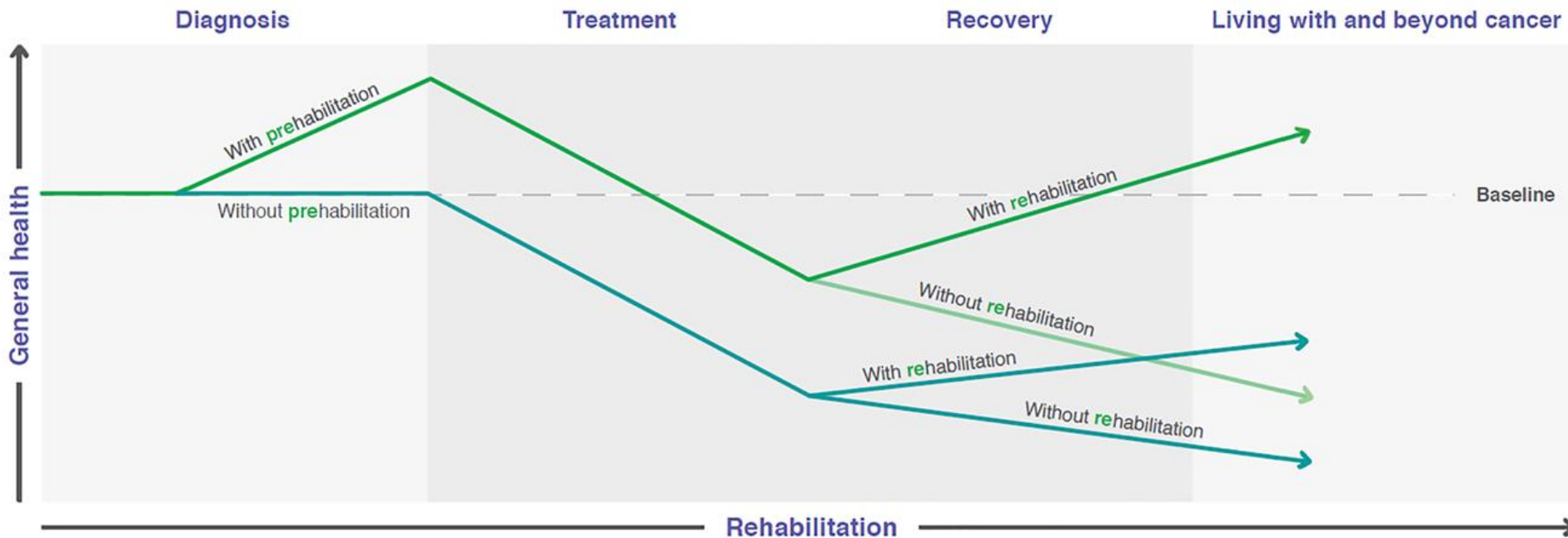


# Prehabilitation



## Hirslanden Anaesthesia Symposium 2024

Davis, J.F., van Rooijen, S.J., Grimmett, C. *et al.* From Theory to Practice: An International Approach to Establishing Prehabilitation Programmes. *Curr Anesthesiol Rep* 12, 129–137 (2022)

# Conflicts of interest

- Swiss National Science Foundation IICT Grant 2020 (Prof. Wüthrich)
- PREHABIL project supported by Nestlé (products)
  
- I am not an exercise physiologist
- I am not a dietician

# Objectives

- Introduction
- Surgical stress and its consequences
- Concept of functional status (aka capacity)
- Prehabilitation to improve functional capacity?
- Components of Prehabilitation
- Clinical Evidence
- Patient Selection and Assessment
- Return on Investment

42.

**GRAND  
PRIX  
VON  
BERN**



**Grand-Prix von Bern 16,093 km**  
**Altstadt Grand-Prix 4,7 km**  
**Altstadt Walking 4,7 km**  
**Bären Grand-Prix 1,6 km**

[gpbern.ch](http://gpbern.ch)

**18. MAI 2024**



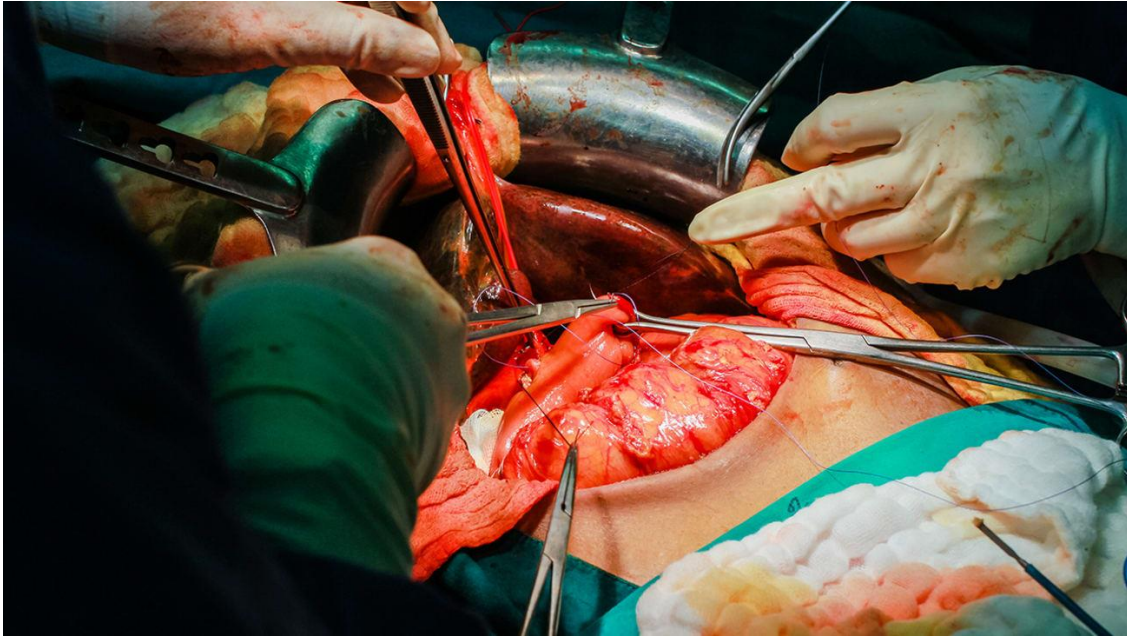
- Exercise for weeks and months
- Eat a healthy diet
- Look through your training log and training plan.
- Hydrate, hydrate, hydrate.
- Stretch and foam roll.
- Go to bed early.

**And surgery?**

More in common than we think?

Vs.

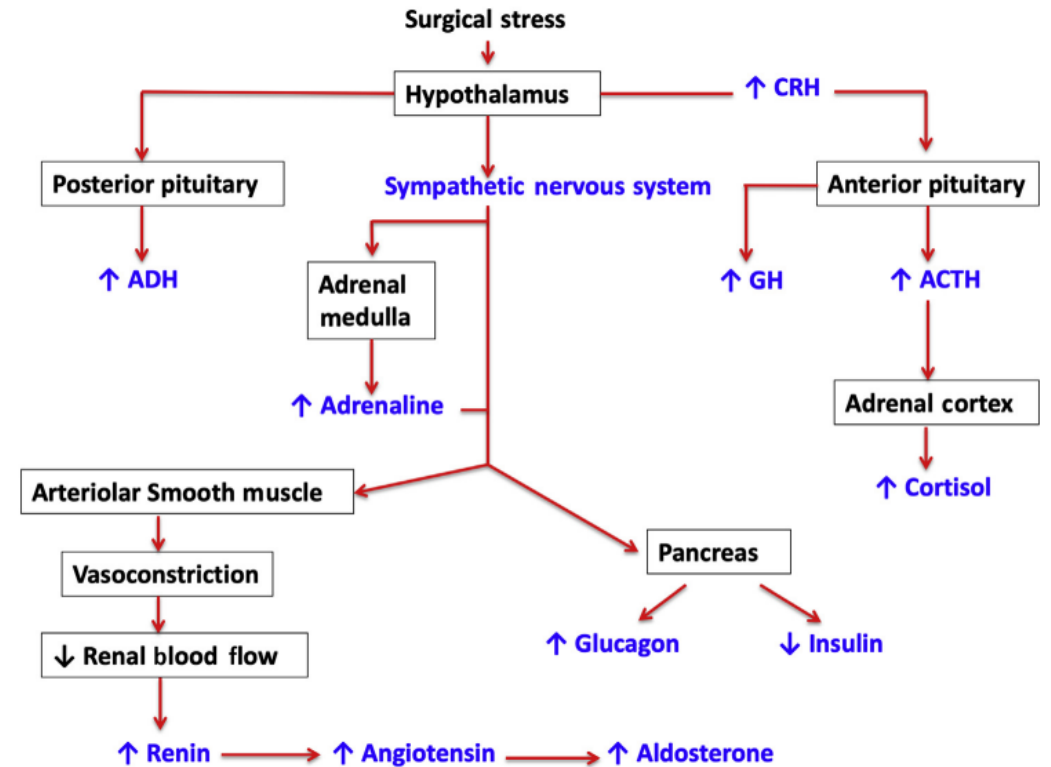
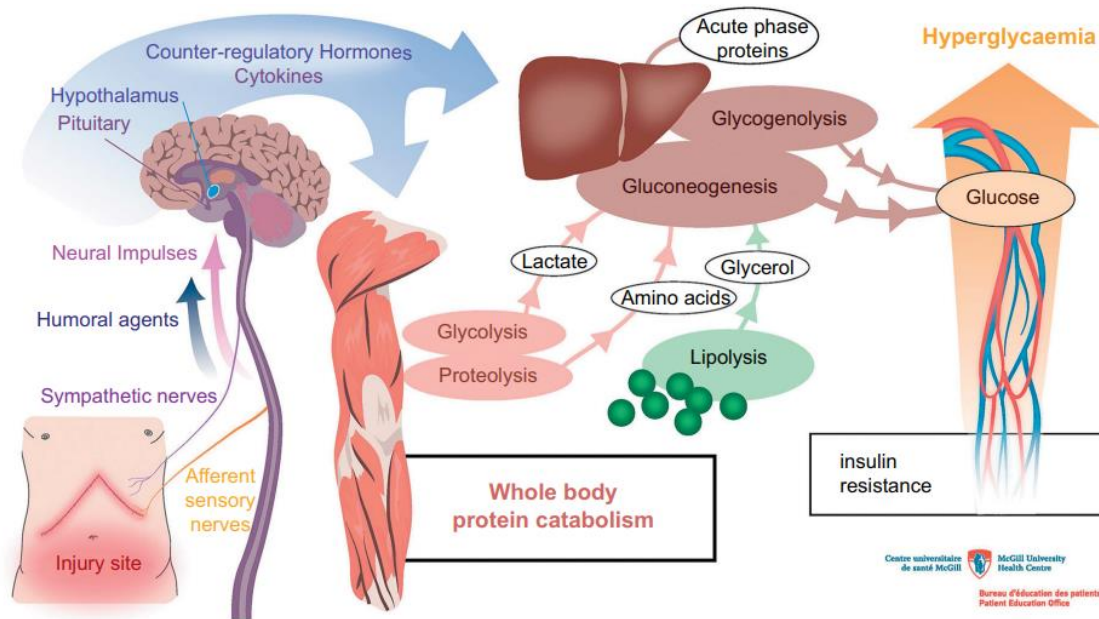
Surgical stress



Exercise induced stress



# Surgical stress response



**Haemodynamic response:** hypertension, tachykardia, urinary retention

# Poor functional status leads to poor postoperative outcomes



Clinical Science |  Full Access

## Outcomes of total hip and knee replacement: Preoperative functional status predicts outcomes at six months after surgery

Paul R. Fortin, Ann E. Clarke, Lawrence Joseph, Matthew H. Liang, Michael Tanzer, Diane Ferland, Charlotte Phillips, Alison J. Partridge, Patrick Bélisle, Anne H. Fossel, Nizar Mahomed ... See all authors 

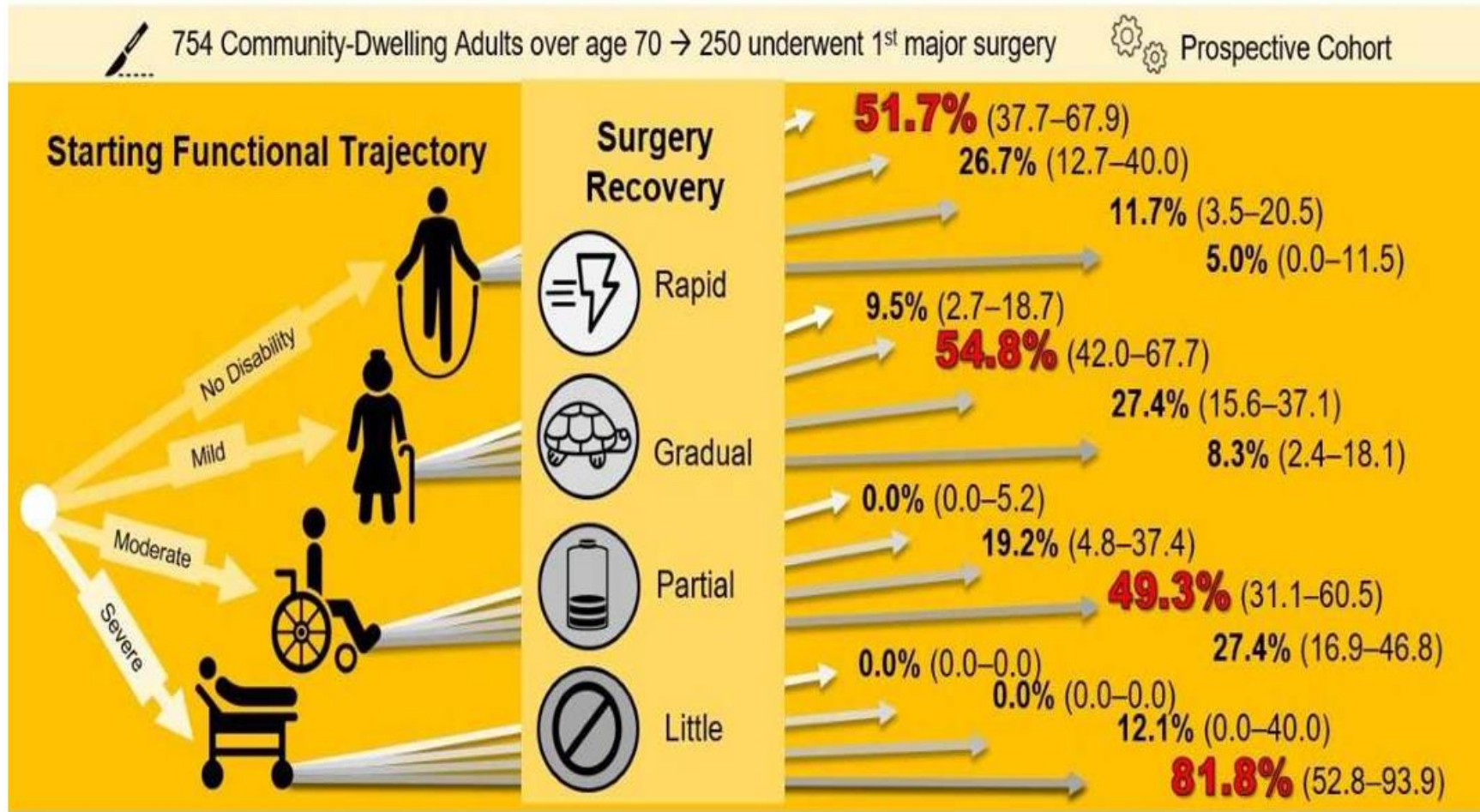
First published: 26 April 2001 | [https://doi.org/10.1002/1529-0131\(199908\)42:8<1722::AID-ANR22>3.0.CO;2-R](https://doi.org/10.1002/1529-0131(199908)42:8<1722::AID-ANR22>3.0.CO;2-R) | Citations: 510



s after  
view

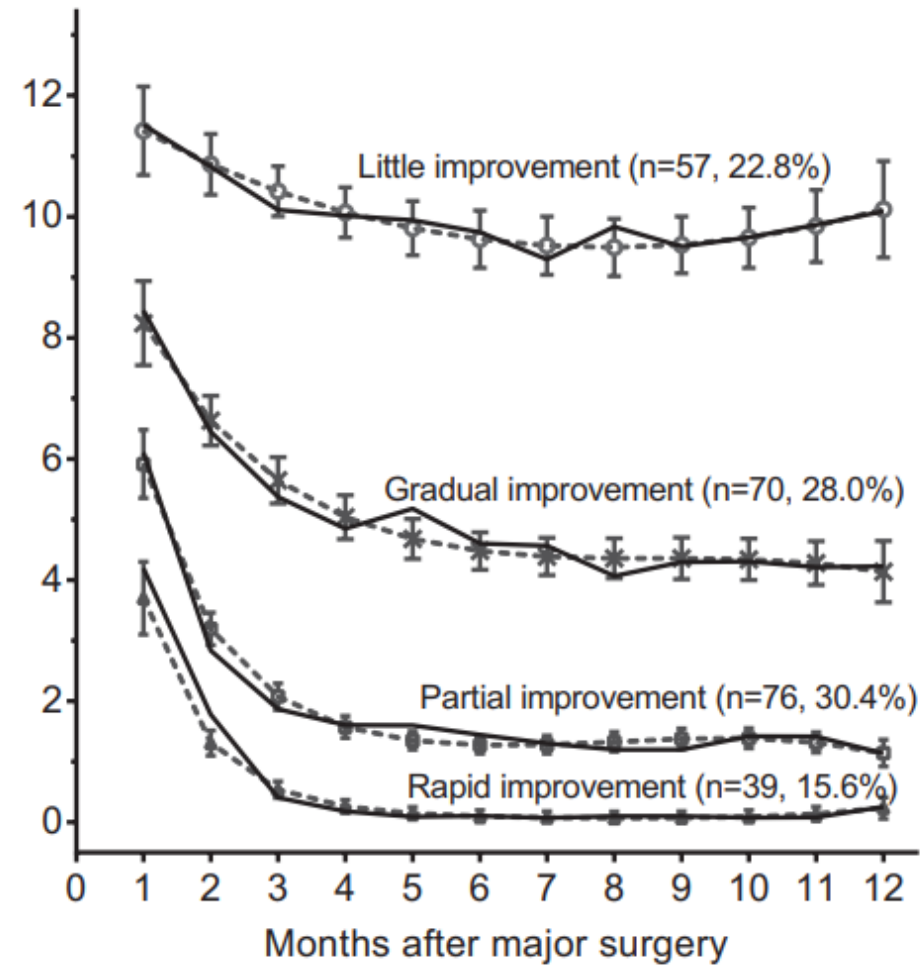
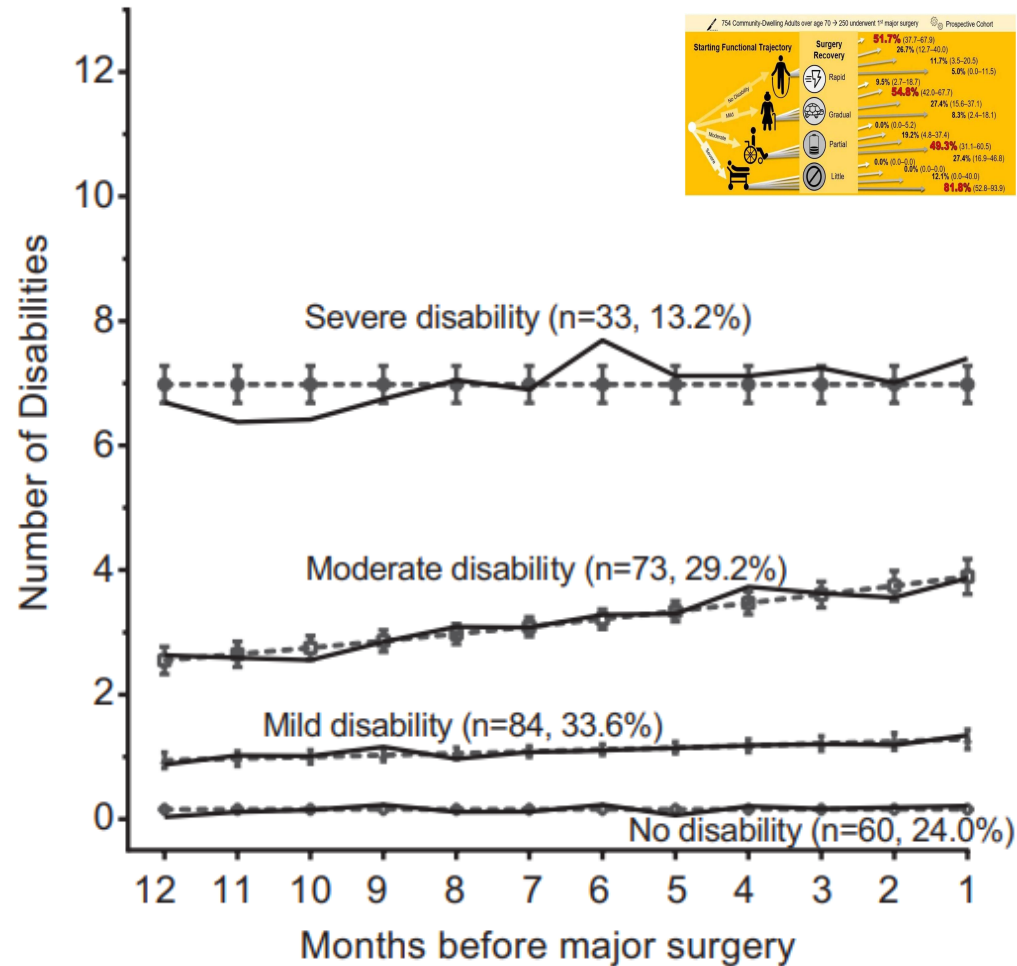
AHIP<sup>f</sup>,  
FACS<sup>g</sup>  

# Poor functional status leads to poor postoperative outcomes



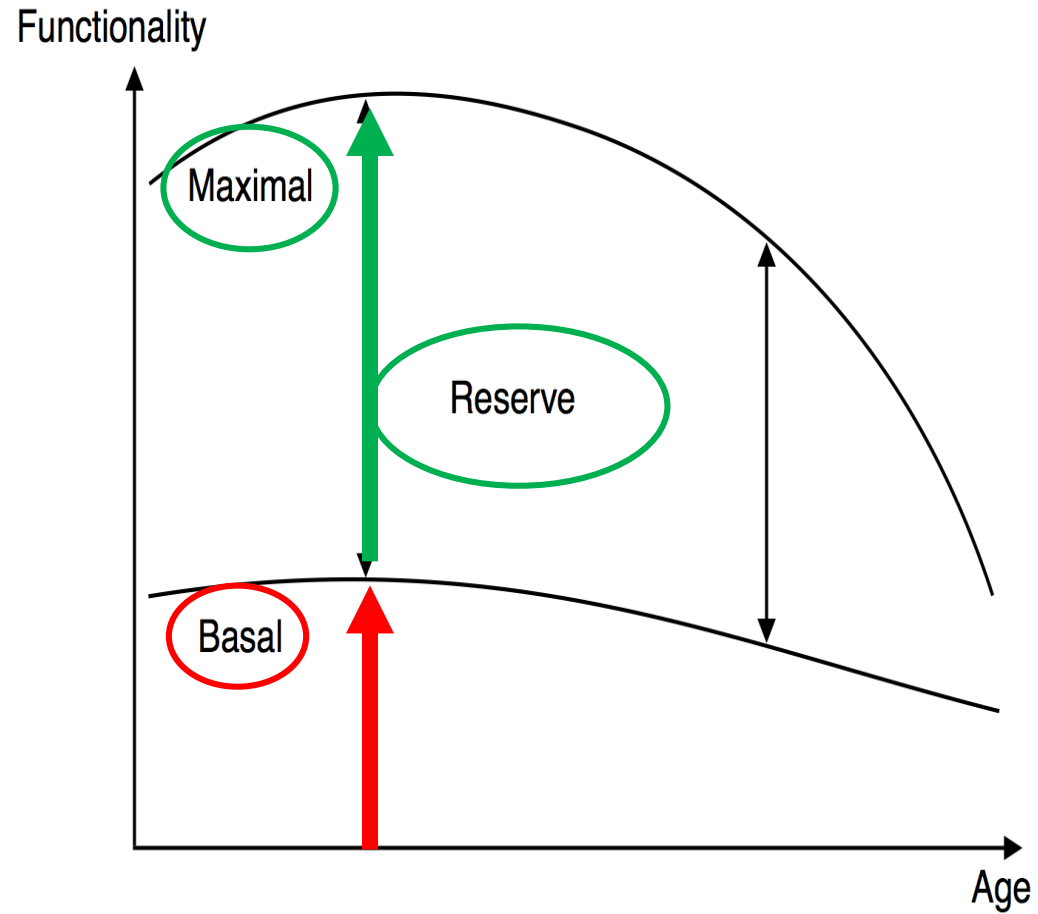
Stabenau HF, Becher RD, Gahbauer EA, Leo-Summers L, Allore HG, Gill TM. Functional Trajectories Before and After Major Surgery in Older Adults. Ann Surg. 2018 Dec;268(6):911-917.

# Poor functional status leads to poor postoperative outcomes



Stabenau HF, Becher RD, Gahbauer EA, Leo-Summers L, Allore HG, Gill TM. Functional Trajectories Before and After Major Surgery in Older Adults. Ann Surg. 2018 Dec;268(6):911-917.

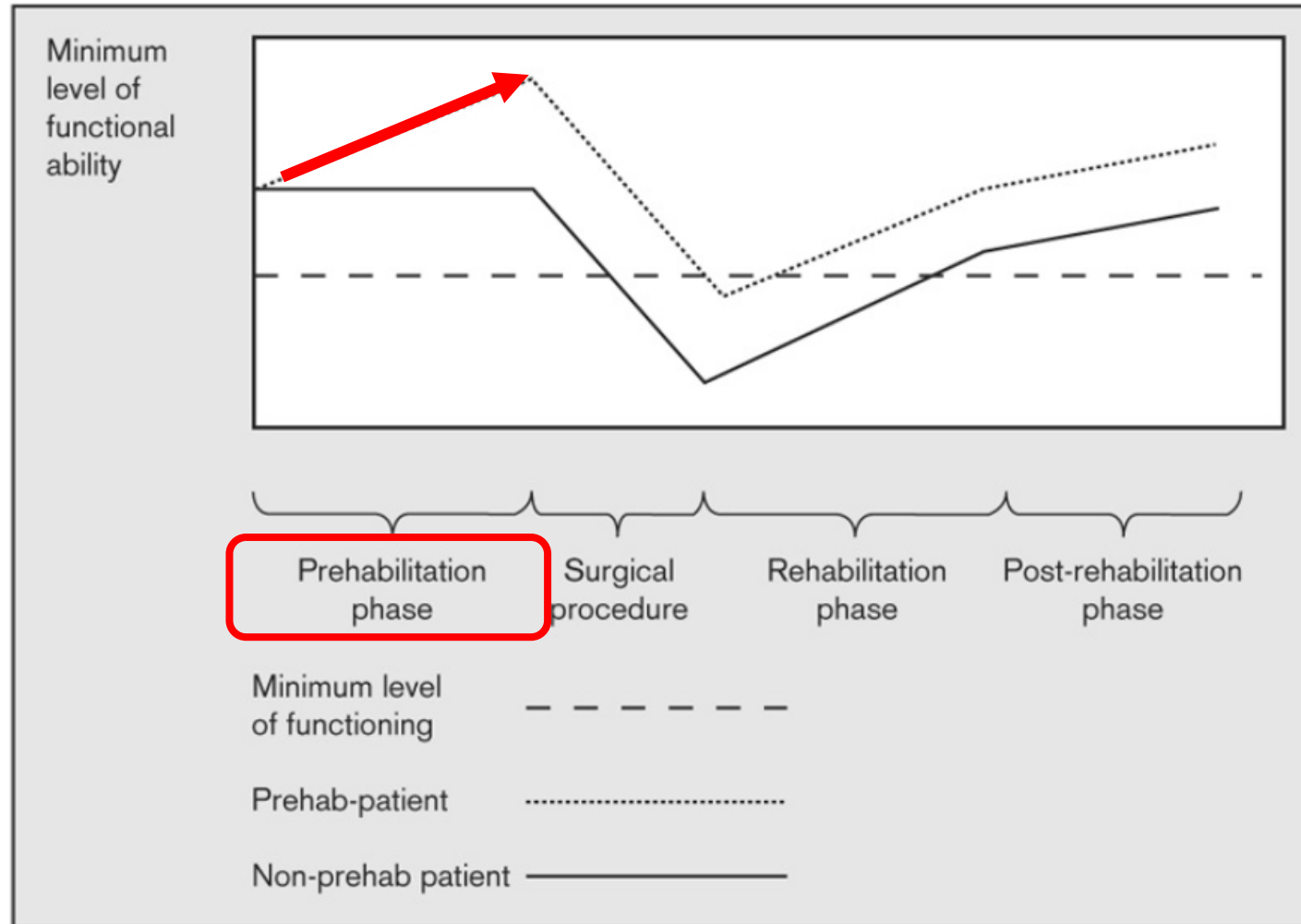
# Functional capacity



## What is prehabilitation?

“Prehabilitation is a process from diagnosis to surgery, consisting of one or more preoperative interventions of exercise, nutrition, psychological strategies and respiratory training, that aims to **enhance functional capacity** and **physiological reserve** to allow patients to withstand surgical stressors, improve postoperative outcomes, and facilitate recovery.”

# What is prehabilitation?

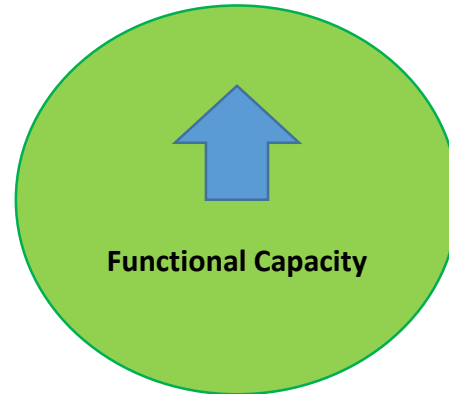


Carli F, Zavorsky GS. Optimizing functional exercise capacity in the elderly surgical population. *Curr Opin Clin Nutr Metab Care*. 2005

# Prehabilitation Interventions




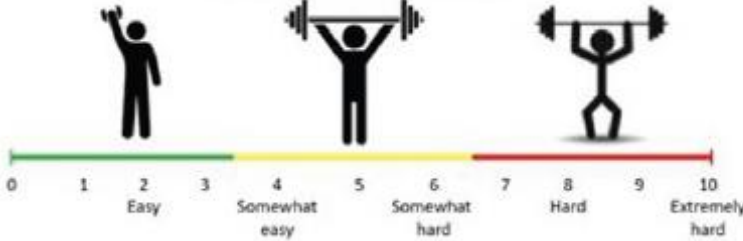

## Physical Activity

- Endurance
- Strength
- Flexibility

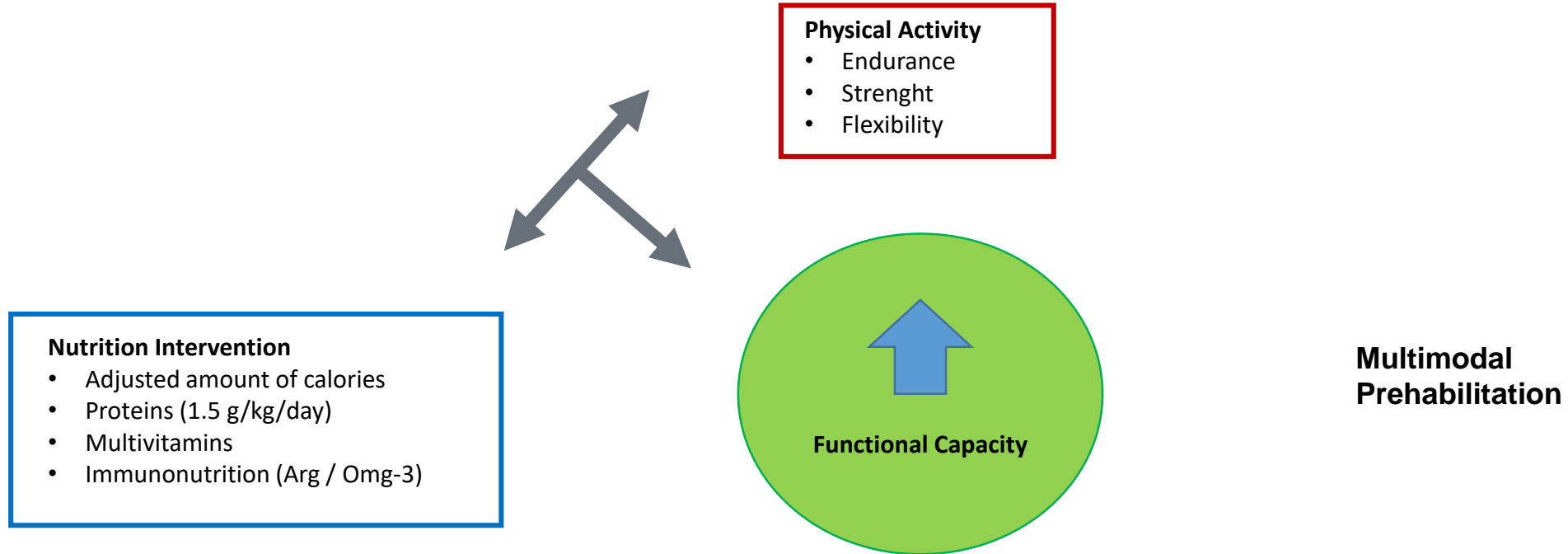


**Unimodal  
Prehabilitation**

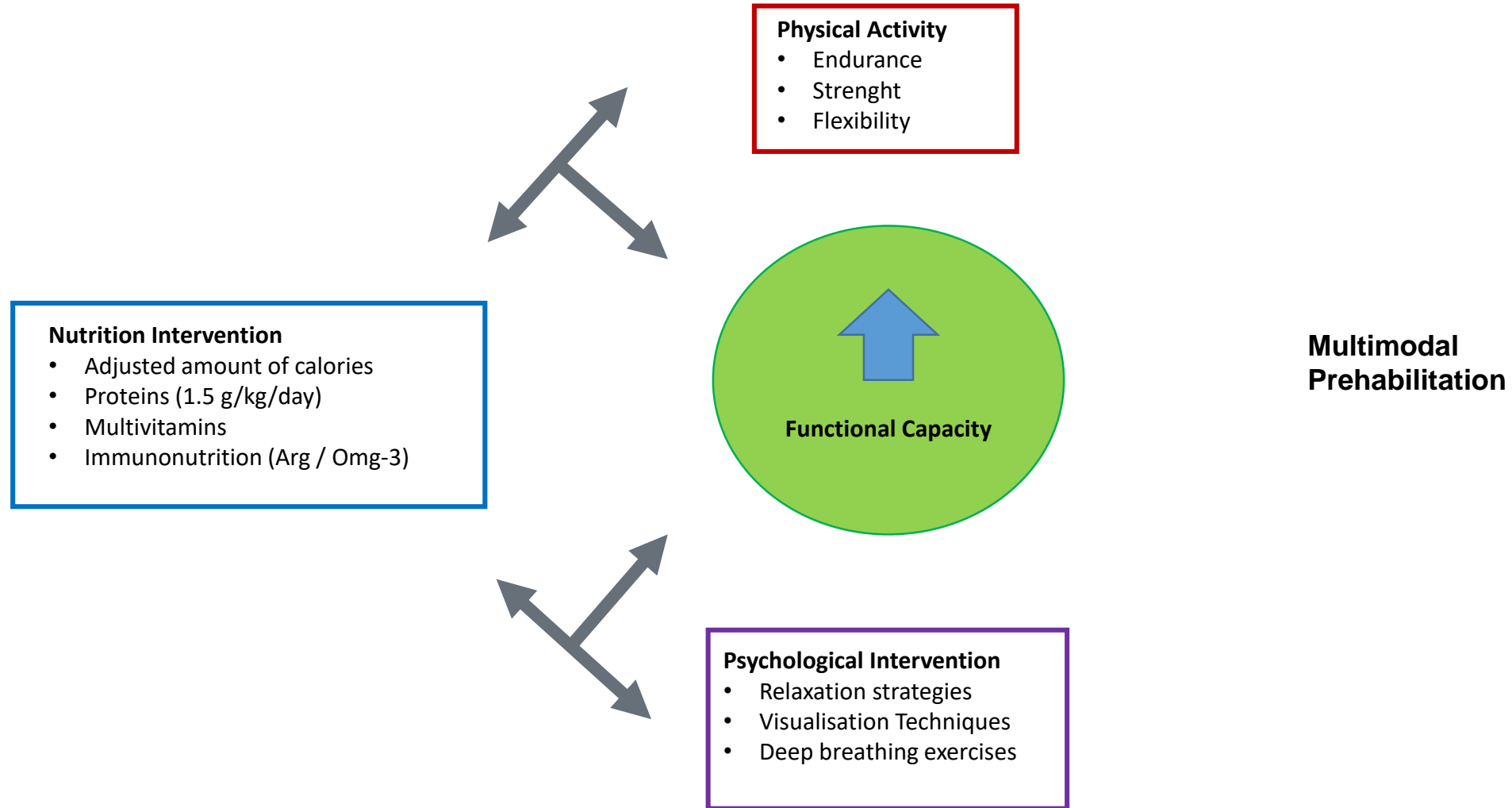
# Prehabilitation Interventions

<p><b>Aerobic (30 minutes/day of moderate intensity)</b></p>  <p><b>Modified BORG Scale</b></p>  <p><b>Types of Exercises</b> Walking, Jogging, Running, Hiking, Biking, Rowing, Swimming etc.</p>	<p><b>Resistance (1-2 sets of 8-15 repetitions)</b></p>  <p><b>Modified BORG Scale</b></p>  <p><b>Types of Exercises</b> Push ups, Chest, Back, Seated row, Shoulder abduction, Biceps flexion, Triceps extension, Quadriceps extension, Leg flexion, Calf raises, Abdominal curls</p>
<p><b>Balance &amp; Flexibility (2-3 times and held for 20-30 seconds)</b></p> 	<p><b>Inspiratory Muscle Training (2 times/day, 30 repetitions each time)</b> Prescription: 30% of capacity achieved on spirometer gauge.</p>

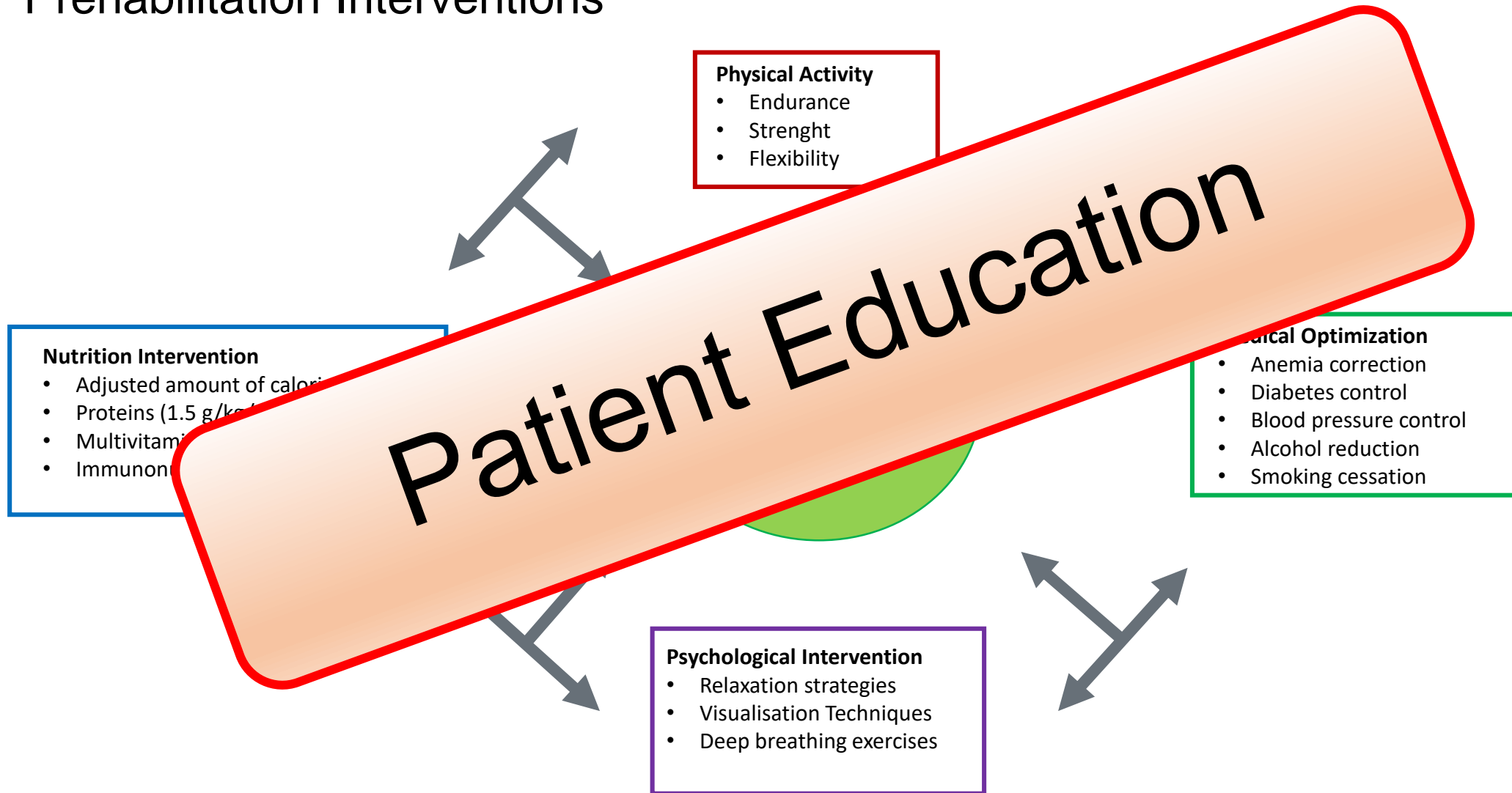
# Prehabilitation Interventions



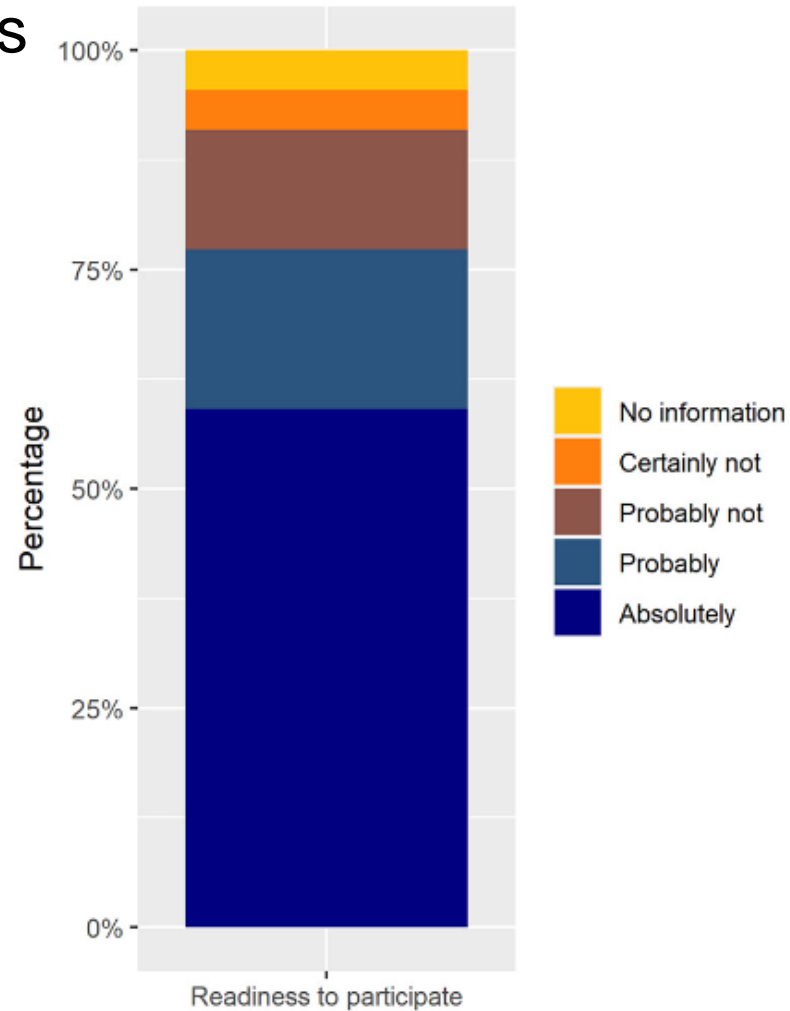
# Prehabilitation Interventions



# Prehabilitation Interventions

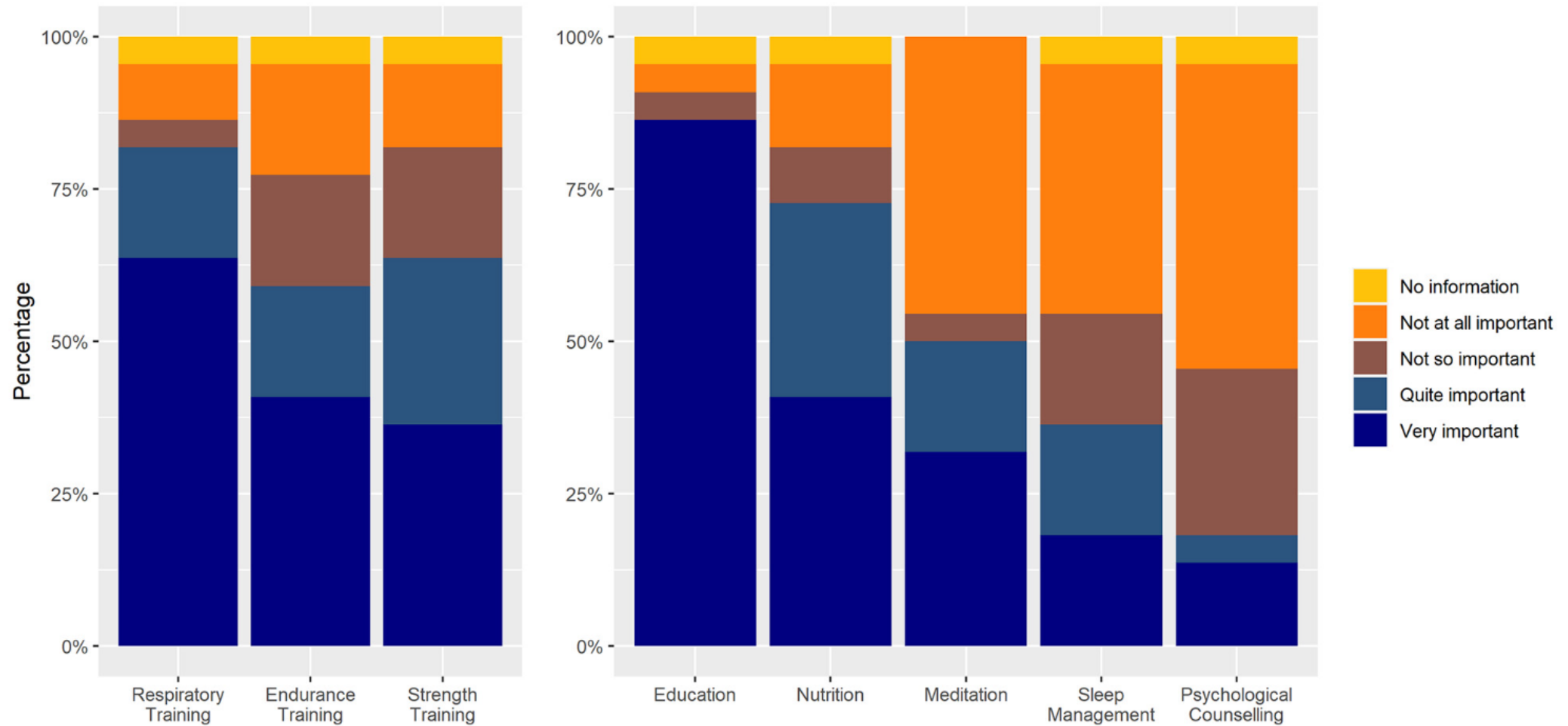


# Prehabilitation Interventions

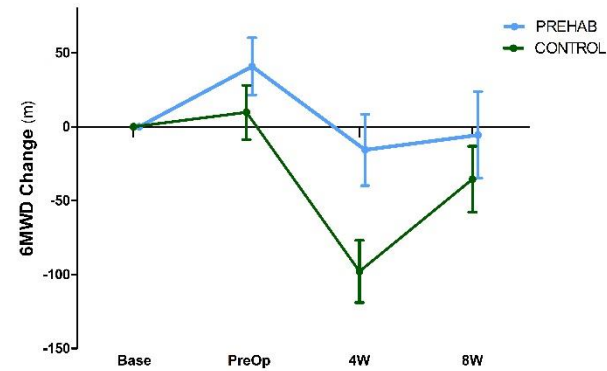
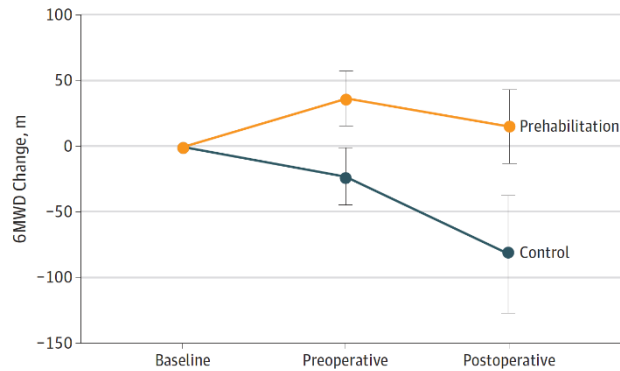
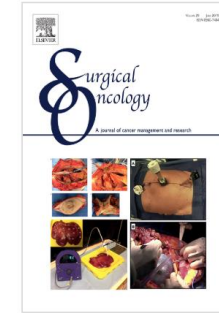
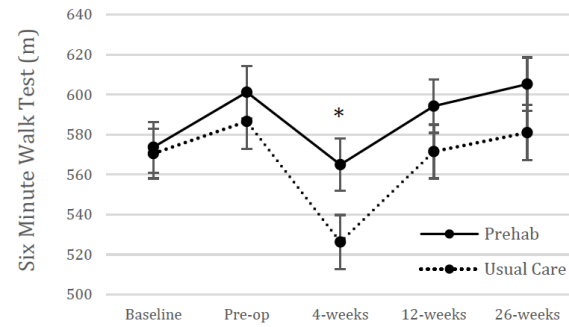
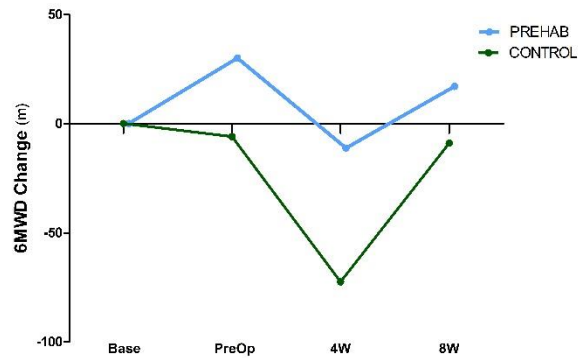
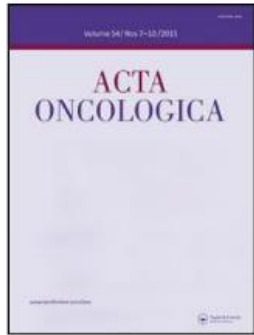


**Figure 1.** Patient willingness to participate in a prehabilitation programme. Shown are the themed answers to the Question: Would you be/have been willing to participate in an individualised surgery preparation programme?

# Prehabilitation Interventions



# Evidence – proof of concept



JAMA Surgery

EUROPEAN  
UROLOGY  
FOCUS


# Evidence – clinical practice

Open access

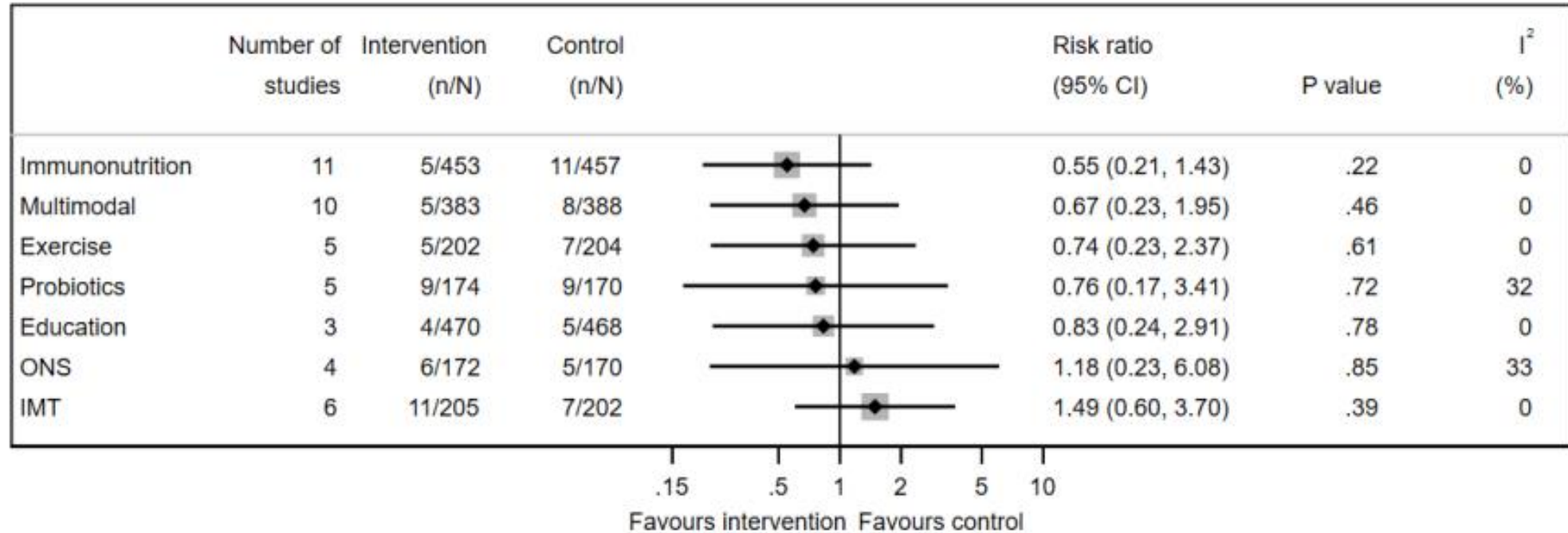
Original research

## **BMJ Open Pre-admission interventions (prehabilitation) to improve outcome after major elective surgery: a systematic review and meta-analysis**

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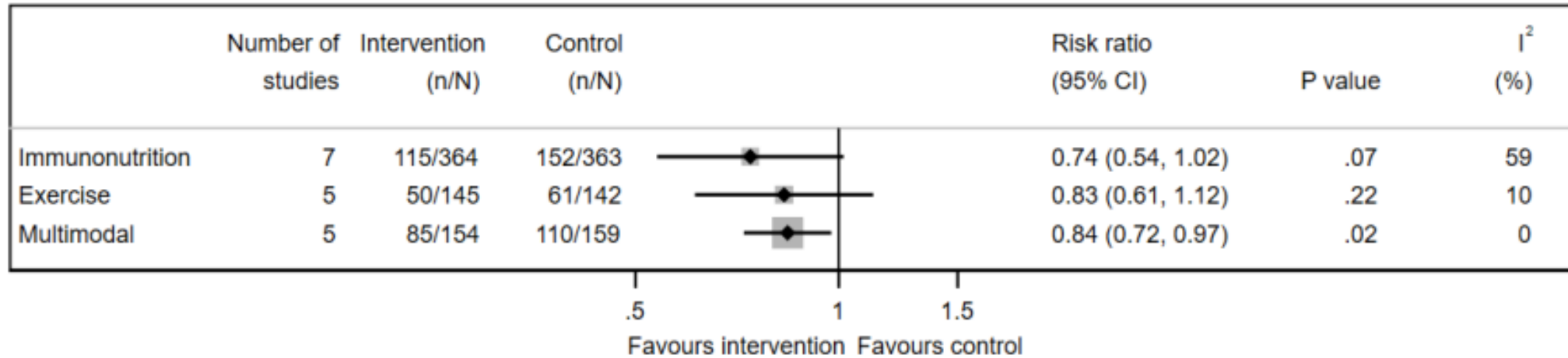
Rachel Perry <sup>1</sup>, Georgia Herbert,<sup>1</sup> Charlotte Atkinson,<sup>1</sup> Clare England,<sup>1,2</sup> Kate Northstone,<sup>3</sup> Sarah Baos,<sup>4</sup> Tim Brush,<sup>4</sup> Amanda Chong,<sup>1</sup> Andy Ness,<sup>1,5</sup> Jessica Harris,<sup>4</sup> Anne Haase,<sup>6</sup> Sanjoy Shah,<sup>7</sup> Maria Pufulete<sup>4</sup>

# Evidence – clinical practice



**Figure 2** Forest plot of prehabilitation for reducing all-cause perioperative mortality. All interventions were tested with usual care as control. IMT, inspiratory muscle training; ONS, oral nutritional supplements.

# Evidence – clinical practice



**Figure 4** Forest plot of prehabilitation for reducing total postoperative complications. All interventions were tested with usual care as control.

# Evidence – clinical practice

BJA

British Journal of Anaesthesia, 128 (2): 244–257 (2022)

doi: [10.1016/j.bja.2021.11.014](https://doi.org/10.1016/j.bja.2021.11.014)

Advance Access Publication Date: 16 December 2021

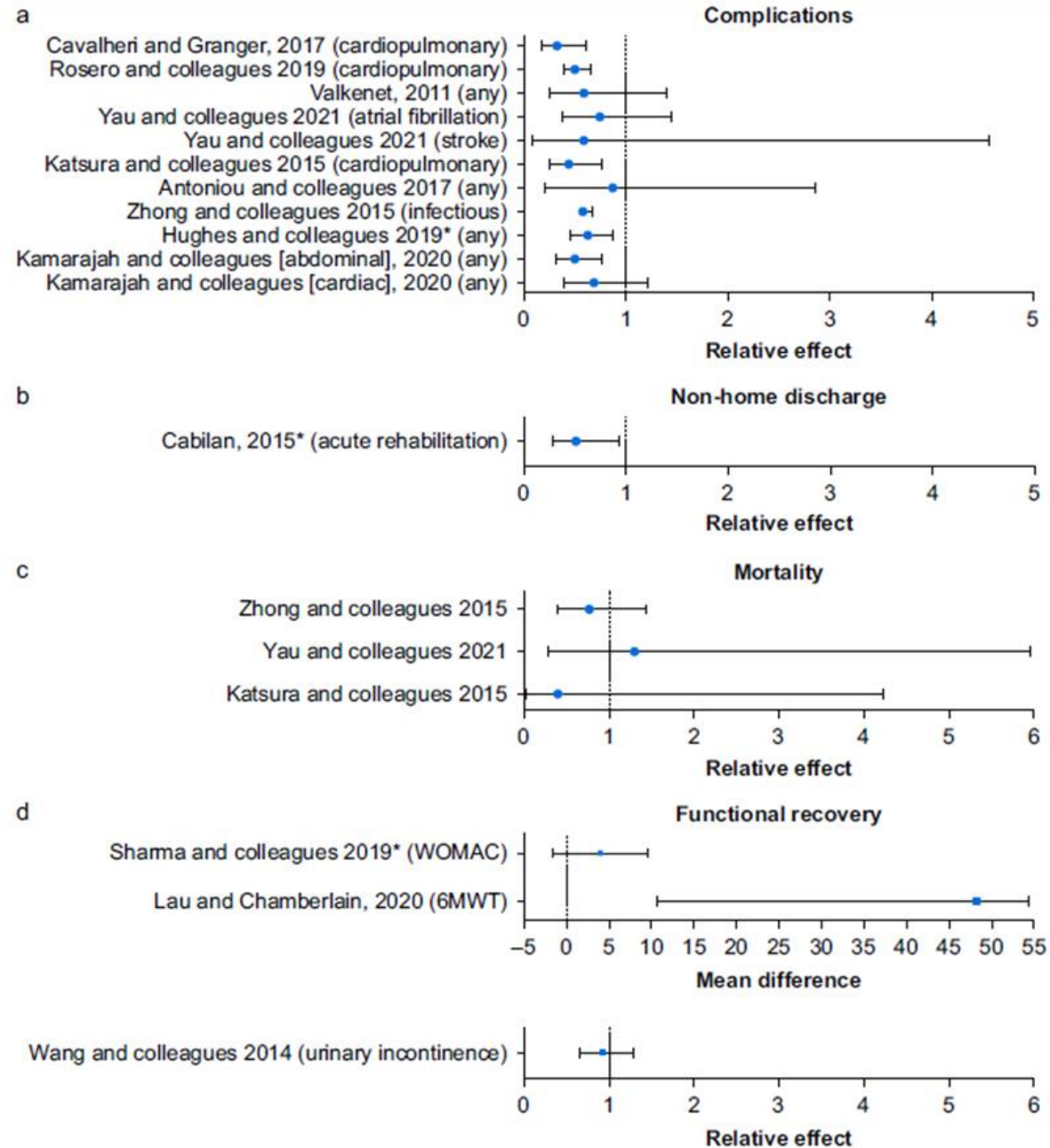
Review Article

## CLINICAL PRACTICE

### Prehabilitation in adult patients undergoing surgery: an umbrella review of systematic reviews

Daniel I. McIsaac<sup>1,2,3,\*†</sup>, Marlyn Gill<sup>4</sup>, Laura Boland<sup>5</sup>, Brian Hutton<sup>1,3</sup>, Karina Branje<sup>1,2</sup>, Julia Shaw<sup>1,2</sup>, Alexa L. Grudzinski<sup>1</sup>, Natasha Barone<sup>6</sup>, Chelsia Gillis<sup>7</sup> on behalf of the Prehabilitation Knowledge Network<sup>†</sup>

# Evidence – clinical practice



# Evidence – clinical practice

## Conclusions:

- Low certainty evidence suggests that prehabilitation may improve postoperative outcomes.
- Future low risk of bias, randomised trials, synthesised using recommended standards, are required to inform practice.
- **Optimal patient selection, intervention design, and intervention duration** must also be determined.



## Patient selection – Exercise capacity



## Patient selection – Exercise capacity

***«Can you climb two flights of stairs?»***

# Patient selection – Exercise capacity

---

## Assessment of functional capacity before major non-cardiac surgery: an international, prospective cohort study



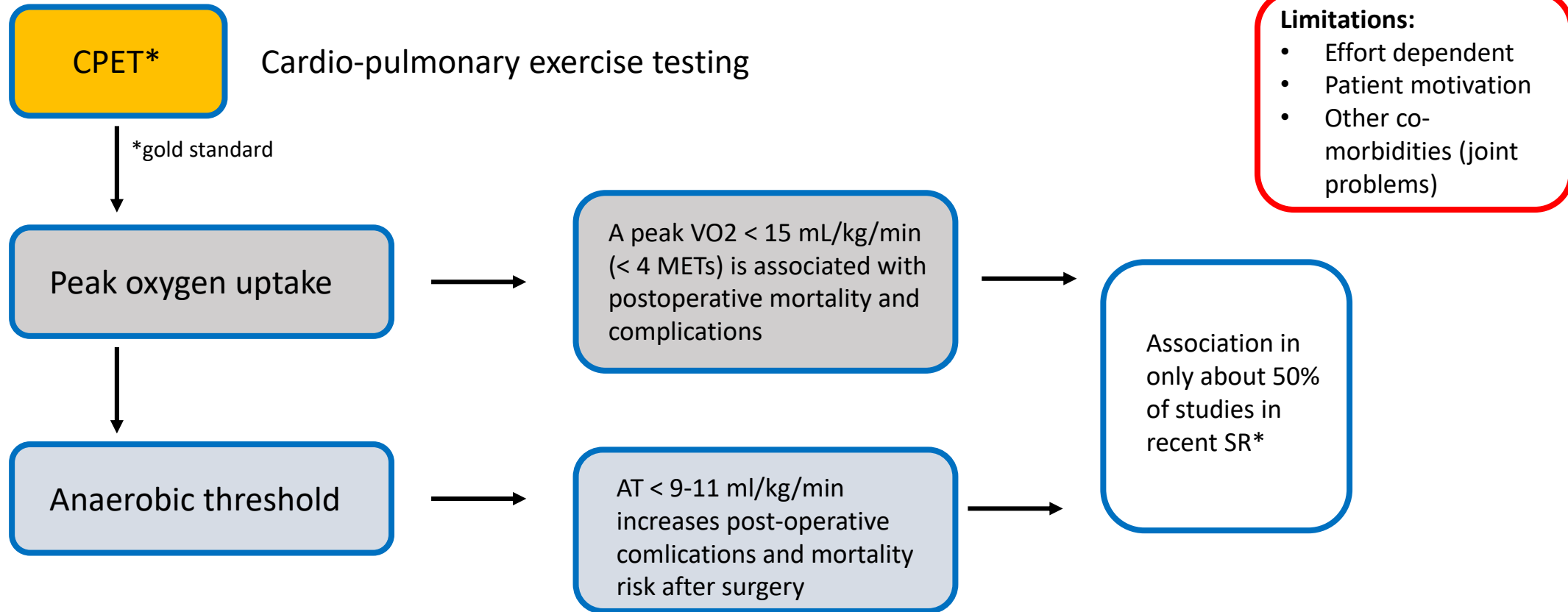
*Duminda N Wijesundera, Rupert M Pearse, Mark A Shulman, Tom E F Abbott, Elizabeth Torres, Althea Ambosta, Bernard L Croal, John T Granton, Kevin E Thorpe, Michael P W Grocott, Catherine Farrington, Paul S Myles, Brian H Cuthbertson, on behalf of the METS study investigators*

### Summary

**Background** Functional capacity is an important component of risk assessment for major surgery. Doctors' clinical *Lancet 2018; 391: 2631-40*

**Main message:** Subjectively assessed functional capacity should not be used for preoperative risk evaluation.

# Patient selection – Exercise capacity



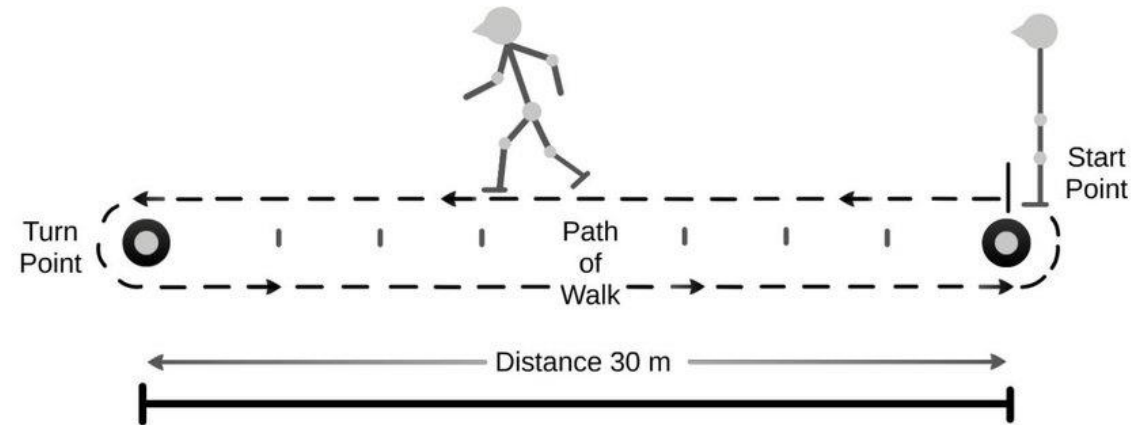
\* Systematic reviews have identified frequent study limitations in CPET trials, including small sample size, single-centre design, heterogeneous patient populations, variable CPET methodology and outcome measurements, and high risk of bias due to infrequent blinding.

# Patient selection – Exercise capacity

6-MWT

6-minute walking test

- Walking >510 m predicts 12-month disability-free survival,
- Walking < 350 m predicted 12 month disability (90% sensitivity; 73% specificity)
- For these outcomes, the 6-MWT was equivalent or superior to CPET.



Choice of test depends on:

- Familiarity/convenience
- Physical environment e.g access to 20 m corridor / gym space
- Resources / funding e.g. CPET
- Availability of staff
- Staff training

# Patient selection – Exercise capacity

DASI score

Duke  
Activity  
Status  
Index

Is the patient able to:	
Take care of self e.g. eating, dressing, bathing, using the toilet	<input type="radio"/> No 0 <input checked="" type="radio"/> Yes +2.75
Walk indoors	<input type="radio"/> No 0 <input checked="" type="radio"/> Yes +1.75
Walk 1-2 blocks on level ground	<input type="radio"/> No 0 <input checked="" type="radio"/> Yes +2.75

**9.95** points

The higher the score (maximum 58.2), the higher the functional status.

**3.97** METs

[Copy Results](#) [Next Steps >>>](#)

e.g. scrubbing floors, lifting or moving heavy furniture	<input checked="" type="radio"/> No 0 <input type="radio"/> Yes +4.5
Do yardwork e.g. raking leaves, weeding, pushing a power mower	<input checked="" type="radio"/> No 0 <input type="radio"/> Yes +4.5
Have sexual relations	<input checked="" type="radio"/> No 0 <input type="radio"/> Yes +5.25
Participate in moderate recreational activities e.g. golf, bowling, dancing, doubles tennis, throwing a baseball or football	<input checked="" type="radio"/> No 0 <input type="radio"/> Yes +6
Participate in strenuous sports e.g. swimming, singles tennis, football, basketball, skiing	<input checked="" type="radio"/> No 0 <input type="radio"/> Yes +7.5

## Exercise capacity – Take home messages

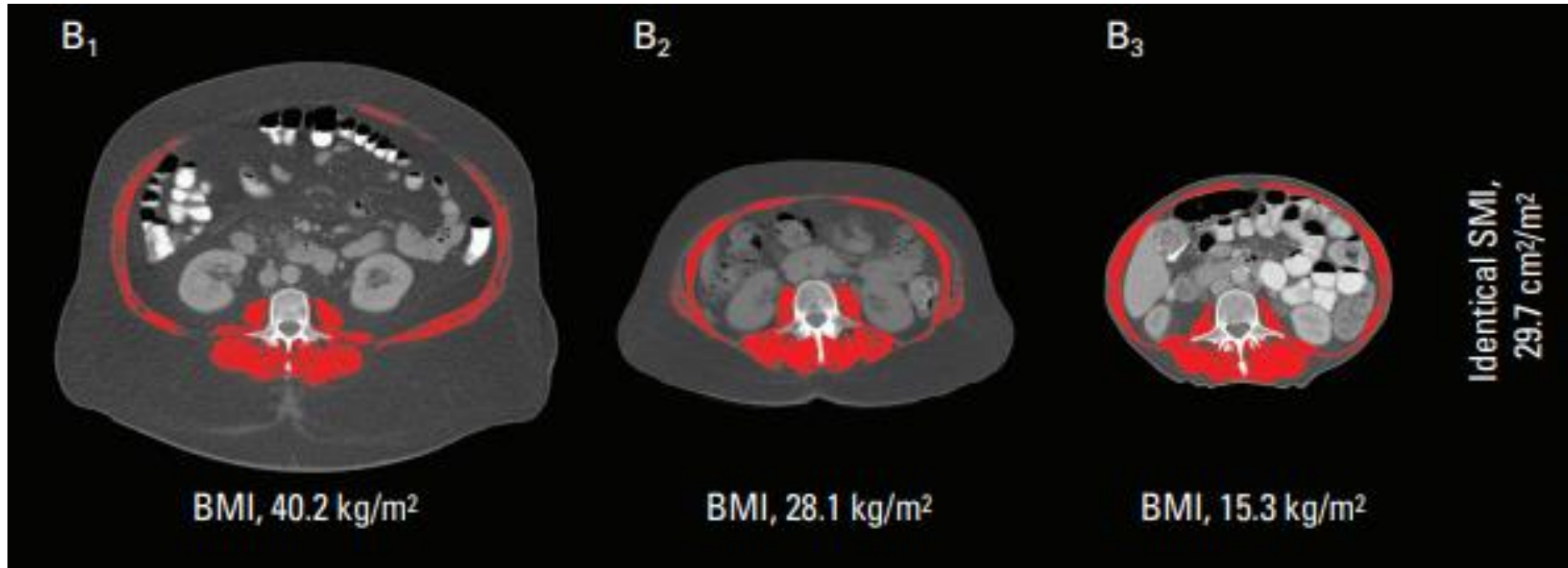
- Functional status screening/assessment is a key component of preoperative risk assessment, although there is not one single parameter or cut-point that reliably discriminates patients at “high-risk” of post-operative complications and/or death.
- There is a margin of error in all CPET parameters, and a single cut-off to discriminate between high versus low risk may be overly simplistic
- DASI is more accurate at predicting post-operative outcomes than subjective clinician assessment
- Pre-operative CPET may be useful in selected patients, especially those identified as high-risk using DASI.

# Patient selection – Nutritional screening

Who is malnourished?

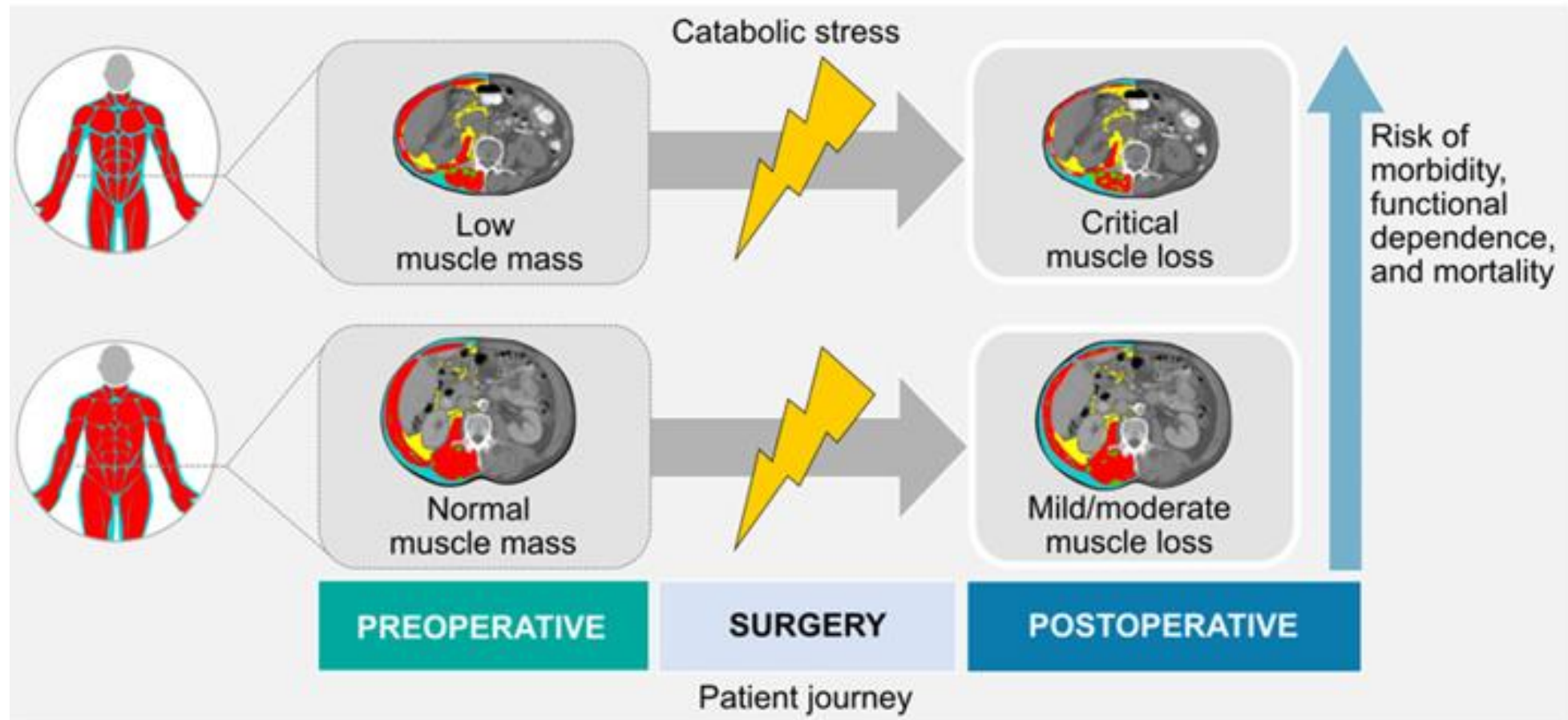


## Patient selection – Nutritional screening



Martin L et al. Cancer cachexia in the age of obesity: skeletal muscle depletion is a powerful prognostic factor, independent of body mass index. J Clin Oncol. 2013 Apr 20;31(12):1539-47

# Patient selection – Nutritional screening



# Patient selection – Nutritional screening

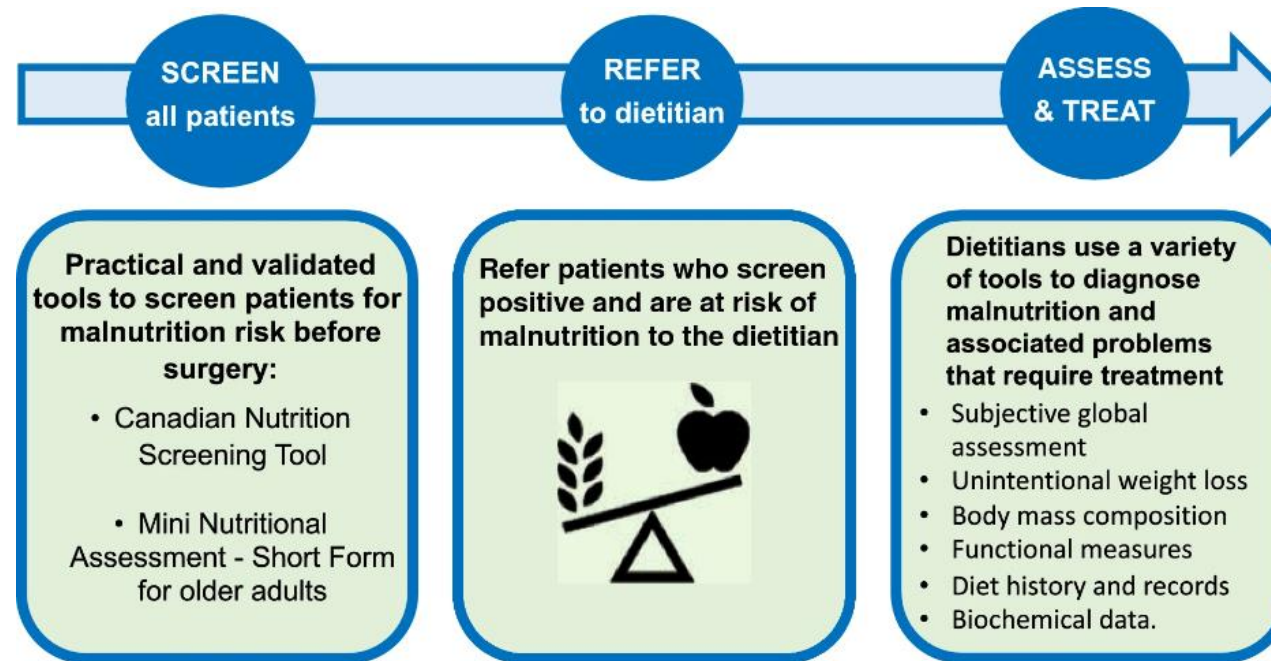
## Canadian Nutrition Screening Tool (CNST)

Have you lost weight in the past 6 months WITHOUT TRYING to lose weight?

Have you been eating less than usual FOR MORE THAN A WEEK?

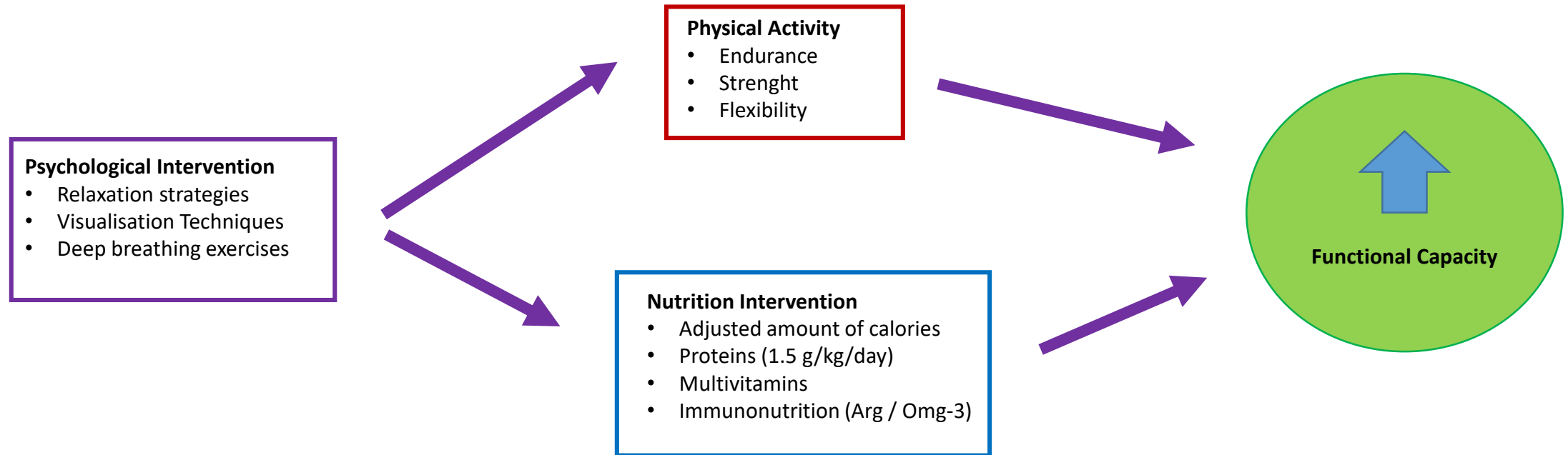
Two “YES” indicate nutrition risk and patients need an assessment to confirm Malnutrition.

# Nutritional screening – take home message



# Patient selection – Anxiety and Depression

Patients with cancer who have high levels of psychological distress have poor treatment compliance and worse outcomes.



# Patient selection – Anxiety and Depression

## Psychological Intervention

- Relaxation strategies
- Visualisation Techniques
- Deep breathing exercises

## Hospital Anxiety and Depression Scale (HADS)

Tick the box beside the reply that is closest to how you have been feeling in the past week.  
Don't take too long over you replies: your immediate is best.

D	A		D	A	
		<b>I feel tense or 'wound up':</b>			<b>I feel as if I am slowed down:</b>
3		Most of the time	3		Nearly all the time
2		A lot of the time	2		Very often
1		From time to time, occasionally	1		Sometimes
0		Not at all	0		Not at all
		<b>I still enjoy the things I used to enjoy:</b>			<b>I get a sort of frightened feeling like 'butterflies' in the stomach:</b>
0		Definitely as much	0		Not at all
1		Not quite so much	1		Occasionally
2		Only a little	2		Quite Often
3		Hardly at all	3		Very Often
		<b>I get a sort of frightened feeling as if something awful is about to happen:</b>			<b>I have lost interest in my appearance:</b>
3		Very definitely and quite badly	3		Definitely
2		Yes, but not too badly	2		I don't take as much care as I should
1		A little, but it doesn't worry me	1		I may not take quite as much care
0		Not at all	0		I take just as much care as ever
		<b>I can laugh and see the funny side of things:</b>			<b>I feel restless as I have to be on the move:</b>
0		As much as I always could	3		Very much indeed
1		Not quite so much now	2		Quite a lot
2		Definitely not so much now	1		Not very much
3		Not at all	0		Not at all
		<b>Worrying thoughts go through my mind:</b>			<b>I look forward with enjoyment to things:</b>
3		A great deal of the time	0		As much as I ever did
2		A lot of the time	1		Rather less than I used to
1		From time to time, but not too often	2		Definitely less than I used to
0		Only occasionally	3		Hardly at all
		<b>I feel cheerful:</b>			<b>I get sudden feelings of panic:</b>
3		Not at all	3		Very often indeed
2		Not often	2		Quite often
1		Sometimes	1		Not very often
0		Most of the time	0		Not at all
		<b>I can sit at ease and feel relaxed:</b>			<b>I can enjoy a good book or radio or TV program:</b>
0		Definitely	0		Often
1		Usually	1		Sometimes
2		Not Often	2		Not often
3		Not at all	3		Very seldom

Please check you have answered all the questions

# Patient selection – Frailty



Decreased tolerance of stressors (physical, physiologic, psychosocial)



Loss of independence

# Patient selection – Frailty

INO OP 07		M. Marti	J. Rothe	
✓	Beat	08:45	Uniportale, thorakoskopisch-assistierte Lobektomie Oberlappen rechts mit radikaler mediastinaler Lymphadenektomie - Rechts	Fixer
✓	M	63 Jahre	3 Ö. Senbaklavaci - (Keine Rolle)	Station
1.82	85.6	15:48	Peri-OP 150	Deut:020 O WEST
				ZAWR
✓	Marianne	11:15	Thorakoskopisch-assistierte Empyemausräumung rechts - Rechts	Dringlich
✓	W	52 Jahre	3 K. Gioutsos - Primär - Tel.: 031 664 46	Station
1.71	73	09:40	Peri-OP 120	Deut:ISB M NORD 0
				ZAWR
✓	Theodor	13:15	Thorakoskopisch-assistierte Dekortikation ca. 1 Lunge rechts - Rechts	Station
✓	M	84 Jahre	3 B. Kostovski - Primär	Station
1.88	64.7	22:10	Peri-OP 150	Deut:020 O WEST
				ZAWR
✓	Jürg	21:35	Diagnostische LSC - N. z.	Dringlich
✓	M	66 Jahre	4 A. Fiore - Erste Assistenz - Tel.: 031 664	Station
1.96	199	02:14	End 90	Deut:020 M WEST
				ZAWR
INO OP 08		R. Lampert	N. Wolfer	
✓	Erich	08:45	Hiatoplastik nach Ösophagektomie mit Relaxing Insicion - N. z.	Station
✗	M	71 Jahre	Y. Borbély - Primär	Station
1.8	59.7	15:50	Peri-OP 210	Deut:020 P WEST
				ZAWR
✓	Yvonne	12:15	Magenreposition, Hiatoplastik und Fundoplikatio LSC - N. z.	Station
✗	W	75 Jahre	Y. Borbély - Primär	Station
1.57	82.9	16:15	Peri-OP 120	Deut:020 P OST
				ZAWR
INO OP 08		R. Lampert	N. Wolfer	
✓	Hans-	15:05	Dünndarmsegmentresektion - N. z. OSME Symphysenplatte und Zementplombe, Entnahme Mikrobiologie (Weichteil 1x, 2x Knochenproben) - N. z.	Dringlich
✓	M	77 Jahre	3 A. Fiore - Zweiter Operateur - Tel.: 031	Station
--	76.5	08:28	Peri-OP 190	Deut:ISB M SUED 0
				ZAWR
✓	Antonina	23:10	Diagnostische Laparoskopie, Reposition Leistenhernie rechts, ggf. Dünndarmsegmentresektion, ggf. TAPP, ggf. offen - Rechts	Dringlich
✗	W	66 Jahre	J. Zindel - Primär - Tel.: 031 664 14 22	Station
1.65	76.5	09:01	Peri-OP 90	Ukrai020 P OST
				ZAWR
INO OP 09		F. Frei	S. Satraniti	
✓	Nadja	08:45	Nephrektomie rechts nach NTx - Rechts	Elektiv
✗	W	45 Jahre	V. Banz Wüthrich - Zweiter Operateur -	Station
1.54	59.5	14:20	Peri-OP 150	Deut:020 P WEST
				ZAWR
✓	Peter	11:15	Diagnostische Laparoskopie, Konversion auf quere rechtsseitige Oberbauchlaparotomie und atypische Leberresektion Segment VI	Elektiv
✓	M	84 Jahre	3 V. Banz Wüthrich - Zweiter Operateur -	Station
1.75	89.4	15:01	Peri-OP 180	Deut:020 P WEST
				IMC
✓	Ernst	16:00	VAC Wechsel tief Abdomen - N. z.	Fixer
✗	M	77 Jahre	G. Beldi - Primär - Tel.: 031 632 82 75	Station
1.73	68	22:16	At AVR 90	Deut:020 P OST
				ZAWR
INO OP 10		S. Probst	J. Schnyder	
✓	Gezim	08:45	Lap. Nierentnahme - N. z.	Elektiv
✗	M	38 Jahre	G. Beldi - (Keine Rolle) - Tel.: 031 632	Station
1.76	74	15:50	End 150	Deut:020 P OST
				IMC

# Patient selection – Frailty

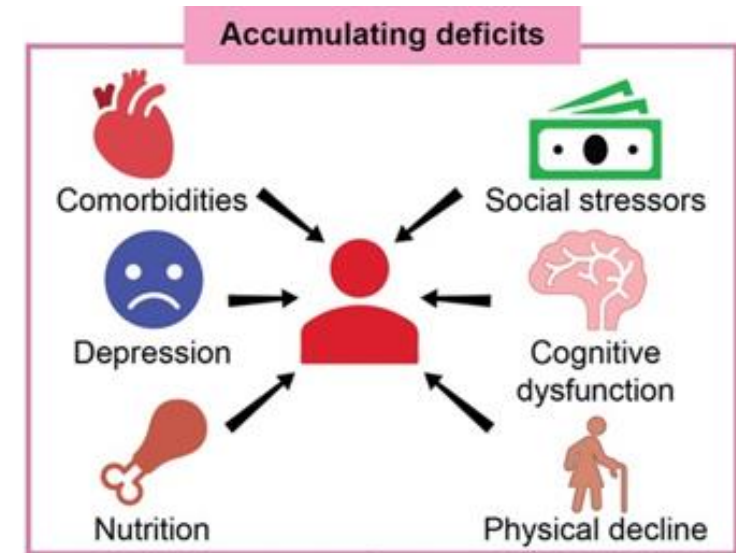
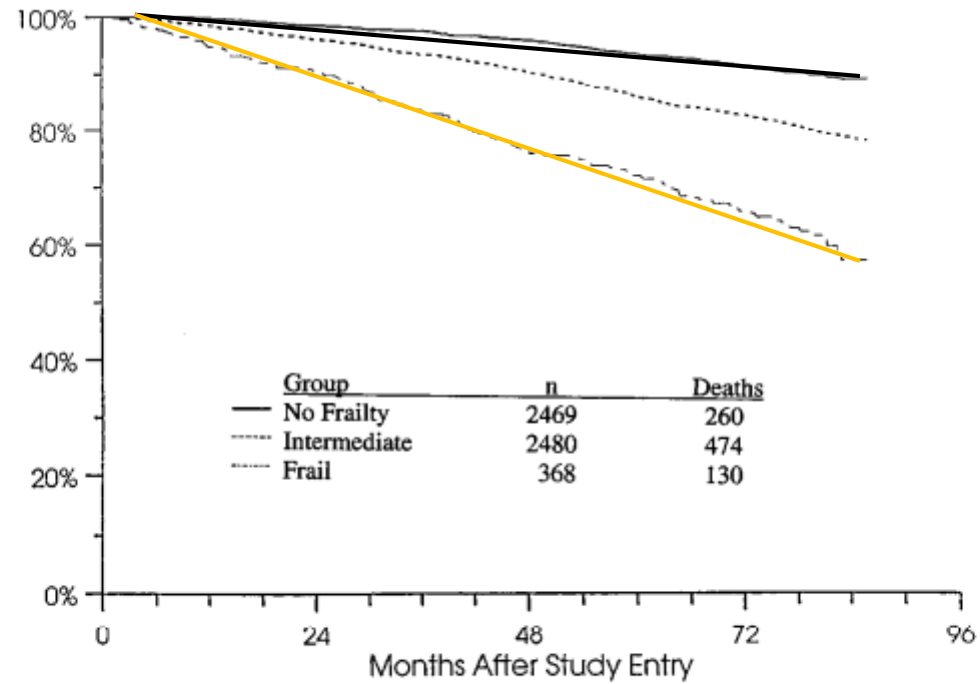
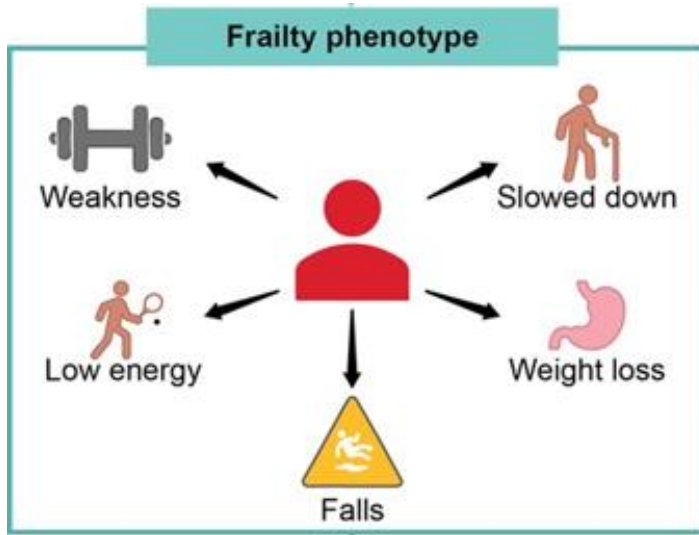











Figure 4. Survival curve estimates (unadjusted) over 72 months of follow-up by frailty status at baseline: Frail (3 or more criteria present); Intermediate (1 or 2 criteria present); Not frail (0 criteria present). (Data are from both cohorts.)

# Patient selection – Frailty

## CLINICAL FRAILITY SCALE

	<b>1</b>	<b>VERY FIT</b>	People who are robust, active, energetic and motivated. They tend to exercise regularly and are among the fittest for their age.
	<b>2</b>	<b>FIT</b>	People who have <b>no active disease symptoms</b> but are less fit than category 1. Often, they exercise or are very <b>active occasionally</b> , e.g., seasonally.
	<b>3</b>	<b>MANAGING WELL</b>	People whose <b>medical problems are well controlled</b> , even if occasionally symptomatic, but often are <b>not regularly active</b> beyond routine walking.
	<b>4</b>	<b>LIVING WITH VERY MILD FRAILITY</b>	Previously “vulnerable,” this category marks early transition from complete independence. While <b>not dependent</b> on others for daily help, often <b>symptoms limit activities</b> . A common complaint is being “slowed up” and/or being tired during the day.
	<b>5</b>	<b>LIVING WITH MILD FRAILITY</b>	People who often have <b>more evident slowing</b> , and need help with <b>high order instrumental activities of daily living</b> (finances, transportation, heavy housework). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation, medications and begins to restrict light housework.

	<b>6</b>	<b>LIVING WITH MODERATE FRAILITY</b>	People who need help with <b>all outside activities</b> and with <b>keeping house</b> . Inside, they often have problems with stairs and need <b>help with bathing</b> and might need minimal assistance (cuing, standby) with dressing.
	<b>7</b>	<b>LIVING WITH SEVERE FRAILITY</b>	<b>Completely dependent for personal care</b> , from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~6 months).
	<b>8</b>	<b>LIVING WITH VERY SEVERE FRAILITY</b>	Completely dependent for personal care and approaching end of life. Typically, they could not recover even from a minor illness.
	<b>9</b>	<b>TERMINALLY ILL</b>	Approaching the end of life. This category applies to people with a <b>life expectancy &lt;6 months</b> , who are <b>not otherwise living with severe frailty</b> . (Many terminally ill people can still exercise until very close to death.)

### SCORING FRAILITY IN PEOPLE WITH DEMENTIA

The degree of frailty generally 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. In very severe dementia they are often bedfast. Many are virtually mute.



Clinical Frailty Scale ©2005–2020 Rockwood, Version 2.0 (EN). All rights reserved. For permission: [www.geriatricmedicineresearch.ca](http://www.geriatricmedicineresearch.ca)  
Rockwood K et al. A global clinical measure of fitness

# Return on investment

Surgical Patient Optimization Collaborative (**SPOC**)  
British Columbia, Canada

## Objective & Methods

- Estimate the net financial impact of SPOC for four procedures: arthroplasty, colorectal, gynecology and urology
- Identified impact of SPOC on the rates of post-surgical complications (SSI, UTI and re-operation) and on surgical LOS
- Calculated the additional costs or savings associated with those changes
- Added cost of delivering SPOC to arrive at the net financial impact

# Return on investment

## Results – SPOC and NSQIP complication rates

SPOC	Procedure type	Cases (n)	% post-surg SSI	% post-surg UTI	Reoperation rate	LOS
	Arthroplasty	2695	1.37	.33	.33	1.99
	Colorectal	90	2.22	0	3.33	3.51
	Gynecology	66	1.52	0	0	0.66
	Urology	119	0	.84	0.84	0.80

NSQIP	Procedure type	Cases (n)	% post-surg SSI	% post-surg UTI	Reoperation rate	LOS
	Arthroplasty	15960	1.62	0.87	1.36	2.52
	Colorectal	3904	8.42	3.10	3.40	5.83
	Gynecology	11023	2.81	3.20	1.13	1.25
	Urology	7423	1.93	3.12	1.41	1.67

# Return on investment

## Results – Net financial impact

<b>Procedure type</b>	<b>Average cost of optimization per patient</b>	<b>Average cost impact of SPOC per patient*</b>	<b>Net financial impact of SPOC, per patient optimized*</b>
<b>Arthroplasty</b>	\$193	-\$1514	-\$1320
<b>Colorectal</b>	\$1789	-\$6450	-\$4661
<b>Gynecology</b>	\$502	-\$2588	-\$2086
<b>Urology</b>	\$502	-\$3432	-\$2931

# Conclusions

What is  
prehabilitation?

Individualized  
Prescribed  
Non-pharmacological  
Multimodal interventions  
Supports self management  
Promoting resilience  
Before treatment  
Enabled by behaviour change

# Conclusions

What is  
prehabilitation?

Exercise (?activity?)  
Nutrition  
Psychology  
Behaviour change  
Smoking cessation  
Alcohol cessation  
Other interventions?

# Conclusions

What is the aim  
of  
prehabilitation?

Empowerment & quality of life  
Recovery (reduced harm)  
Long-term health  
Disease modification?

Patient selection!

Better in – Better out.

