



OPTIMIZING SURGICAL OUTCOME THROUGH ERAS AND PRE-HABILITATION

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Learning Objectives

- Describe opportunities for improving nutrition care in surgery
 - Implementation science approaches
- Discuss Enhancing Recovery After Surgery approaches
- Review how ERAS impacts Nutrition Care
- Describe Pre-Habilitation and its impact on outcome

ERAS Guiding Principles: *A Paradigm Shift*

- Conventional perioperative metabolic care: a stress response to major surgery is inevitable.
- ERAS: a substantial element of the stress response can be avoided with the appropriate application of modern anaesthetic, analgesic and metabolic support techniques.
- Conventional postoperative care: emphasize prolonged rest for both the patient and their gastrointestinal tract.
- ERAS: In the catabolic patient, medium-term functional decline will ensue if active steps are not taken to return the patient to full function as soon as possible.

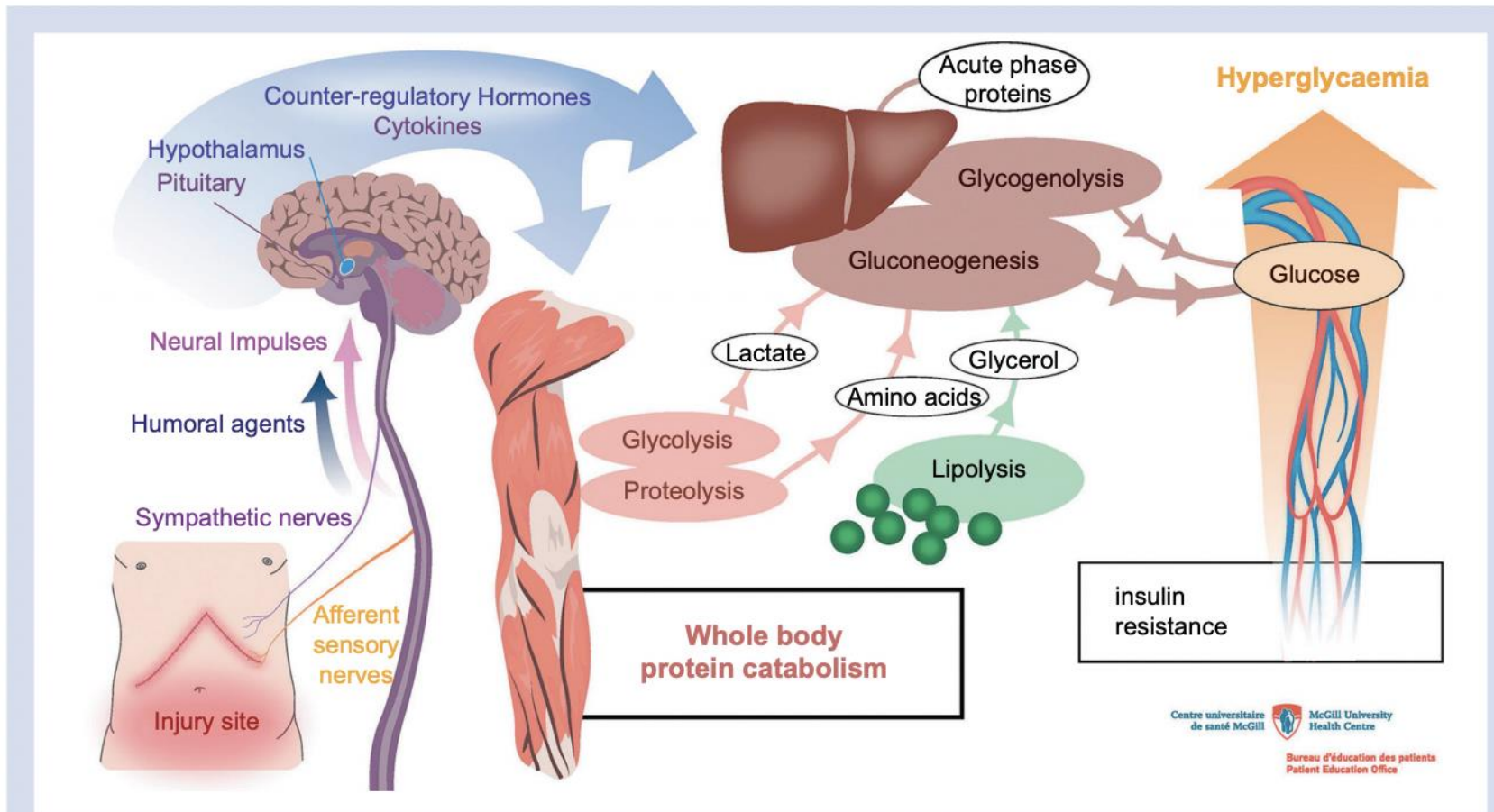


Fig 1. Surgical stress response. An increase in circulating glucocorticoids, catecholamines, and glucagon (i.e. counter-regulatory hormones) is elicited by activation of the hypothalamic–pituitary–adrenal axis and sympathetic nervous system. The response is mediated by afferent nerves and humoral factors including cytokines generated from the site of injury. Mobilisation of energy reserves promotes hyperglycaemia and catabolism. Hyperglycaemia develops as a consequence of insulin resistance coupled with an inappropriately high hepatic glucose production. Proteolysis and lipolysis accelerate to provide precursors for gluconeogenesis. The resultant amino acid efflux also supports the synthesis of proteins involved in the acute-phase response. (Reprinted with permission from Gillis et al⁵, figure 1.)



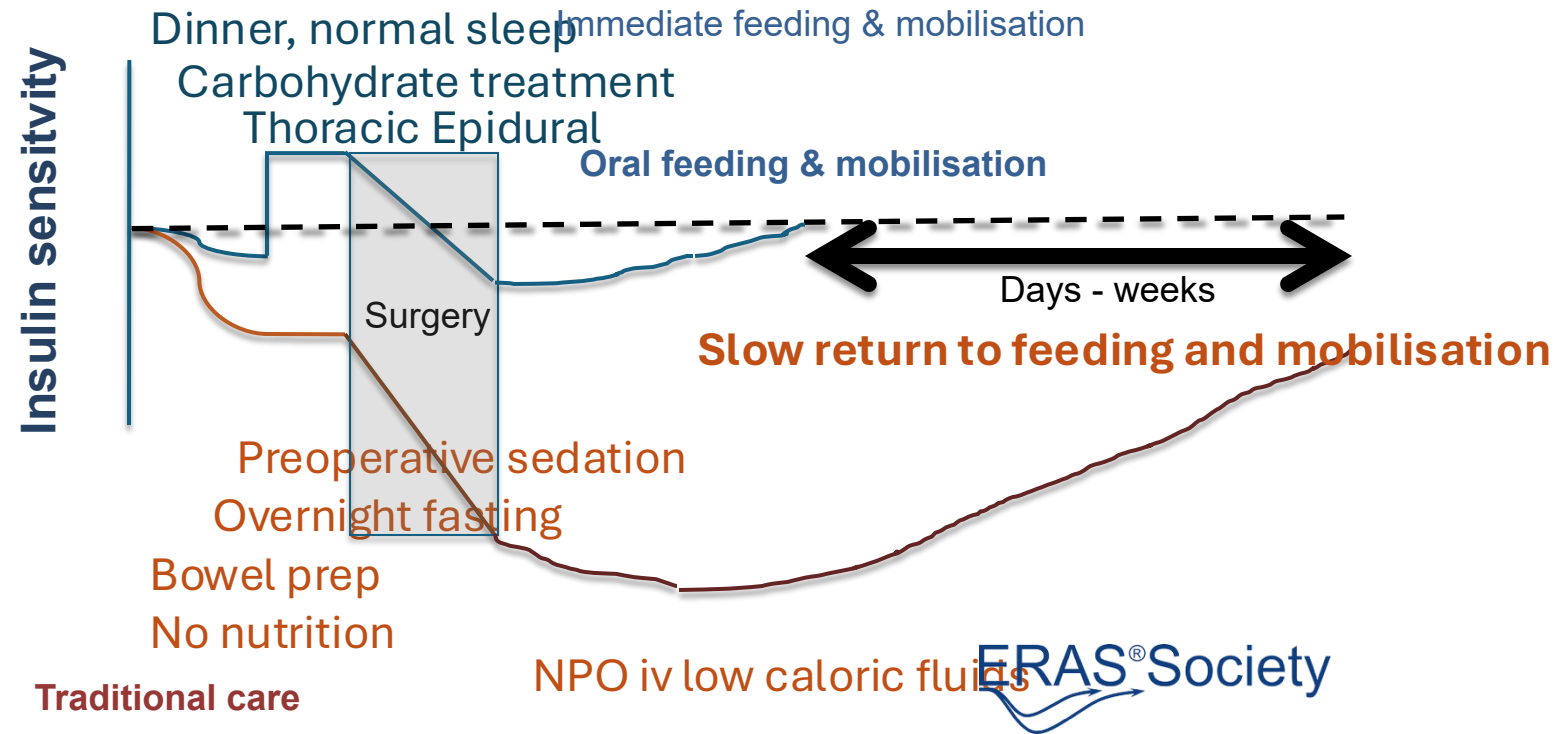
Enhanced Recovery After Surgery

What are we trying to achieve?

Patient back to preoperative function

- **Normal gastrointestinal function**
 - **Normal food intake**
 - **Bowel movement**
- **Pain control**
- **Mobility**
- **No complications**

ERAS Care



Ljungqvist JPEN 2012

ERAS: evidence based guidelines

World J Surg
DOI 10.1007/s00268-012-1772-0

Colon



Guidelines for Perioperative Care in Elective Colonic Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations

U. O. Gustafsson · M. J. Scott · W. Schwenk · N. Demartines · D. Roulin ·
N. Francis · C. E. McNaught · J. MacFie · A. S. Liberman · M. Soop ·
A. Hill · R. H. Kennedy · D. N. Lobo · K. Fearon · O. Ljungqvist

World J Surg
DOI 10.1007/s00268-012-1771-1

Pancreas



Guidelines for Perioperative Care for Pancreaticoduodenectomy: Enhanced Recovery After Surgery (ERAS®) Society Recommendations

Kristoffer Lassen · Marielle M. E. Coolen · Karen Slim · Francesco Carli ·
José E. de Aguiar-Nascimento · Markus Schäfer · Rowan W. Parks ·
Kenneth C. H. Fearon · Dileep N. Lobo · Nicolas Demartines · Marco Braga ·
Olle Ljungqvist · Cornelis H. C. Dejong

Others...

- Gastrectomy
- Radical cystectomy
- Breast Reconstruction (Temple-Oberle)
- H&N Cancer (Dort)
- Cesarian Section
- Orthopedics: Hip and Knee
- Cardiothoracic

World J Surg
DOI 10.1007/s00268-012-1787-6

Rectal



Guidelines for Perioperative Care in Elective Rectal/Pelvic Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations

J. Nygren · J. Thacker · F. Carli · K. C. H. Fearon ·
S. Norderval · D. N. Lobo · O. Ljungqvist ·
M. Soop · J. Ramirez

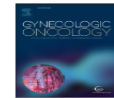


Contents lists available at ScienceDirect

Gynecologic Oncology

journal homepage: www.elsevier.com/locate/ygyno

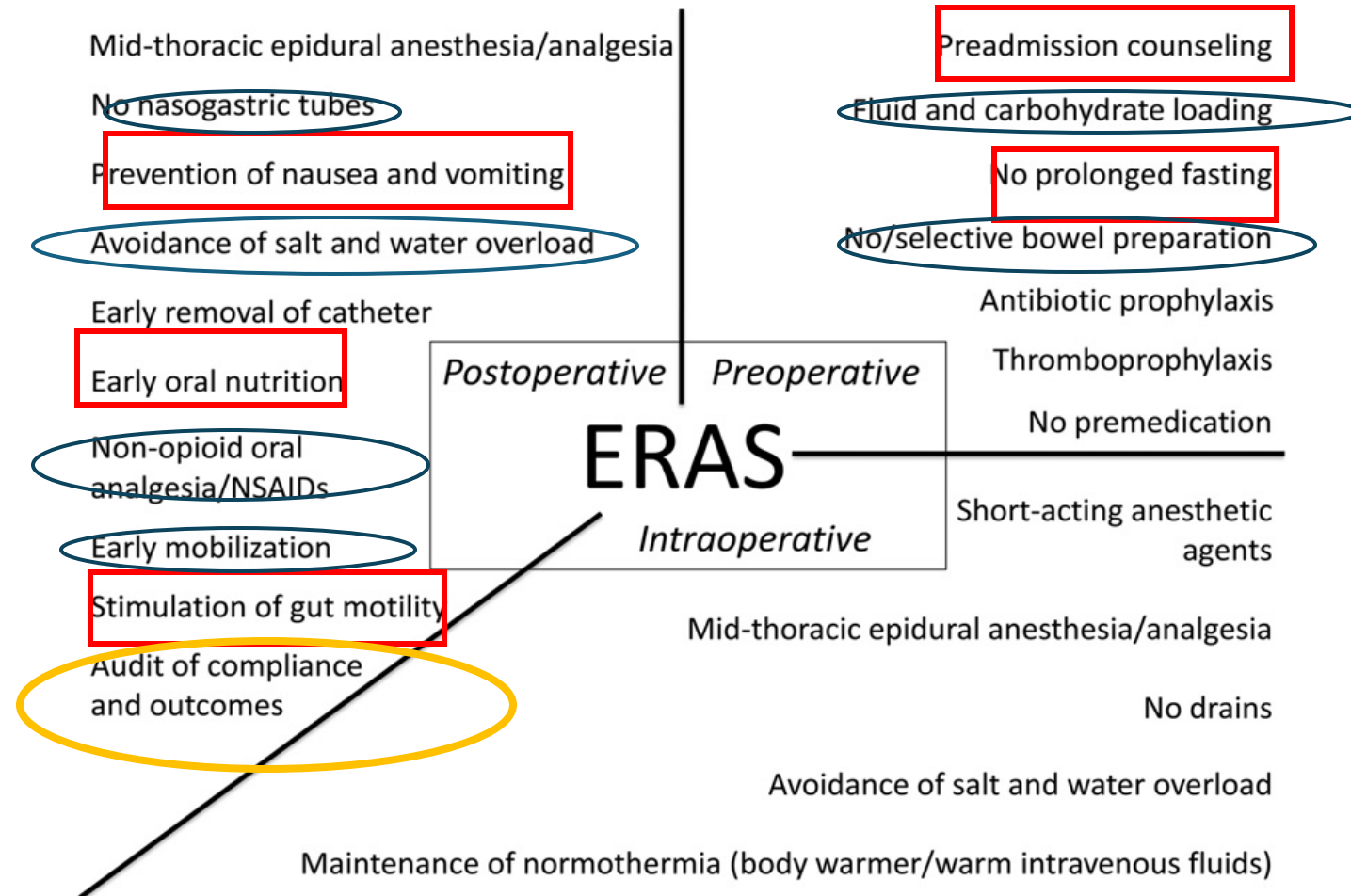
Gyn/
Onc



Guidelines for pre- and intra-operative care in gynecologic/oncology
surgery: Enhanced Recovery After Surgery (ERAS®) Society
recommendations — Part I

Nelson G.^{a,*}, Altman A.D.^b, Nick A.^c, Meyer L.A.^c, Ramirez P.T.^c, Ahtari C.^d, Antrobus J.^e, Huang J.^f, Scott M.^{g,h},
Wijk L.ⁱ, Acheson N.^j, Ljungqvist O.^k, Dowdy S.C.^l

Enhancing **Nutrition** Care in Surgery



Key Aspects of Perioperative Nutrition Care

Weimann et al. Clin Nutr 2006. ESPEN Guidelines on Enteral Nutrition: Surgery

- avoidance of long periods of pre-operative fasting
- re-establishment of oral feeding as early as possible after surgery,
- integration of nutrition into the overall management of the patient,
- metabolic control, e.g. of blood glucose
- reduction of factors which exacerbate stress-related catabolism or impair GI function, optimize symptom control
- early mobilization

- Screening for malnutrition

What to expect from ERAS: audit of compliance to care elements allows tailored interventions resulting in impact on outcome



Savings of around 2,500\$/patient after 20 ERAS patients (Swiss data)

PROV: ERAS Elective Colorectal 2015-2016 Performance Highlights

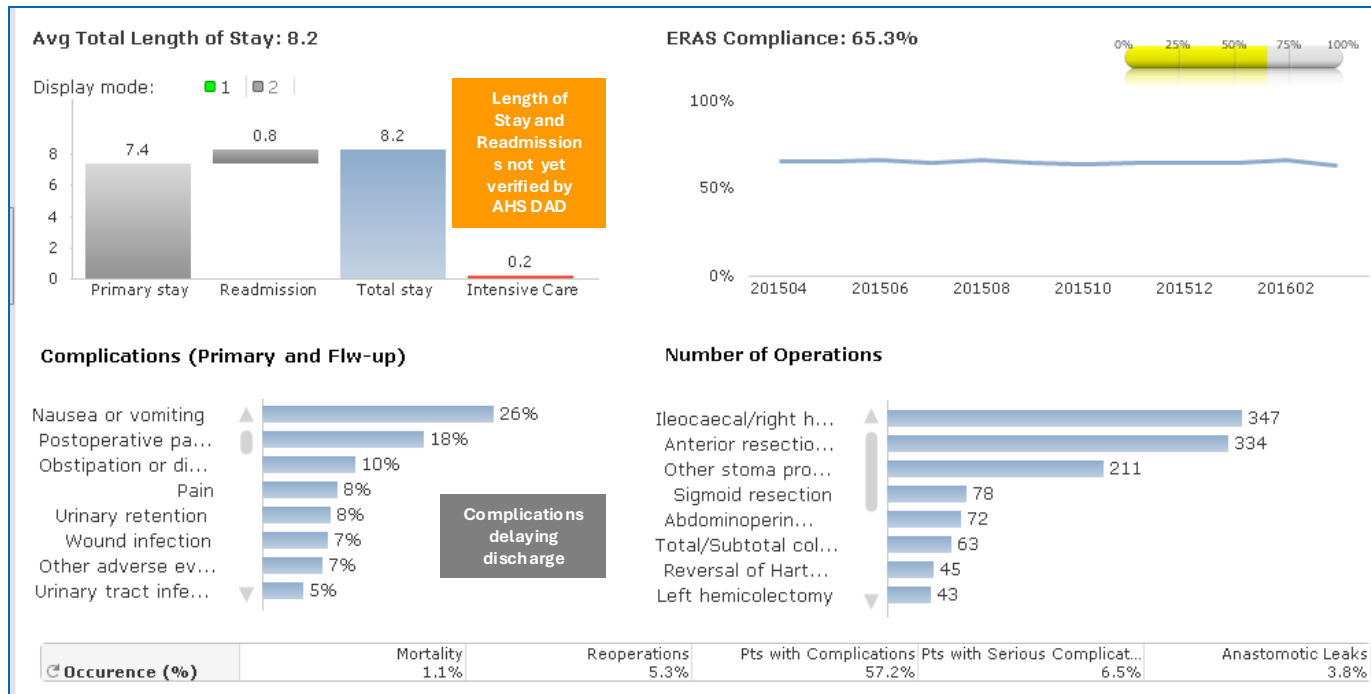
FMC, PLC, GNCH, MCH, UAH, RAH

2. Dashboard Overview

ERAS Alberta

Date Range: Apr 1, 2015 to Mar 31, 2016

N = 1330 patients



Nutrition Care in ERAS

Martin et al Clin Nut 2017

- 3972 patients – elective colorectal and small bowel surgery
- average age of 61.0 ± 14.2 years
- BMI 28.2 ± 6.2 .
- Cancer diagnosis – 47%
- Nutrition Risk Screen Positive: 14% (CNST)

Nutrition Care in ERAS

Martin L, Gramlich L, JPEN 2018

	Pre-ERAS	Post-ERAS	P value
Malnutrition Screening	9%	74%	<0.001
Carbohydrate loading	3%	63%	<0.001
Bowel Prep (no)	55%	72%	<0.01
Time to tolerate first meal	5.9 d	2.9 d	<0.001
ONS consumption POD 0, 1*	0%, 0.2%	20%, 30%	<0.01,

* - ONS consumption target POD 0 = 300kcal; POD 1= 600kcal

Does ERAS Impact Nutrition Care: YES

- Nutrition care becomes part of the care process for surgery
- All HCP involved
- Increase screening, intervention
- Interdisciplinary Nutrition care – becomes integrated with “best care”
- Challenges: capture of relevant nutrition data
- Impact in higher risk populations (eg – Pancreas)?

Optimizing Pain and Symptom Control in ERAS to Enhance Nutrition Care

- Nausea and Vomiting Prophylaxis: assessment, intervention
- Ileus prevention – gum chewing, laxative therapy
- Non-opioid analgesia
- Early mobilization
- Avoidance of tubes and drains
- Appropriate IV hydration

What is prehabilitation?

PREHABILITATION: PARADIGM SHIFT

- Surgical recovery is NOT a passive process.
- Recovery begins BEFORE surgery.

Table 3 Phases with impact on surgical recovery.

Phase of recovery	Definition	Time frame	Example measures
Pre-admission (proposed)	Preparation for postoperative recovery	Weeks to months	Adequate functional capacity to withstand surgical stress; resolution of malnutrition; sense of control and self-efficacy; prophylactic measures provided such as antibiotics and carbohydrate loading
Intraoperative	During the course of the surgical procedure	Hours	Fluid balance, pain and anaesthesia management
Postoperative			
Early	Until discharge from PACU	Hours	Vital signs
Intermediate	Until discharge from hospital	Days	Bowel recovery; length of hospital stay
Late	Until illness no longer disrupts everyday life	Weeks to months	Patient-reported resolution of symptoms; return to pre-surgery activities and functional capacity

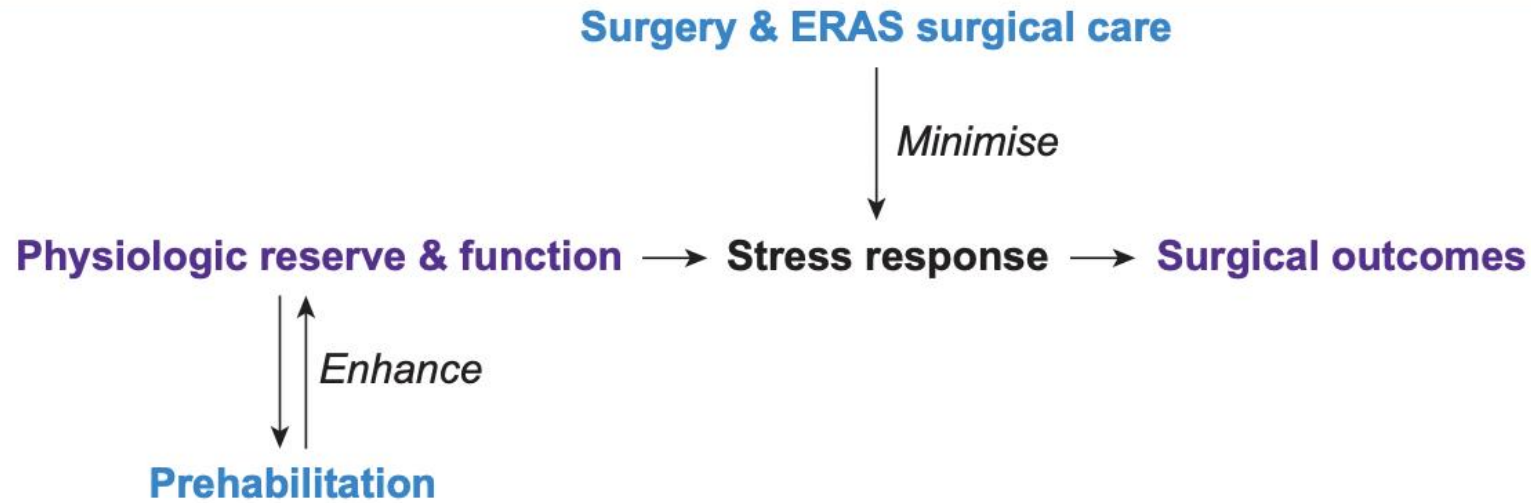


Fig 3. Perioperative interventions modify surgical outcomes through mediation of the surgical stress response. Patients present to surgery with unique *physiological reserves* and *physiological capacities* that influence *surgical outcomes*. A patient's physiological reserve can alter (i.e. mediate) *surgical stress*: a patient with adequate physiological reserve will likely generate a typical surgical stress response, whereas a patient with inadequate physiological reserve is likely to generate an impaired stress response (overexpressed or underexpressed responses to injury). Enhanced recovery after surgery (ERAS) and prehabilitation interventions can modify surgical outcomes in complementary ways through mediation of the surgical stress response. ERAS interventions minimise the surgical stress response, whereas prehabilitation interventions enhance physiological reserve and functional capacity. Having poor physiological reserve and functional capacity (e.g. malnutrition, frailty) can make full participation and adherence to prehabilitation challenging, potentially limiting the intervention's efficacy.

PREHABILITATION: DEFINED

Prehabilitation:

An intervention designed to improve functional capacity in preparation for *an impending stressor*

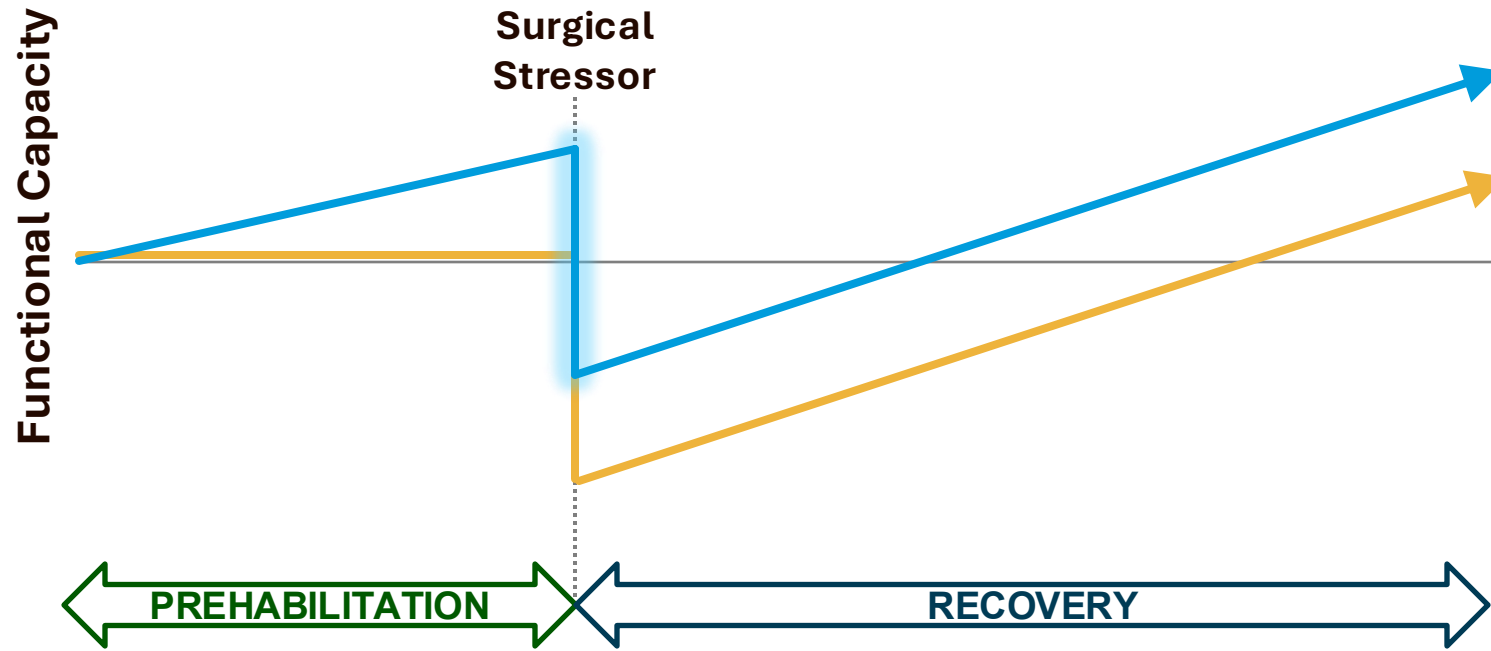


Table 1 An example of a multimodal prehabilitation program. Prehabilitation programs are evolving as ongoing trials add to our understanding of who, what, and how patients benefit from prehabilitation.

	Prehabilitation components		
	Nutrition	Exercise	Psychosocial
Screen and assess	Canadian Nutrition Screening Tool ¹⁰⁴ Patient-Generated Subjective Global Assessment (PG-SGA) ¹⁰⁵ Haemoglobin A1C Body composition ¹⁰⁶ C-reactive protein ¹⁰⁶	Duke Activity Status Index ¹⁰⁸ Gait speed ¹⁰⁹ Six-minute walk test (6MWT)	Hospital anxiety and depression scale (HADS) ¹¹⁰ Distress thermometer ¹¹¹
Diagnose or identify	Malnutrition Sarcopaenia Poor glycaemic control Inadequate energy protein intake	Frailty Sedentary behaviour	Distress
Intervene	Risk stratified and personalised ¹⁰⁷ : PG-SGA <4 or SGA A: Nutrition class PG-SGA 4–8 or SGA B: Short, targeted intervention to treat primary diagnosis PG-SGA ≥9 or SGA C: Specialist intervention with one-on-one counselling (often requires supplementation or nutrition support).	Risk stratified and personalised to include major muscle group strengthening and aerobic prescription.	Personalised interventions for patients and caregivers can include: Breathing exercises Visualisation Relaxation Guided meditation Goal setting and self-monitoring Positive reinforcement Social support
Monitor and evaluate	PG-SGA numeric score Food records and recalls Adherence to supplements Weight Body composition	Borg rating of perceived exertion scale to monitor progression 6MWT 30-s sit-to-stand Arm curl test Accelerometer Activity logs or questionnaires	HADS HeartMath Patient reported outcomes, experience, and satisfaction questionnaires

Functional Capacity

FUNCTIONAL CAPACITY: WHAT IS IT?

Functional capacity is the ability to independently perform the physical and mental activities of daily life, including recreational, occupational, and leisure activities.

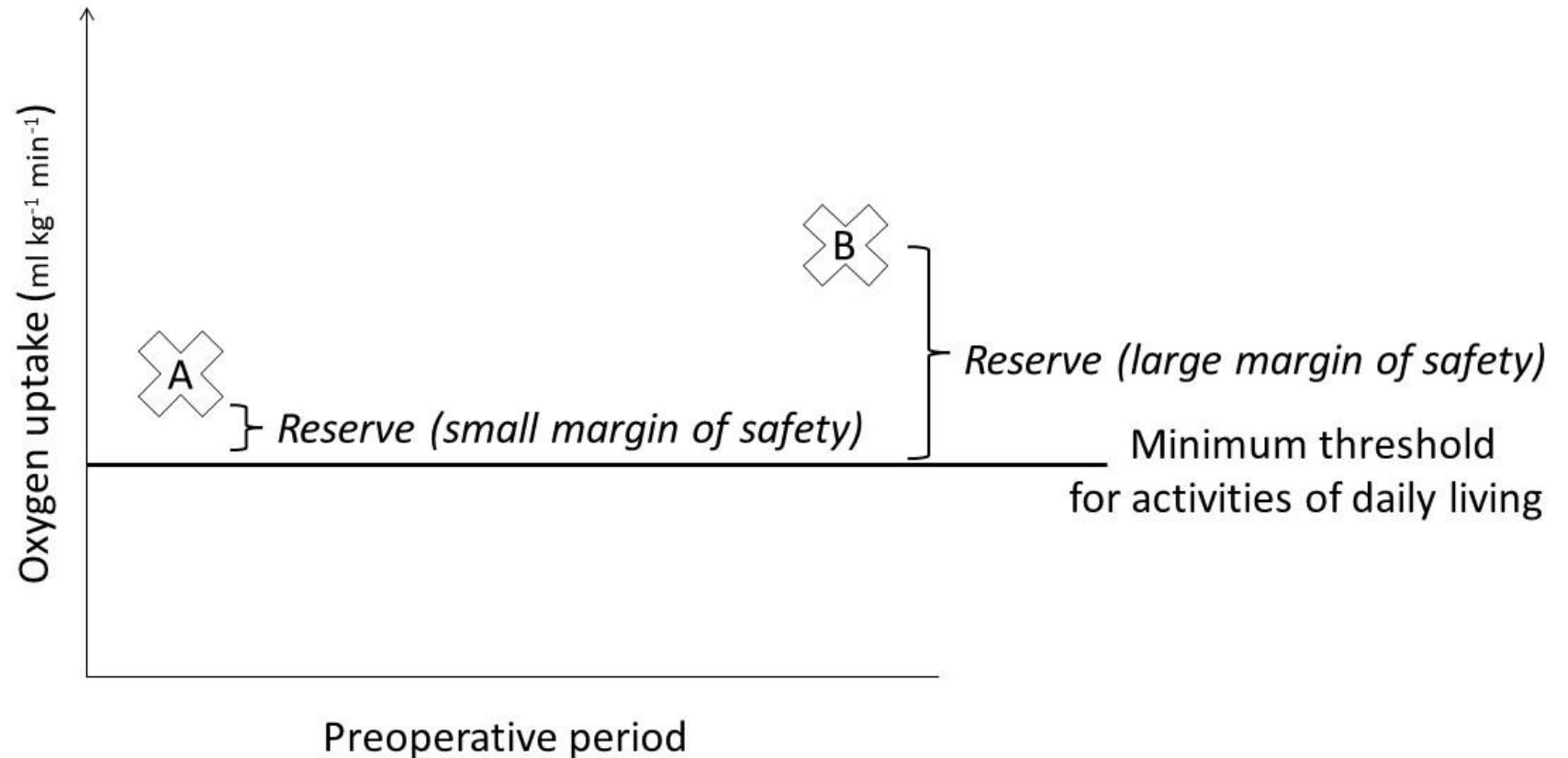
Common functional capacity tests used in prehabilitation



FUNCTIONAL CAPACITY: WHY IS IT IMPORTANT FOR SURGERY?

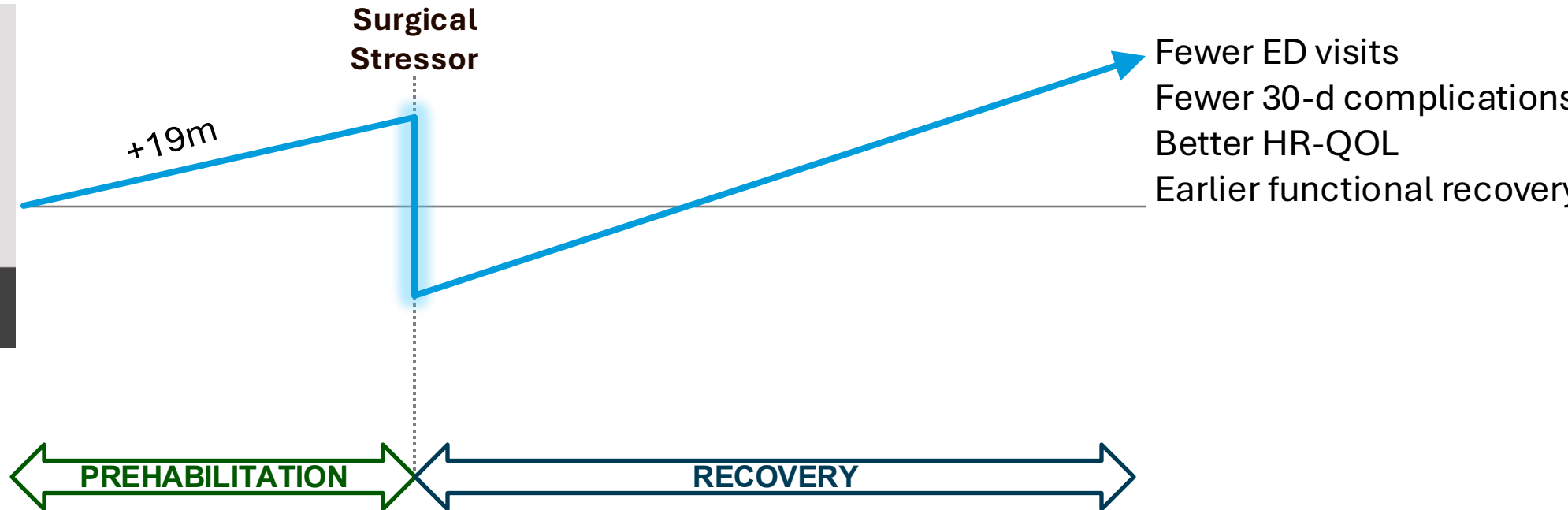
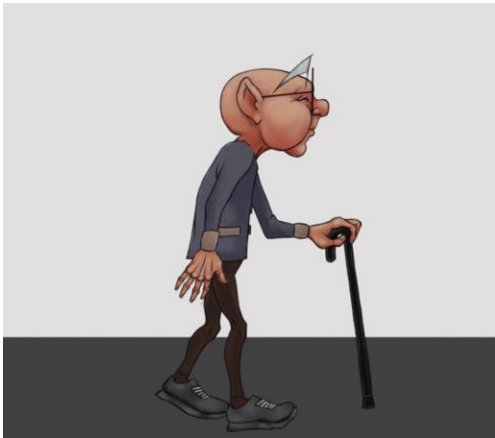


CPET measurement of oxygen uptake at increasing levels of physical work (i.e., exercise capacity)

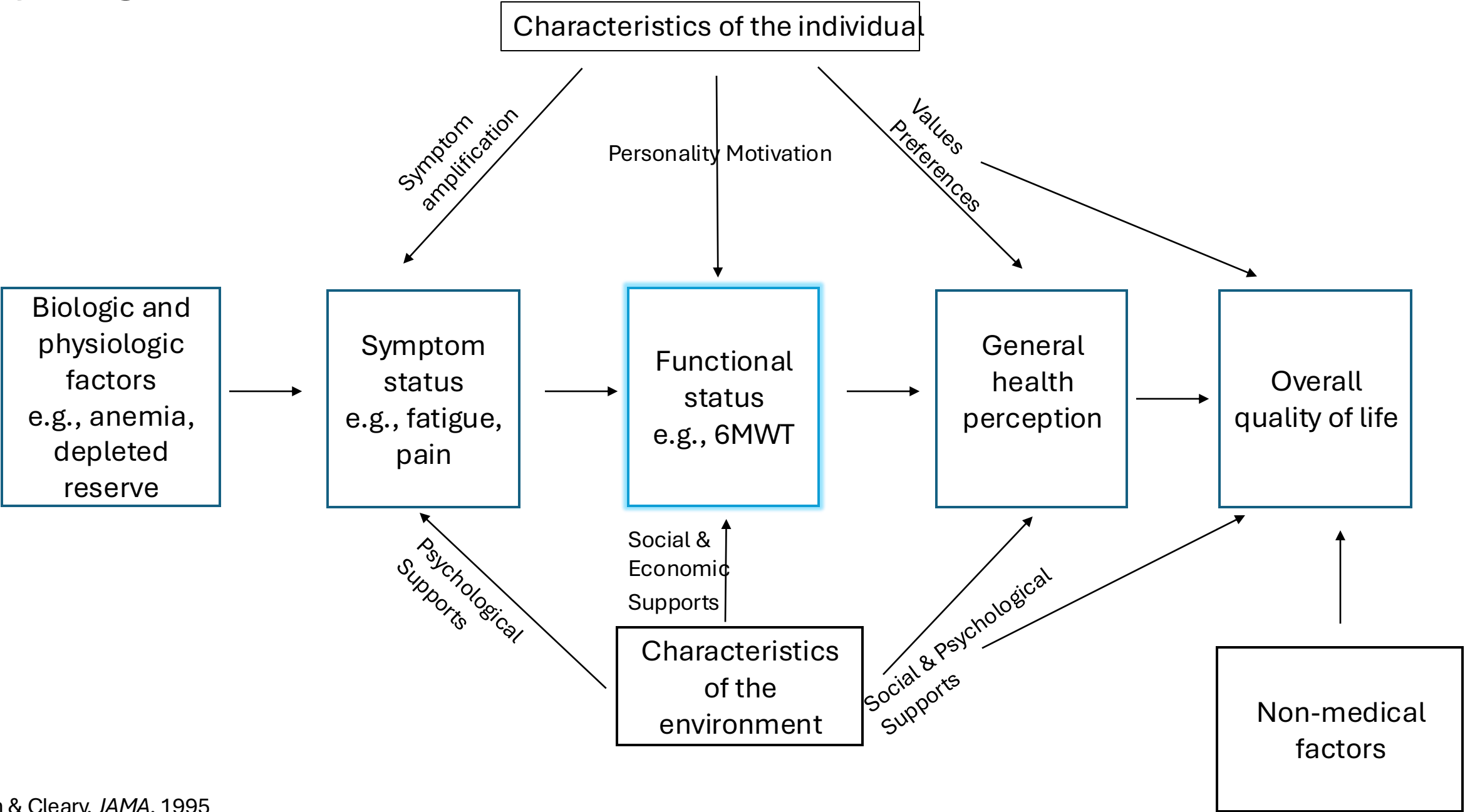


IMPROVED FUNCTIONAL CAPACITY IS ASSOCIATED WITH BETTER SURGICAL OUTCOMES

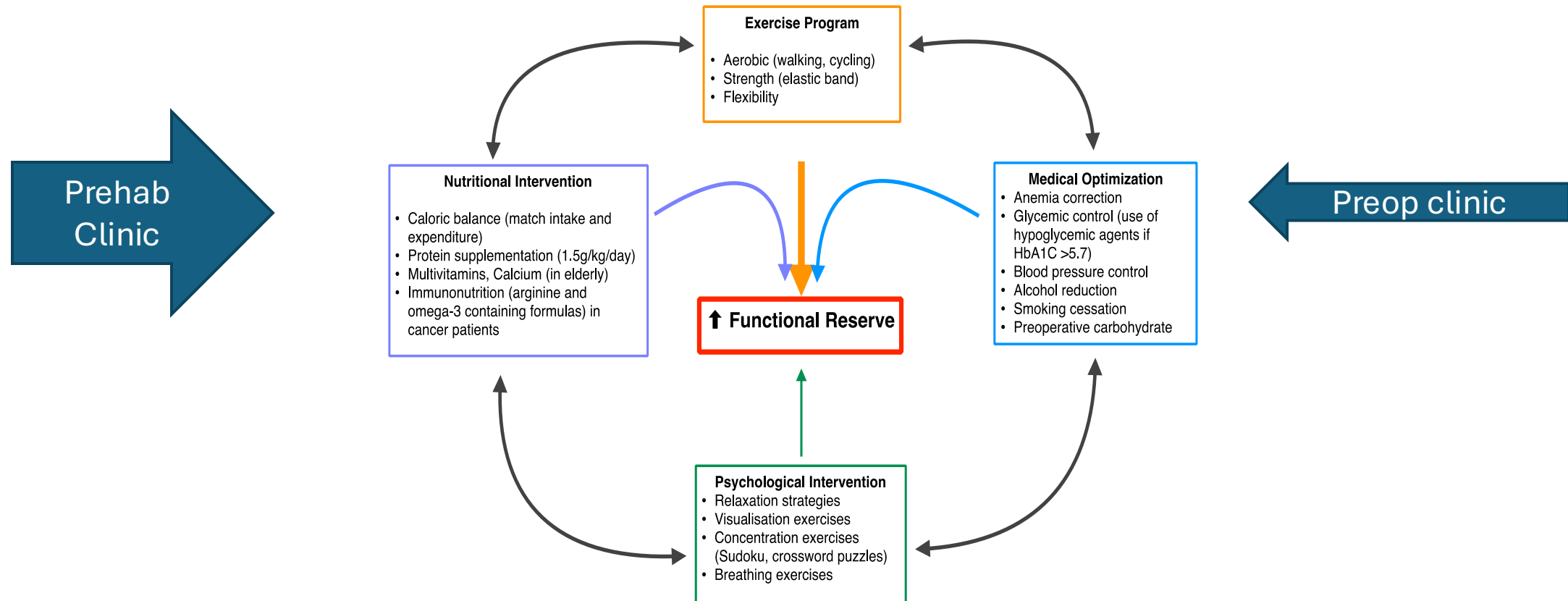
Functional Capacity (6MWT)



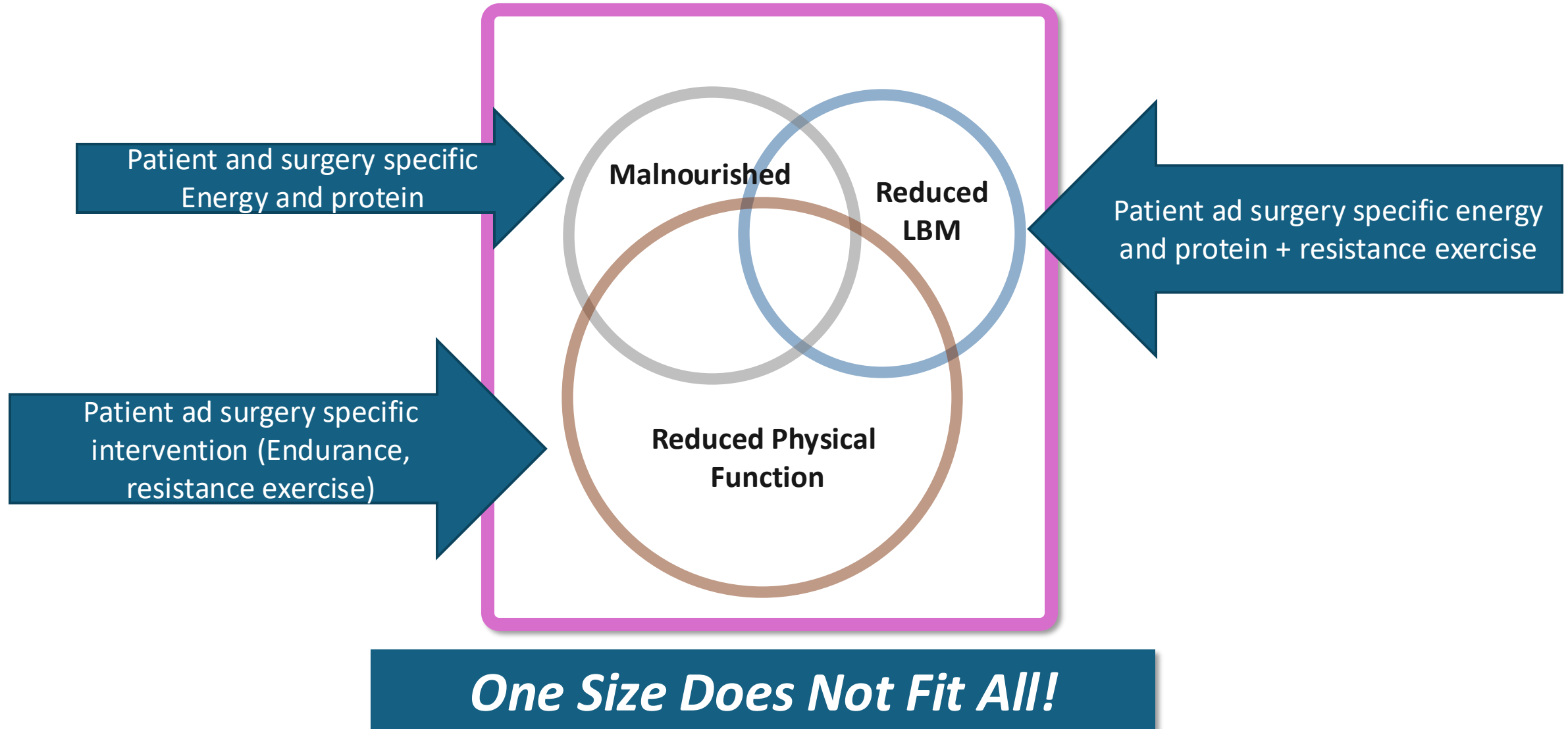
Many things influence function!



Multimodal Transdisciplinary Prehabilitation

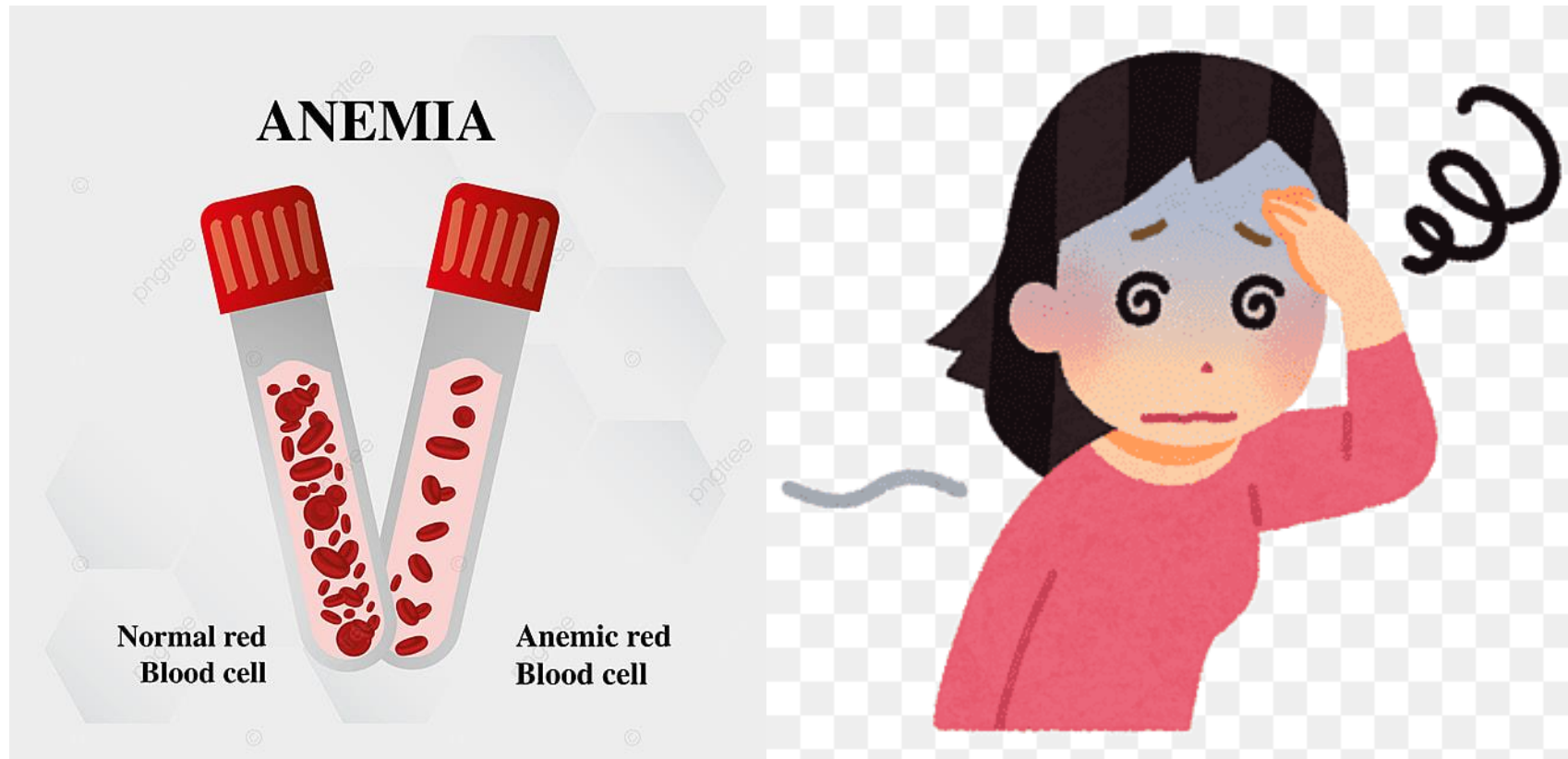


Risk-stratified and targeted prehabilitation care



ANEMIA & DIMINISHED PHYSICAL FUNCTION

Anemia affects oxygen carrying capacity, which impairs aerobic capacity



CORRECT ANEMIA

- A deficient circulating red blood cell mass, with a hemoglobin (Hgb) concentration of less than 130 g/L for *both sexes*.
- If anemia is present, further testing required to determine etiology.
- For Iron deficiency anemia, consider treatment with oral iron: 40–60 mg of iron per day or 80–100 mg on alternate days may be appropriate dosing for at least 6–8 weeks.
- *Intravenous iron should be considered when surgery is planned in less than 6 weeks or in patients in whom oral absorption will be impaired.*
- The amount of intravenous iron required can be calculated with the following formula: Total iron deficiency [mg] = (Target Hgb – Baseline Hgb [g/L]) · 0.24 · Body weight [kg] + 500 for iron stores

Role of nutrition in enhancing functional capacity

MALNUTRITION MODIFIES FUNCTIONAL RESPONSE TO PREHABILITATION

PG-SGA <4

(n=104)

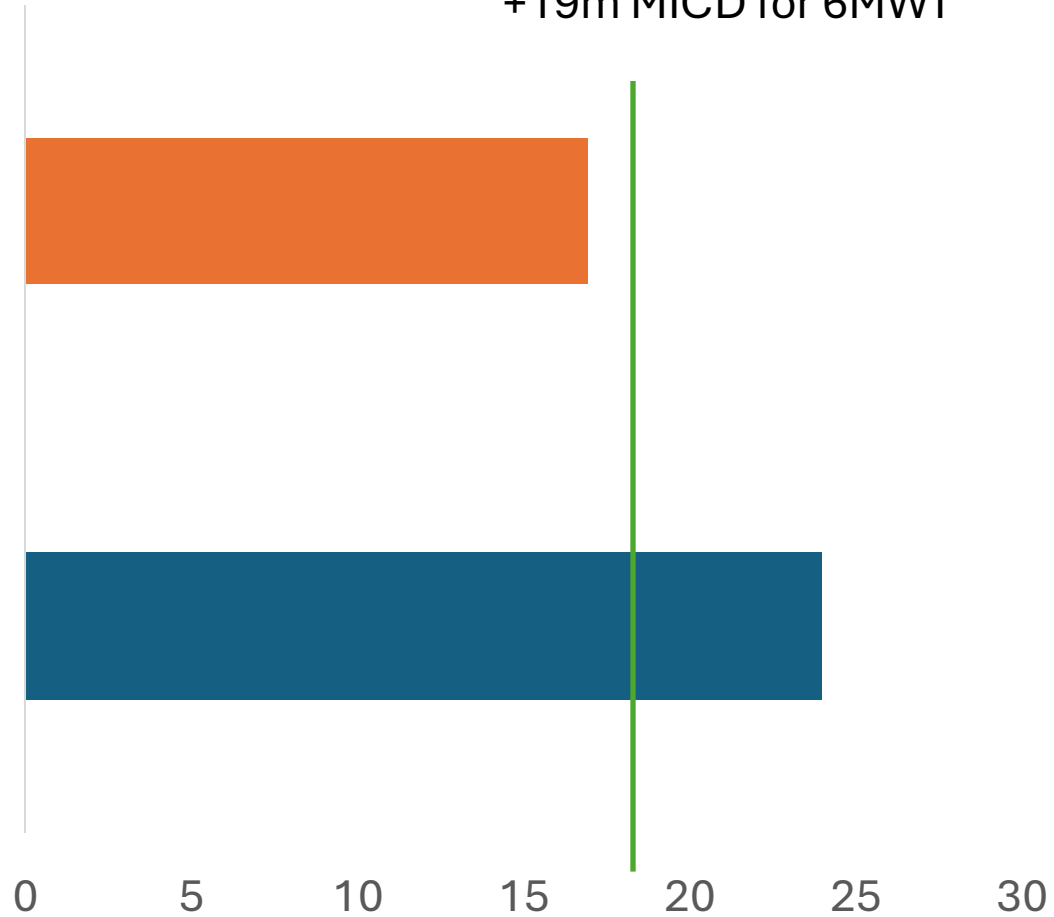
+19m MICD for 6MWT

Prehab Program for CRC:
-home based cardio and
resistance exercises
-nutrition counselling
with protein
supplements
-antianxiety strategies

Multimodal Prehabilitation

Control

Mean change in 6MWT before colorectal cancer surgery



1. Identify & Treat Malnutrition

SCREEN



Canadian Nutrition Screening
Tool (CNST)

ASSESS



Patient-Generated
Subjective Global
Assessment (PG-SGA)

TREAT



Risk-stratified pyramid

RISK-STRATIFIED NUTRITION PREHABILITATION

- **UNIVERSAL:**

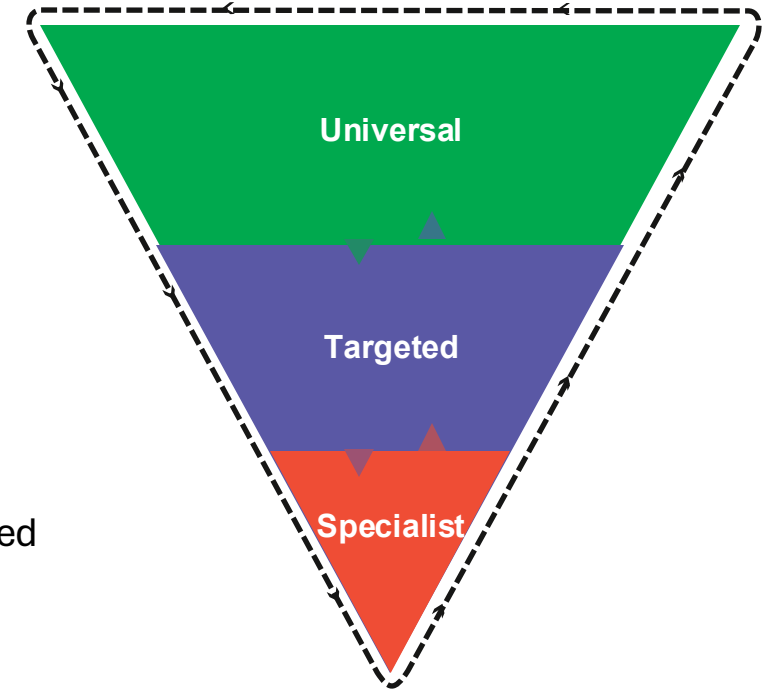
- Class and handouts

- **TARGETED:**

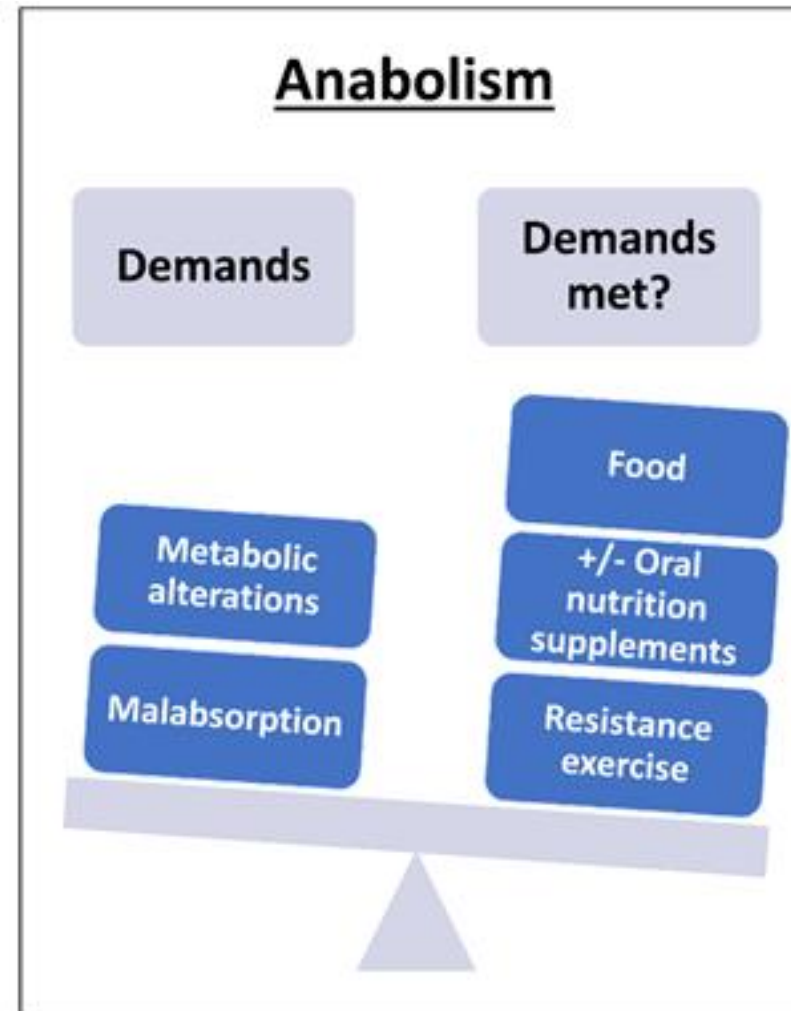
- Nutrition-symptom management
- Follow-up within 7-10 days by telephone or online platform

- **SPECIALIST:**

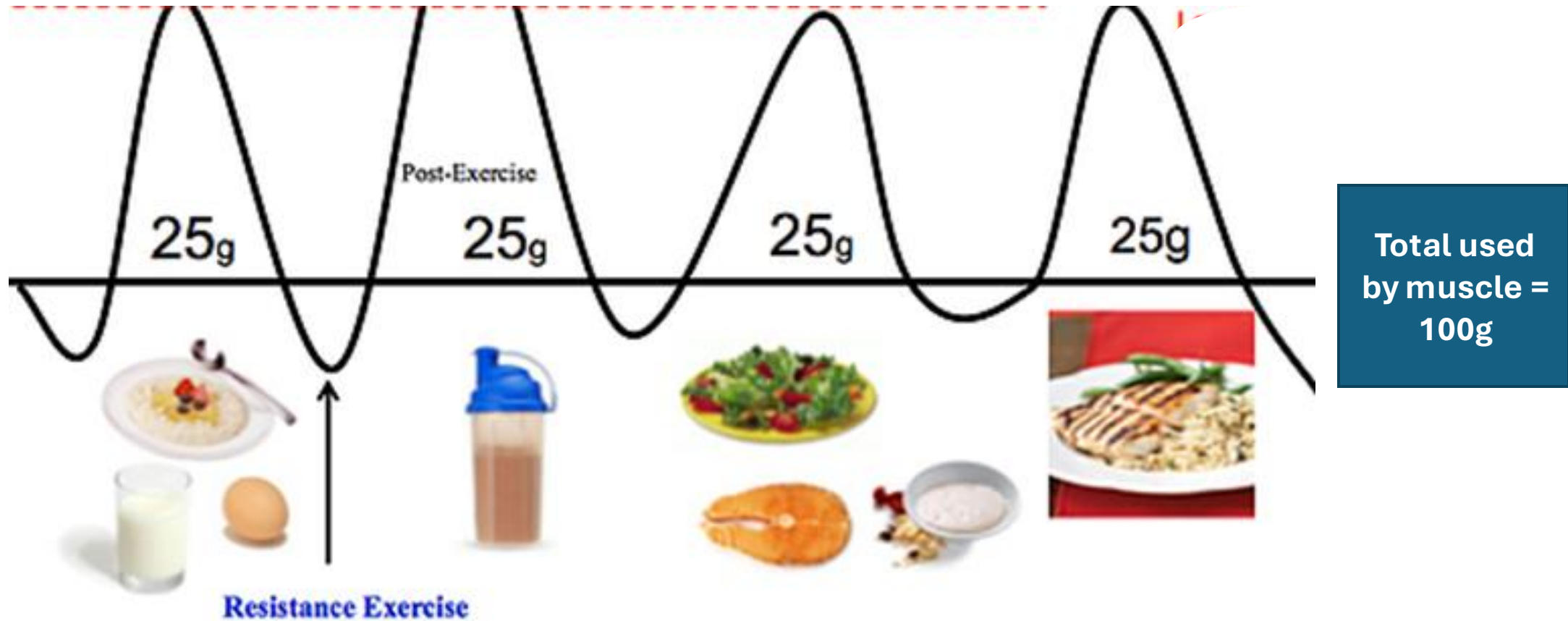
- Energy and protein supplements to meet usual deficit
 - Start with oral nutrition supplements, but enteral/parenteral may be required
- Multivitamin/mineral supplement
- Support energy cost of exercise with additional kcal
- Follow-up within 7 days by telephone or online platform, in person visit within 4 weeks



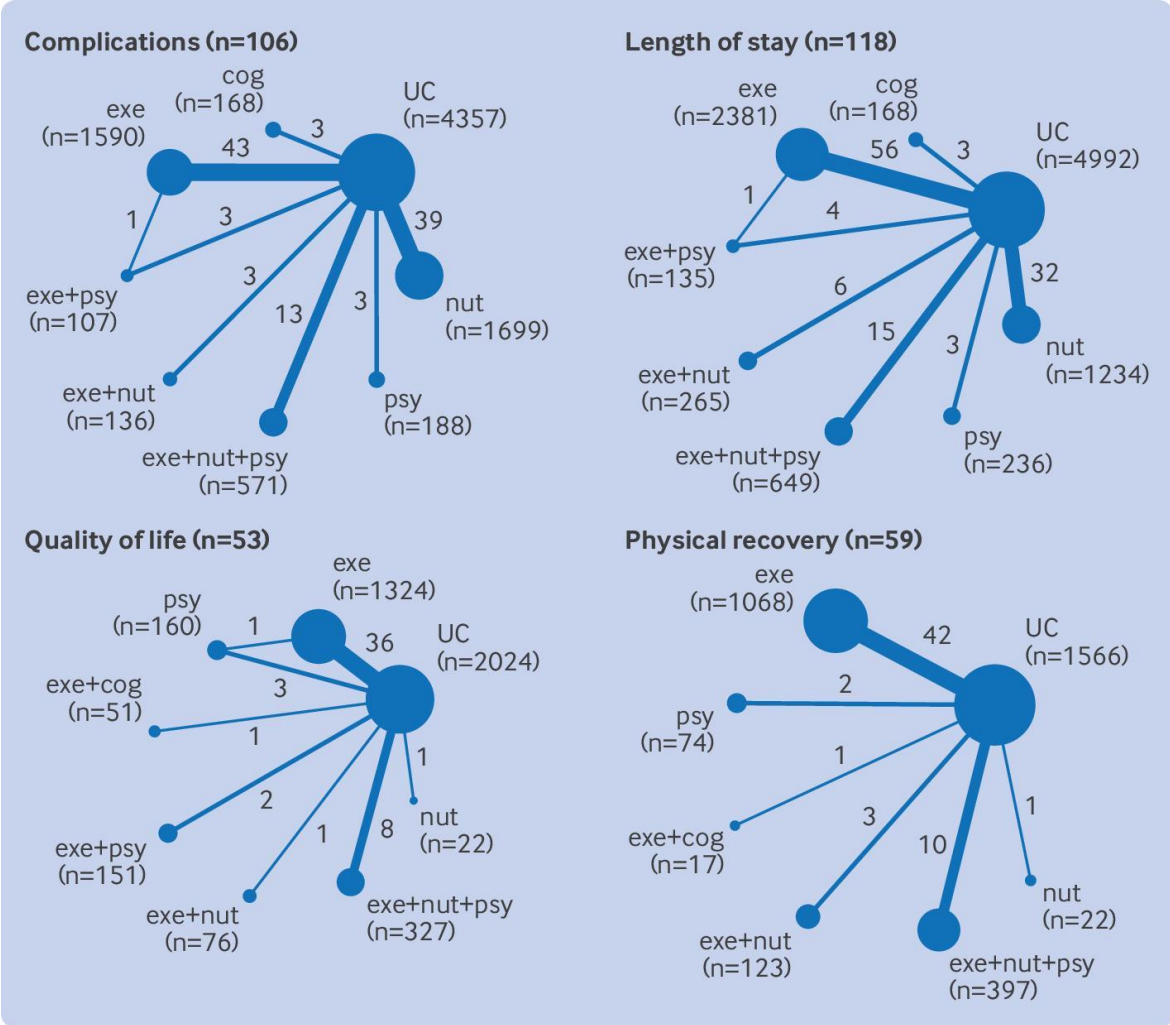
2. Support Protein Anabolism



MEET TOTAL AND PER MEAL RECOMMENDATIONS FOR PROTEIN



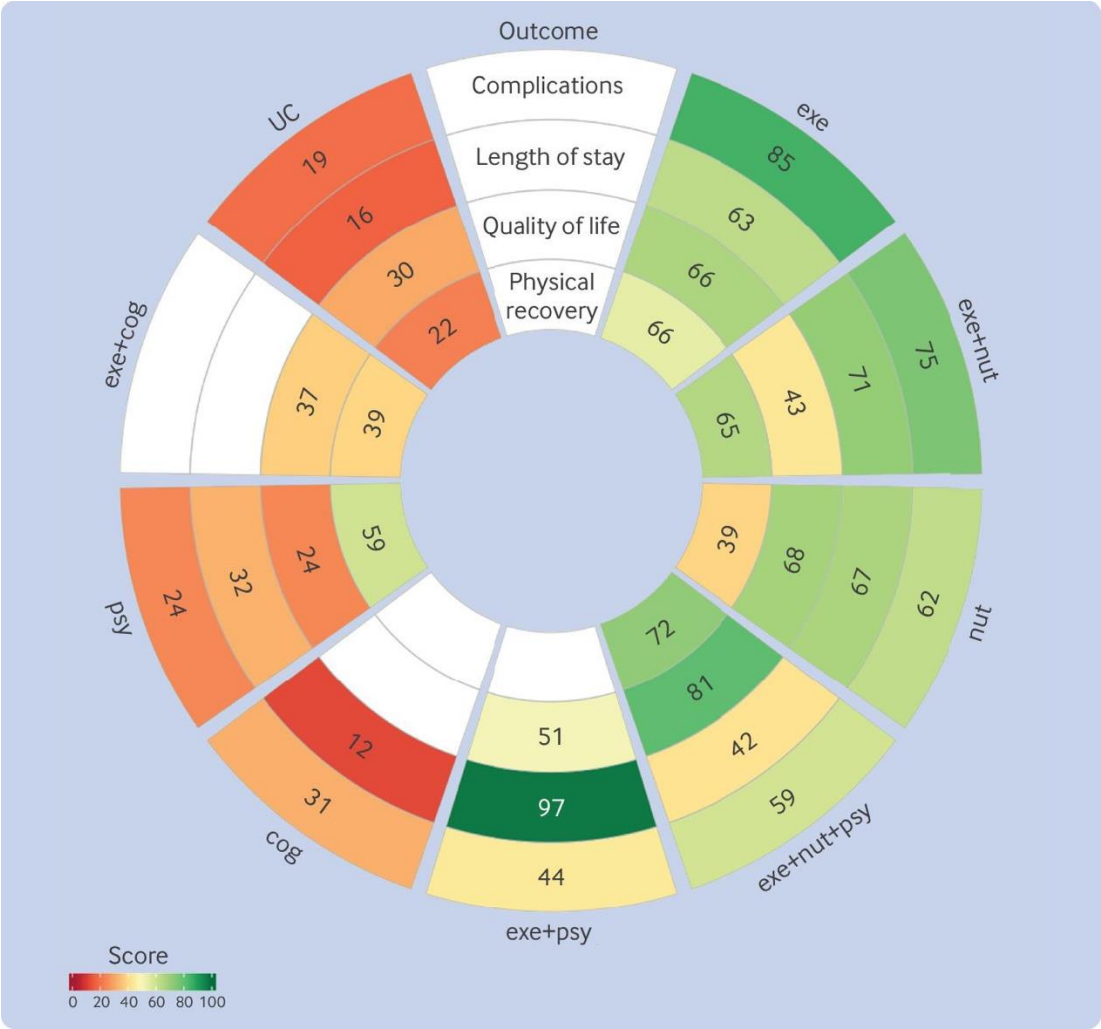
Network diagrams for all critical outcomes (postoperative complications, length of stay in hospital, quality of life, and physical recovery).



Daniel I McIsaac et al. BMJ 2025;388:bmj-2024-081164



Rank-heat plot obtained from treatment-level network meta-analysis.



Daniel I McIsaac et al. BMJ 2025;388:bmj-2024-081164

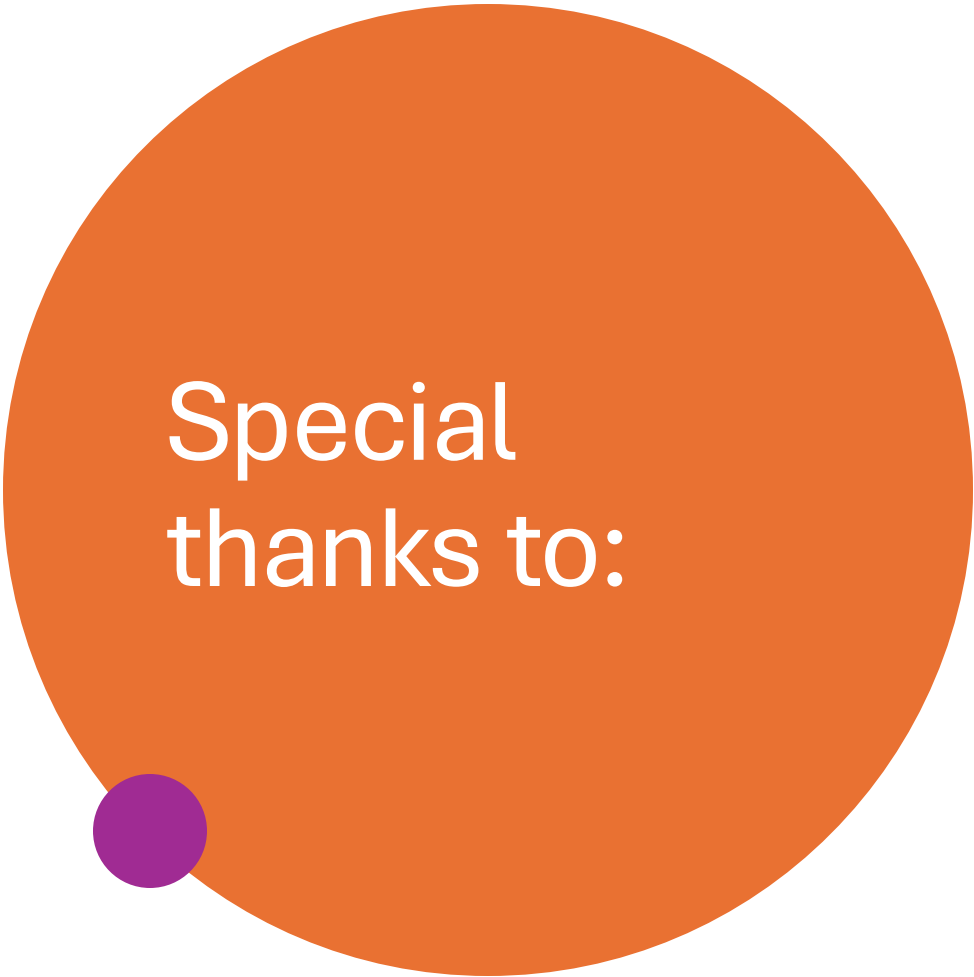


Feasibility of Prehabilitation: Program Considerations for Success

- Raise awareness, provide knowledge, show benefit of intervention
- Appropriate resources: kinesiology, mental health, nutrition
- Integration into primary care, surgery, oncology
- Clear goals; clear outcome measures

Conclusions

- Evolving approaches to optimizing patient, provider and system outcomes in surgery represent opportunity to enhance nutrition care
- Nutrition risk assessment and targeted approaches based on this impact outcome
- Grab opportunities to improve nutrition care whenever they arise!



Special
thanks to:

- Chelsia Gillis RD, PhD, McGill University
- 