rehab/wellness setting
      - Stabilize → Restore → Strengthen
      - Balance → Strengthen → Mutlimodal → Maintanence

Example Routines to Build Exercise Programs

- Full Body & Split Routines
  - Aerobic/ Balance/ Resistance
  - Upper/ Lower Body
  - Push or Pull or Combined
- Metcons
  - Couplet
  - Triplet
- Circuit Training
- Interval Training
- Traditional Sets
- Cluster Sets
- High Speed Resistance Training
- SuperSets
- Drop Sets
- Isometrics
- Eccentrics

Exercise Programming: Metcon

- Couplet (2 movements)
- Triplet (3 movements)
- Can be for time or have a time limit
- Predetermined volume prior to starting the movements
  - Useful for including aerobic movements & resistance movements
  - As much rest as needed & whenever just has to complete all the repetitions

- Couplet:
  - 40-30-20-10
    - Step Up and Overs
    - Wall Push Ups
- Triplet
  - 3 Rounds
    - 25 squats
    - 10 Modified Burpees
    - 12 TRX Rows

Exercise Programming: Circuit Training [47]

- Circuit Training
  - Beneficial as it can include all four groups of the program within a session
  - Use of balance exercises as planned rest periods
  - Exercises can be completed for time or repetitions to include aerobic & resistance training
  - Also allows for continuous volume accumulation

- 4 Rounds
  - 20 reps - TRX Lunges
  - 12 reps - Machine Rows
  - 40 reps - Modified Mountain Climbers
  - 12 reps - Lat Pulldowns
  - 8 reps - Leg Press
  - 12 reps - Modified Push Ups

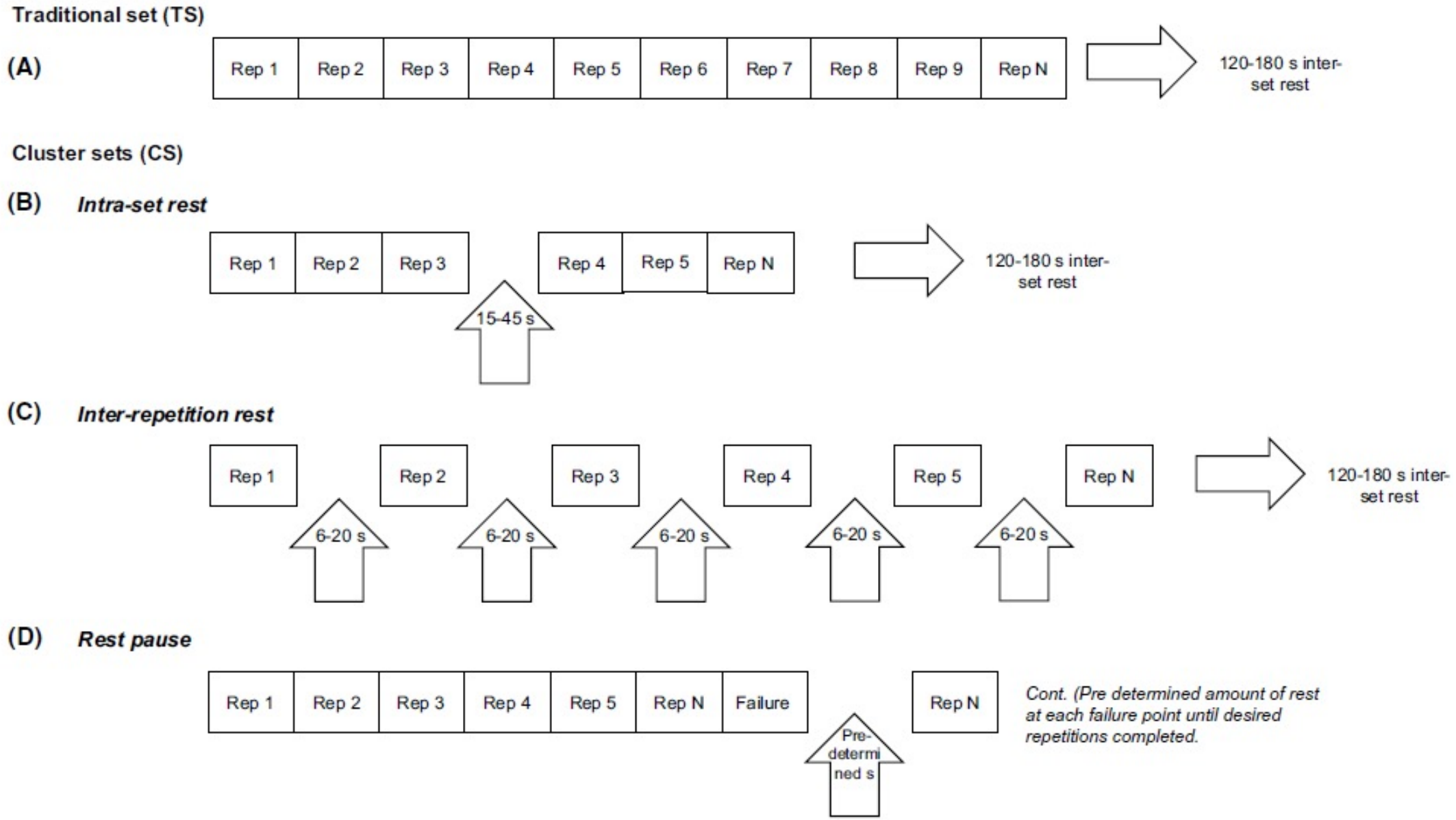
Exercise Programming: Intervals

- Interval Training
  - More based on Work to Rest Intervals
  - Will often be a higher effort whether perceived (RPE) or physiologically (heart rate)
  - Work to Rest ratio can vary based on the person
  - Work can be as little as 10 sec. up to 180 sec.

- Tabata
  - 8 Rounds of 20 sec/ 10 sec (W/R)

- 6 Rounds
  - 30 sec/30 sec (W/R)
    - Mini Squats
    - Wall Push Ups
    - Step Ups
    - Modified Mountain Climbers
  - After each round 2 minute rest

Resistance Training: Cluster Sets 48



Resistance Training: High Speed Resistance Training (HSRT)/ Power Training (PT) [49,50]

- Load is usually heavier but lower load (40-60% 1RM)
- Moves away from the “don’t go too fast/ fast is not better” philosophy
- Concentric phase is completed as fast as possible with a controlled eccentric phase
- Promotion of power; maximal motor unit recruitment; favoring of Type IIa & Type IIx fibers (fast twitch) which are more prone to disuse & atrophy
- Focus on multi-joint movements utilizing larger musculature

Wrap Up

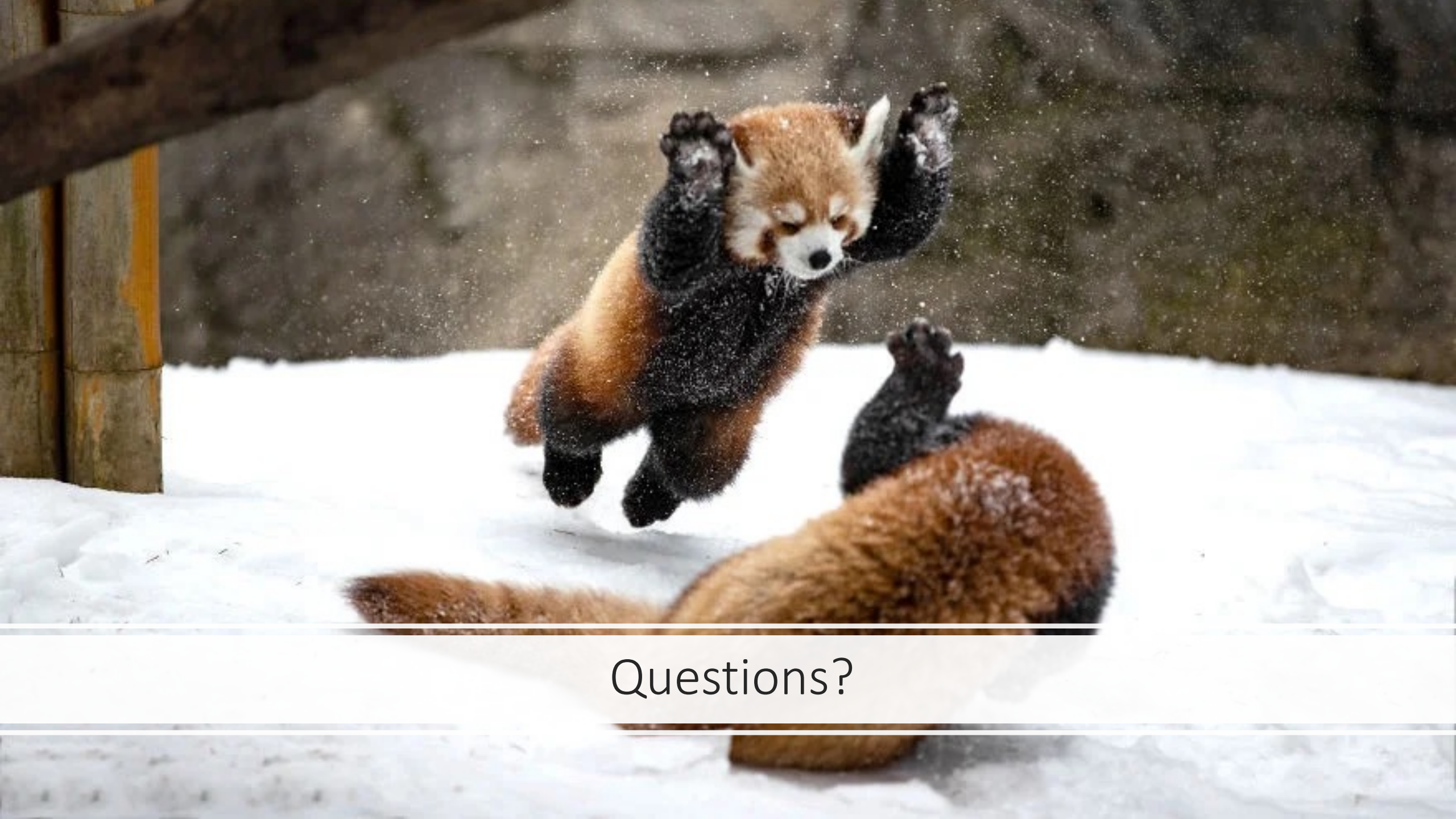
Key Points [51,52]

- If you really want Exercise to be Medicine, then it needs to be specific & at the correct dose (**volume**) just like chemotherapy, radiation therapy, etc.
  - However, some exercise is better than none – we all start somewhere
- The exercise program and exercises need to be thoughtful to the person and situation
  - You don't have to chase the fancy/shiny exercises
    - Keep It Simple and Straightforward (KISS)
  - One exercise can be used an infinite number of ways for an infinite number of responses.
- Consistency within the exercise program to allow for positive adaptations
  - Routinely assess RPE, RIR, performance potential, and benchmarks to ensure progression

Key Points [51,52]

Moving exercise forward in oncology population

- We know exercise is beneficial, but we need to figure out how to
  - Get persons living with & beyond cancer moving
  - Improve understanding of the benefits of exercise to other healthcare professionals, patients, family members, and other persons within the community
  - Promote the use of perspective surveillance with exercise
  - Integrate within health systems, Multi-D clinics, and develop programs to promote exercise and physical activity



Questions?

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