



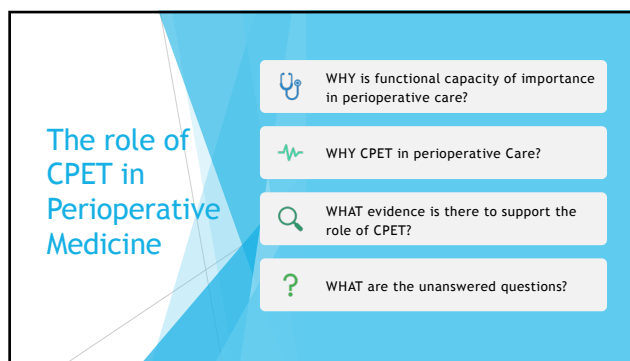
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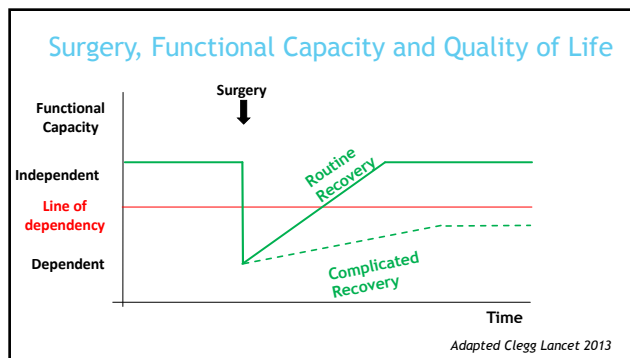
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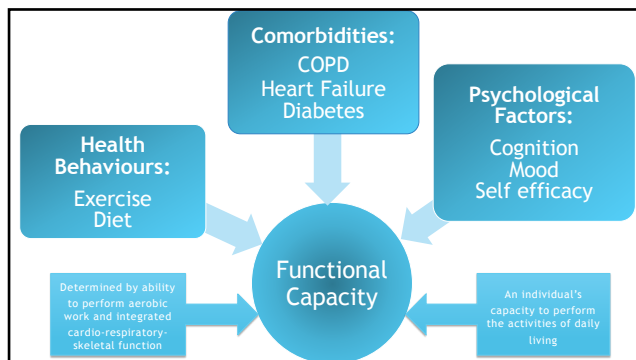
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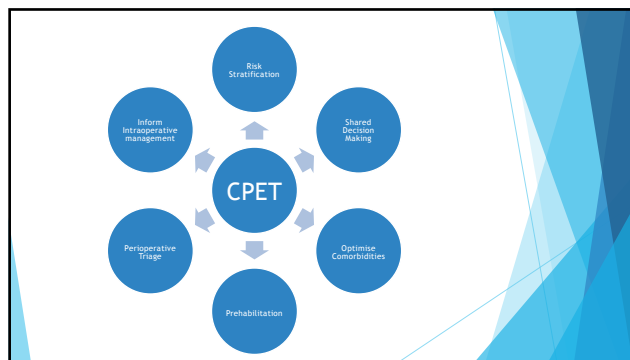
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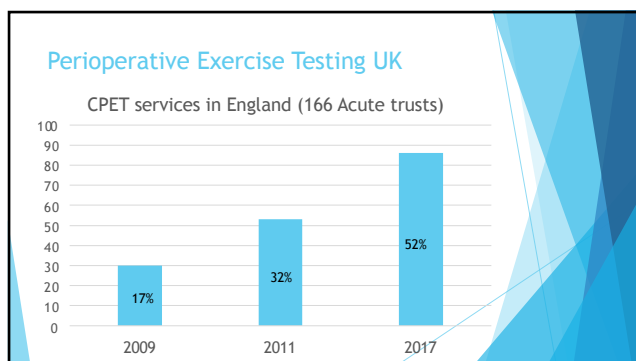
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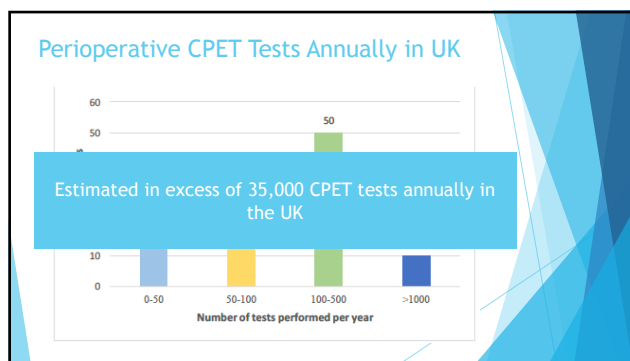
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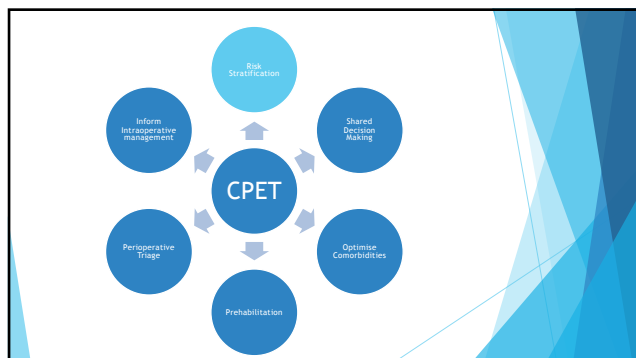
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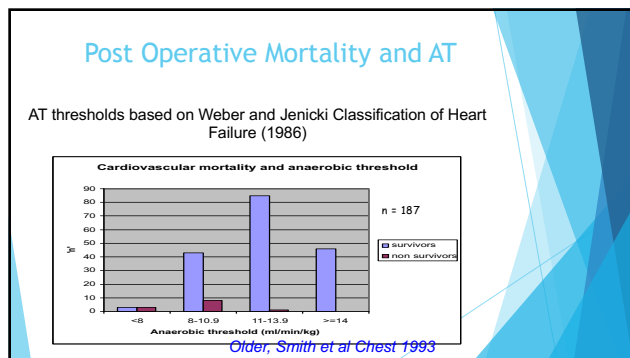
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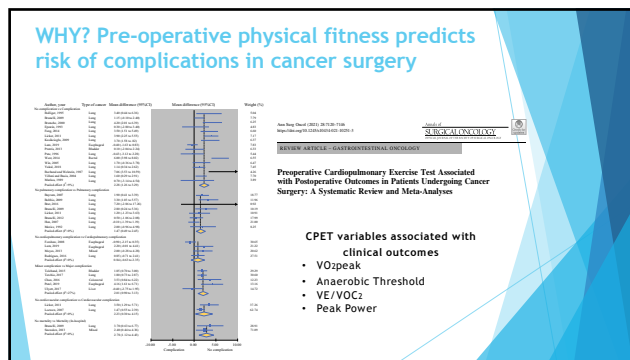


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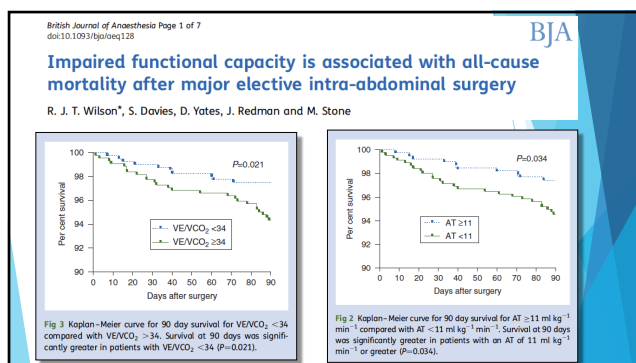
NIHR Southampton Biomedical Research Centre Southampton University Hospital Southampton NHS					
Upper gastrointestinal surgery					
NASAMATSU [52]	52				Morbidity: SD
	oesophagectomy	N		800 mL·min ⁻¹ ·m ⁻¹	Morbidity: SD
NASAMATSU [53]	91				
oesophagectomy					
McCULLOUGH [54]	109 bariatric	Y	<10.5	Y	<15.8
					N
					Primary composite end-point, including IH mortality
HENNES [55]	106 bariatric	Y	<11.1	N	N
					Morbidity: SD
MOSES [56]	108 upper GI	Y	<9.0	N	N
					Morbidity: SD
Urological surgery					
ULIBAY [57]	37 renal and cardiac transplant	Y	<9.5	N	Y
					>53.6
					Mortality: IH
TING [58]	70 renal transplant	Y	<9.4	Y	N
					Mortality: SD
PRENTIS [59]	82 radical cystectomy	Y	<12	N	N
					Morbidity: CD, LOS
TOLCHARE [60]	105 radical cystectomy	Y	<11	N	Y
					>33
					Morbidity: CD, LOS

AT: anaerobic threshold; AAA: abdominal aortic aneurysm; Y: yes; N: no; NM: not measured; GI: gastrointestinal; IH: in-hospital; POMS: post-operative morbidity survey; % pred: % predicted; CD: Clavien-Dindo complication; SD: self defined; LOS: length of stay; PFD: pancreatic fistula definition. Reproduced and modified from [61] with permission.

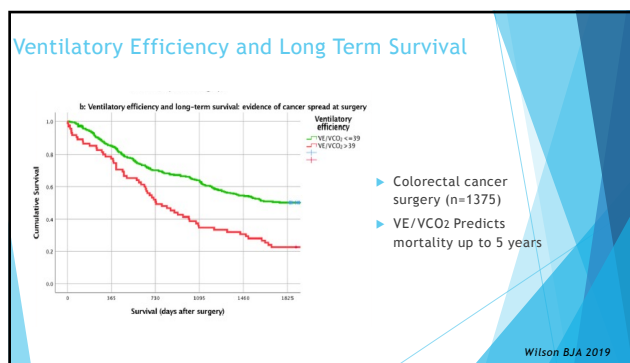
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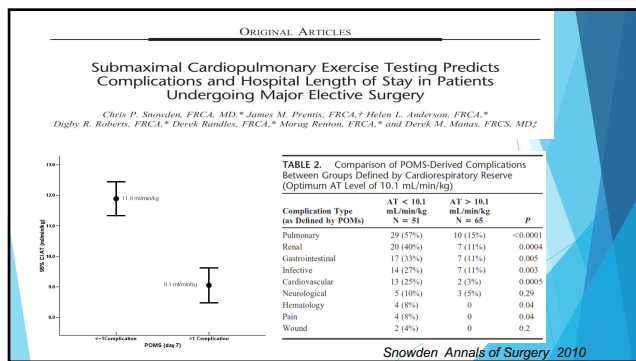
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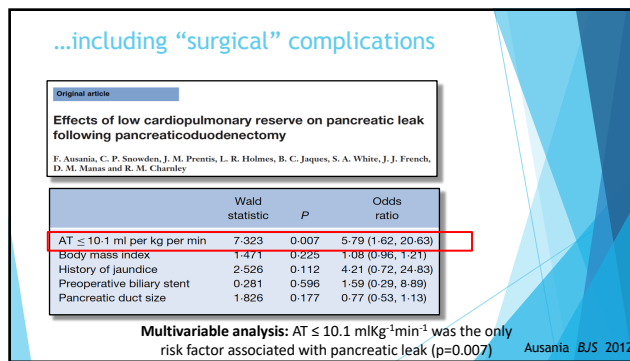
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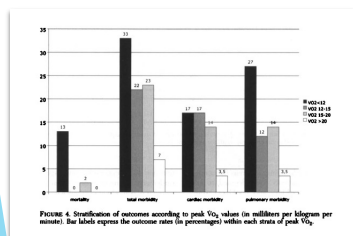


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Thoracic Surgery: Lung Resection

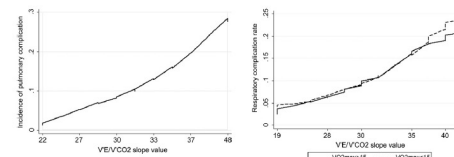


- $\dot{V}O_{2peak} < 12$
- 13-fold increased mortality

Brunelli A. Chest. 2009

19

VE/VCO₂ slope and Pulmonary Complications



Brunelli A. Ann Thorac Surg 2012

20

Prospective Validation of a Pre-operative mortality predictor incorporating CPET variables

Validation of long-term survival prediction for scheduled abdominal aortic aneurysm repair with an independent calculator using only pre-operative variables

J. B. Carlisle,¹ G. Danjoux,² K. Kerr,³ C. Snowden⁴ and M. Swart¹

¹ Consultant, Department of Anaesthesia, Torbay Hospital, Torquay, UK

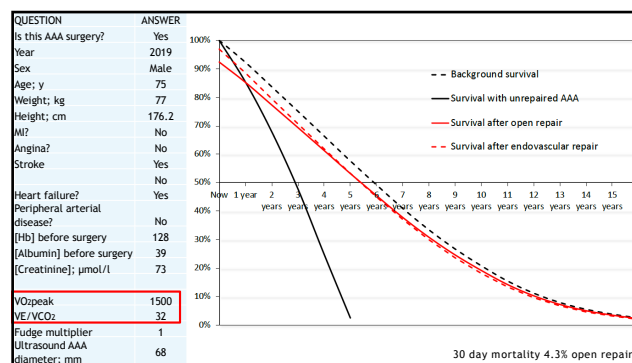
² Professor, Department of Academic Anaesthesia, James Cook University Hospital, Middlesbrough, UK

³ Consultant, Department of Anaesthesia, Sheffield Teaching NHS Foundation Trust, Sheffield, UK

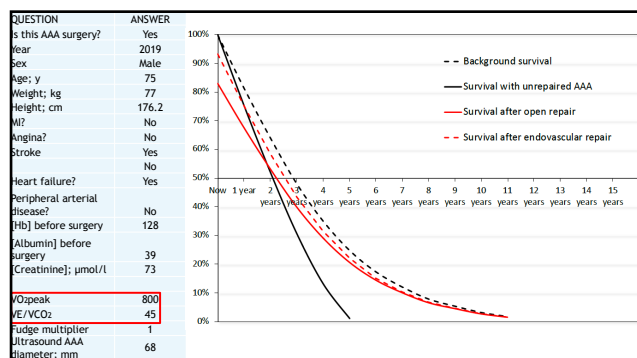
⁴ Consultant, Department of Anaesthesia, Newcastle upon Tyne NHS Foundation Trust, Newcastle, UK

Carlisle, J. BJA 2015

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

Duminda N Wijesundara,¹ Rupert M Pearce,² Mark A Shulman,³ Tom E F Abbott,² Elizabeth Torres,⁴ Bernard L Croal,⁵ John T Kevin E Thorpe,⁶ Michael P W Groot,⁶ Catherine Farrington,⁶ Paul S Myles,⁶ Brian H Cuthbertson,⁶ on behalf of the METS study investigators

THE LANCET

Open Access

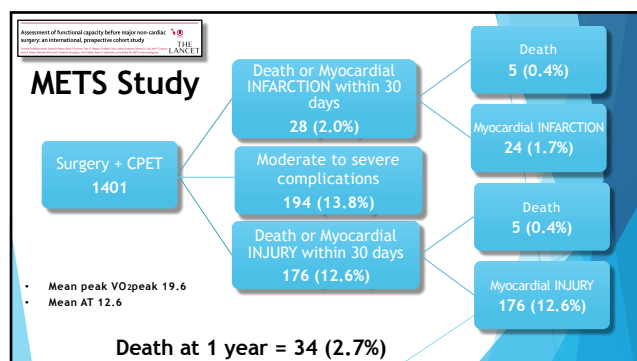
BMJ Open Measurement of Exercise Tolerance before Surgery (METS) study: a protocol for an international multicentre prospective cohort study of cardiopulmonary exercise testing prior to major non-cardiac surgery

International multi-centre

- Canada = 5
- UK = 7
- Australia = 10
- New Zealand = 3

Duminda N Wijesundara,¹ Rupert M Pearce,² Mark A Shulman,³ Tom E F Abbott,² Elizabeth Torres,⁴ Bernard L Croal,⁵ John T Kevin E Thorpe,⁶ Michael P W Groot,⁶ Catherine Farrington,⁶ Paul S Myles,⁶ Brian H Cuthbertson,⁶ on behalf of the METS Study Investigators

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

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

Table S8: Frequency of individual complication types among participants who experienced moderate-or-severe postoperative complications

Complication Type	No Complication or Mild Complications (n = 1027)	Moderate, Severe or Fatal Complications (n=194)
Non-fatal cardiac arrest	0 (0%)	2 (1.0%)
Myocardial infarction	14 (1.2%)	10 (5.2%)
Heart failure	0 (0%)	3 (1.5%)
Stroke or transient ischaemic attack	0 (0%)	1 (0.5%)
Respiratory failure	0 (0%)	18 (9.3%)
Pneumonia	0 (0%)	22 (11.3%)
Deep venous thrombosis or pulmonary embolism	0 (0%)	35 (18.0%)
Surgical site infection	0 (0%)	4 (2.1%)
Unexpected admission to critical care unit	14 (1.4%)	39 (20.1%)
Re-operation	2 (0.2%)	32 (16.5%)

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

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

	30-day death or Myocardial INFARCTION	30-day death or Myocardial INJURY (MINS)	In-hospital moderate or severe complications & death	Death at 1 year
Clinical	NS	NS	NS	NS
DASI	NS	p=0.004	NS	NS
NT-pro-BNP	NS	p=0.02	NS	p=0.02
VO ₂ peak	NS	NS	p=0.008	NS

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Table S5: Sequelae of 27 adverse events during CPET that led to unblinding

	Count
Immediate Consequence of Adverse Event	
Death	0
Cardiac arrest	0
Myocardial infarction	0
Emergency department visit or hospitalisation	2
Subsequent Testing, Consultations or Interventions	
New referral to specialist	10
New medical therapy	5
Stress test, echocardiogram, or angiogram	8
Coronary revascularisation	2
Changes in Surgical Plan	
Delay in planned surgery	6
Modification in planned surgery	2

Abbreviations: CPET, cardiopulmonary exercise testing

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Multi-centre National Audit UK PQIP

Table 4 Univariable logistic regression models for cardiopulmonary exercise testing variables as predictors of major postoperative complications

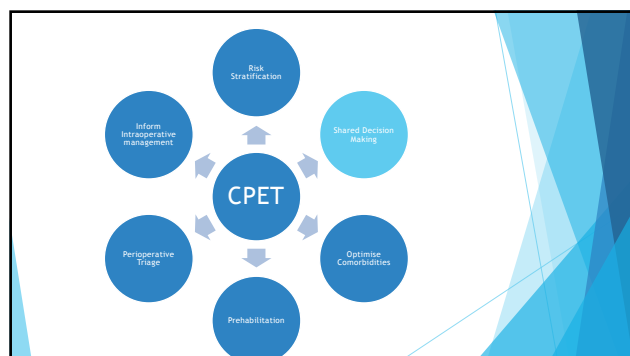
	Coefficient	Standard error	Wald Z-score	Wald Z-score P
Peak power output				
Intercept	-1.5437	0.1688	-9.145	< 0.001
Peak power output	-0.5203	0.1192	-2.687	0.007
Peak oxygen consumption				
Intercept	-1.4333	0.2297	-6.239	< 0.001
Peak oxygen consumption	-0.0303	0.0125	-2.420	0.016
Anaesthetic threshold				
Intercept	-1.7989	0.2434	-7.389	< 0.001
Anaesthetic threshold	-0.0251	0.0109	-2.294	0.048
Ventilatory equivalents				
Intercept	-2.5986	0.3126	-8.310	< 0.001
VE/VCO ₂	0.0293	0.0095	3.036	0.002

VE/VCO₂, ventilatory equivalents for carbon dioxide

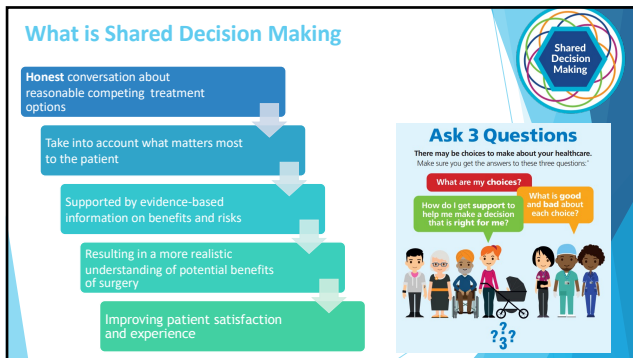
- Prospective Cohort
- National bench marking QI project
- N= 2742
- VO₂peak, VE/VCO₂, PPO
- Associated with morbidity and mortality

Milliken 2022 BJS

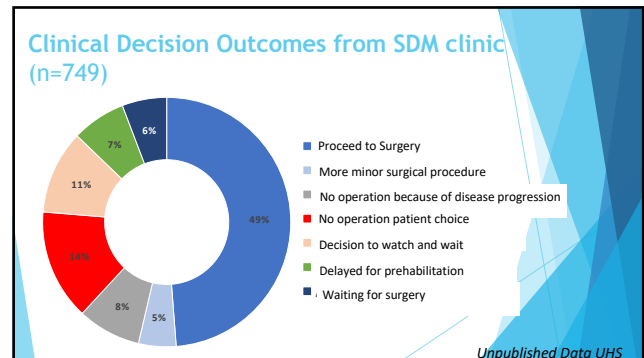
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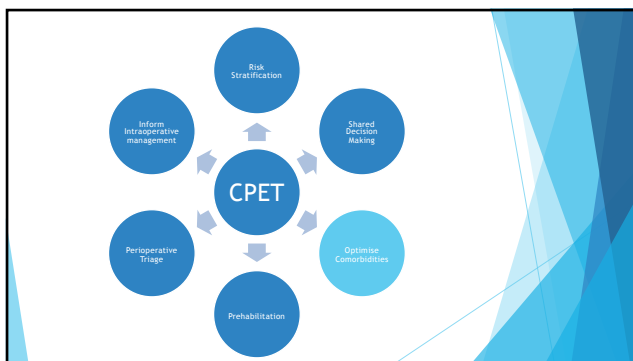
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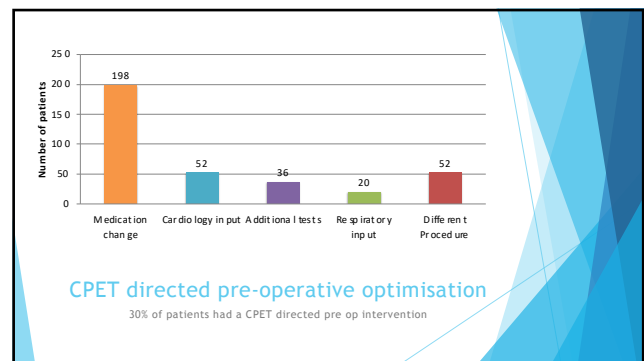
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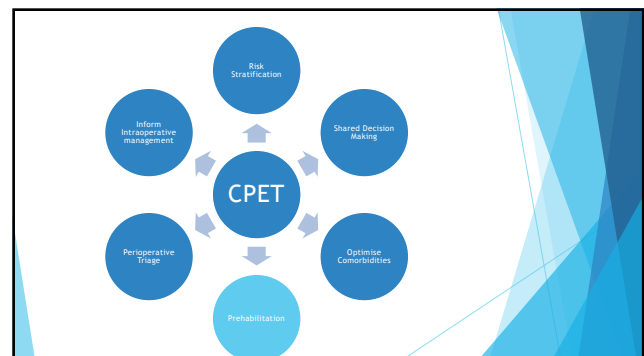
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Table S5: Sequelae of 27 adverse events during CPET that led to unblinding

Immediate Consequence of Adverse Event	Count
Death	0
Cardiac arrest	0
Myocardial infarction	0
Emergency department visit or hospitalisation	2
Subsequent Testing, Consultations or Interventions	
New referral to specialist	10
New medical therapy	5
Stress test, echocardiogram, or angiogram	8
Coronary revascularisation	2
Changes in Surgical Plan	
Delay in planned surgery	6
Modification in planned surgery	2

Abbreviations: CPET, cardiopulmonary exercise testing

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WHAT is Prehabilitation?

- Prehabilitation is a **tailored** intervention before surgery that aims to improve surgical outcome and recovery by improving **physical and psychological resilience**.
- Prehab involves **screening** and **assessment** that directs the **needs based, prescription** of:
 - Exercise
 - Nutrition
 - Psychological support
- Supported by **behaviour change techniques**.

Multimodal prehabilitation

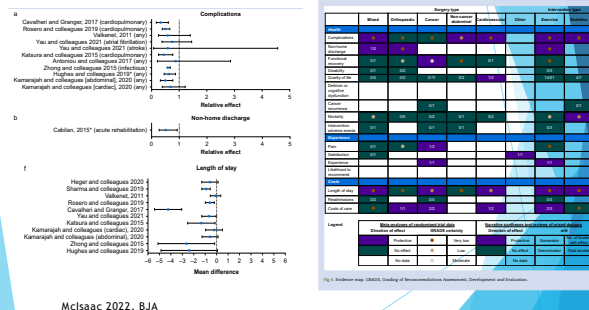
Exercise
Nutrition
Psychological support



RCOA, NIHR, Macmillan Guidance 2024

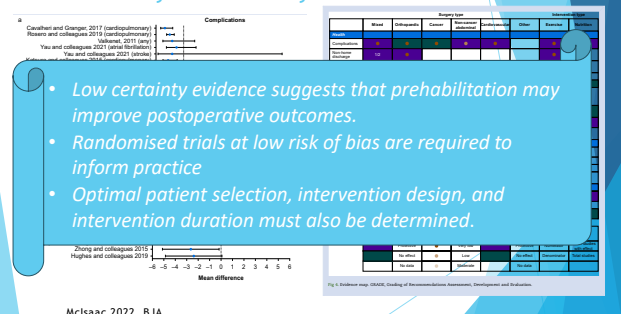
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WHY? Efficacy: Umbrella Systematic review 2022



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WHY? Efficacy: Umbrella Systematic review 2022



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Personalised Prehabilitation in High-risk Patients Undergoing Elective Major Abdominal Surgery

A Randomised Blinded Controlled Trial
 Anaël Barberan-Garcia, MSc,* Maria Uribe, MD,† Josep Roca, Prof. PhD,* Antonio M. Lacy, Prof. PhD,†
 Felipe Burgos, PhD,* Raquel Risco, MD,† Dulce Mondillo, PhD,† Joana Bulant, MD,† Isabel Blanco, PhD,*
 and Graciela Martinez-Padell, PhD*

- High risk patient group
 - Age > 70 and/or ASA 3/4
- Exercise
 - HIT - supervised, 3/week, mean 6 weeks (2), mean sessions 12
 - Physical activity promotion - steps, sit to stand
- Motivational interviewing
- Outcomes
 - Clinical - post operative complications
 - Physiological - endurance time and 6 minute walk test

Annals of Surgery 2017

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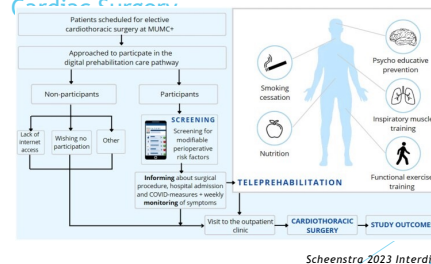
Clinical and Exercise Outcomes

- 50% Reduction in post operative complications
 - Reduced post operative readmission
 - Sustained behaviour change at 3-6 months
 - No increase in cost

(Barberan-Garcia BJA 2019)

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Personalised Digital Prehabilitation in Elective Cardiothoracic Surgery



Scheenstra 2023 Interdiscip cardiovasc thorac surg

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Who did not engage and why?

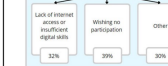
Reasons and predictors of non-participation in a personalized digital prehabilitation care trial for patients undergoing elective cardiothoracic surgery

Summary

In a retrospective study of 815 patients who were scheduled for elective cardiothoracic surgery, the reasons and predictors of non-participation in a personalized digital prehabilitation care trial were evaluated. Non-participants were older and had more perioperative risk factors.

Legend: [OR: odds ratio]

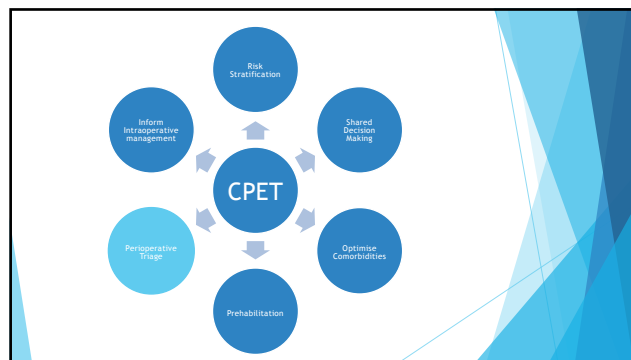
REASONS FOR NON-PARTICIPATION



PREDICTORS FOR NON-PARTICIPATION



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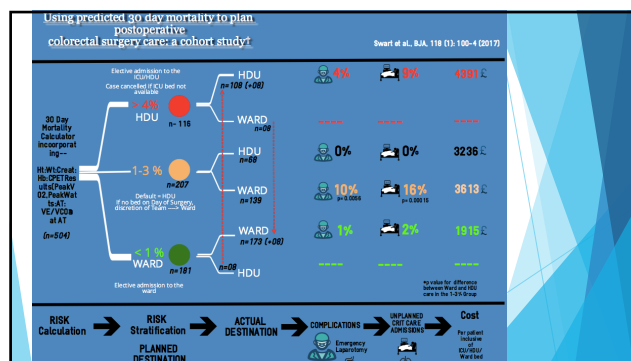
Using predicted 30 day mortality to plan postoperative colorectal surgery care: a cohort study[†]

M. Swart^{1,2}, J. B. Carlisle³ and J. Goddard²

¹Department of Anaesthesia and Perioperative Medicine, Torbay Hospital, Torquay, UK and ²Department of Anaesthesia, Salisbury District Hospital, Salisbury, UK

BJA 2017

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Summary

Pre-operative CPET has multiple applications in perioperative medicine

Risk Evaluation Optimise chronic health conditions Direct shared decision making Inform prehabilitation Informing intra-operative care Triage to critical care



BUT

Data is limited by use of a single variable Risk thresholds evolve as care evolves Larger prospective cohorts are needed

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NIHR Southampton Biomedical Research Centre

Fit4Surgery

University of Southampton

University Hospital Southampton NHS Foundation Trust

Acknowledgements

Research

- Mike Grocott/Prof Sandy Jack (Fit-4-Surgery research Lead)
- Chloe Grimmet (Behavioural Scientist)
- Judit Varkonyi-Sepp (Clinical Psychologist)
- Lewis Matthews (PhD ACF - nutrition)
- David Harvie (ACF - Frailty)
- Frances Wensley (ACF MyOperation)
- Sandy Jackman (ACF CIPHER)
- Malcolm West (Academic Colorectal surgeon)
- Lesley Hawkins (Research Manager)
- Samantha Leggett (Trial Manager)
- Andy Bates (Research Nurse)
- Steve Wootton (Academic Nutrition)

Clinical

- Denny Lewett (Clinical Lead)
- Martyn White (Perioperative Care Lead ACP)
- Imogen Fether (PhD student and Nurse Band 8)
- Gilly Ansell (Deputy POM lead)
- Alice Aarvold (Deputy POM lead)
- Charlie Allan (Perioperative Anaemia Lead)
- Mark Edwards (Pre-assessment Lead)
- Ester Acinas Devila
- Carin Dear
- Praddy Topley
- Claire Holleran
- Kate Donovan
- Mel Cooper (Manager/Admin)
- Stephanie Berry (Admin)
- Lisa Sheppard (Anaemia Lead nurse)
- James Otto (Exercise physiologist/prehab)
- Gurinder Rayat (Exercise physiologist)

NHS Digital

NHS England

NIAA

WESSEX CANCER TRUST

NHS Wessex Cancer Alliance

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Questions?

LET'S **Be active** Every day

World Health Organization

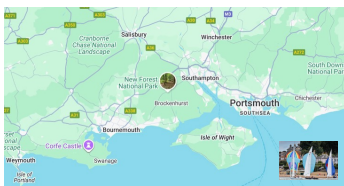
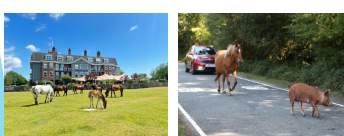
MAKING EVERY CONTACT COUNT

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European Practicum 2026
Prehabilitation and Perioperative Care

14-18th September
Brockenhurst,
Southampton
UK

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after a couple of sessions on the bike I thought: "actually, I quite like this". And I was feeling better

Prehabilitation helps you contribute to your cancer story - so you have your own ownership and don't just feel you are being 'done to'

I would definitely recommend it to anybody ... Very, very much so. It's very much... It's very worth doing

After the surgery, what I did was... right at the very start, I downloaded CT yoga exercises. So, even when I was in hospital, I was doing CT yoga exercises. And my personal trainer hasn't taken me back yet. She said she won't (laughing) until September. But what I've been doing is a lot of walking. And that's... that's certainly helping as well

It makes you feel more in control of your treatment.

I certainly felt that the exercise really did prepare me. It did help. Because I was at a pretty low ebb when I started. So, you know, I was really at a low ebb and this gave me something to go forward

Takes your mind off it all - something to focus on.

I've only gone and bought myself a bike so I can carry on with the hills

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BJA

British Journal of Anaesthesia, 133 (2): 305–315 (2024)

doi: 10.1016/j.bja.2024.03.015
Advance Access Publication Date: 26 April 2024
Review Article

CLINICAL PRACTICE

Towards a common definition of surgical prehabilitation: a scoping review of randomised trials

Chloé Fleurent-Grégoire^{1,2,3,4}, Nicola Burgess^{5,6}, Daniel I. McIsaac^{3,4,7,8}, Stéphanie Chevalier^{1,2,3,4}, Julio F. Fiore Jr.⁹, Francesco Carli¹⁰, Denny Levett¹¹, John Moore¹², Michael P. Grocott¹³, Robert Copeland¹⁴, Lara Edbrooke^{15,16}, Dominique Engel¹⁷, Giuseppe Dario Testa¹⁸, Linda Denehy^{19,20,21} and Chelsia Gillis^{19,20,21}

'Pre-habilitation 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.'

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