



P_01

Prehabilitation for esophago-gastric cancer surgery: a randomized control trial

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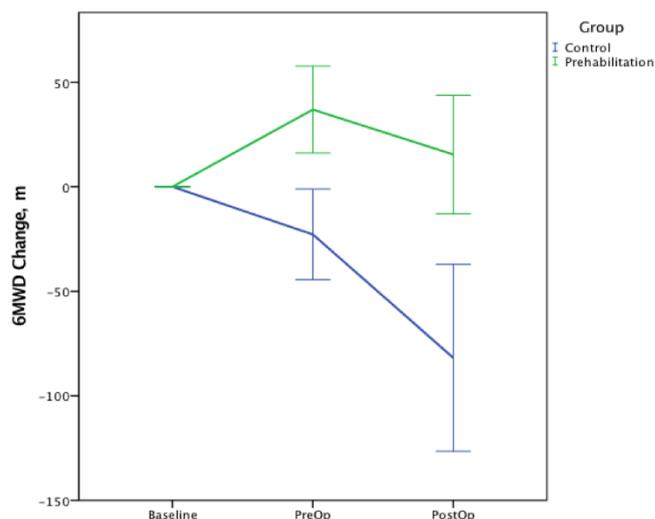
Introduction: Esophago-gastric surgery is associated with short and long-term side effects resulting from impaired nutritional, physical, and performance status. Thus, preserving functional capacity is of paramount importance for care continuum in these patients. Prehabilitation is a preoperative conditioning intervention involving exercise and nutrition.¹ Although evidence suggests that prehabilitation promotes functional recovery after colorectal cancer surgery,² no studies are available in upper gastrointestinal surgery. With the present study, our purpose was to determine whether prehabilitation is feasible, safe, and efficacious in improving perioperative physical status of patients undergoing esophago-gastric surgery for cancer.

Methods: A randomized controlled trial was conducted in a single university institution (McGill University Health Centre, Montreal, QC, Canada), involving adults awaiting elective esophago-gastric resection for cancer. Appropriate ethical approval has been obtained. Preoperative exercise, prescribed by a kinesiologist, was a 4-day per week, home-based, structured aerobic and resistance training. A dietician prescribed a preoperative diet therapy aimed at balancing daily meals and meeting patient's metabolic requirement; whey protein supplement was prescribed, if needed, to guarantee a protein intake of 1.2-1.5" [quotrightB?]g/kg/d. All participants received a standardized perioperative care according to the Enhanced Recovery After Surgery Society Guideline (ERAS) pathway.³ Primary outcome was change in functional capacity, measured with distance walked during a 6-minute walk test (6MWD). Patients underwent 3 assessments, baseline, preoperative (end of prehabilitation period) and postoperative (4 to 8 weeks after surgery), and data were compared between groups over time.

Results: Between February 2013 and February 2017, 68 patients were randomized and 51 included in the primary analysis. Patients in the prehabilitation group, compared with control, improved functional capacity both preoperatively (6MWD change 36.9 ±51.4 vs. -22.80 ±52.5 meters, P< 0.001) and postoperatively (6MWD change 15.4 ±65.6 vs. -81.8 ±87.0, P< 0.001) (Figure 1). A higher proportion of patients in prehabilitation group experienced a significant change in functional capacity before surgery (61% vs. 4%, P<0.001) and after surgery (52% vs. 6%, P<0.001). There were no statistically significant differences between groups in the main surgical outcomes, such as postoperative complications, length of hospital stay, emergency department visit, or hospital readmission.

Conclusion: Prehabilitation improved perioperative functional in patients undergoing esophago-gastric surgery for cancer.

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Caption 2: Trajectory of Perioperative Functional Capacity



P_02

Effect of prehabilitation on fitness in patients undergoing neoadjuvant treatment and oesophagogastric cancer surgery: A randomised controlled trial

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Introduction: Neoadjuvant chemotherapy (NAC) and surgery improves 5-year survival in patients with locally-advanced oesophagogastric (OG) cancer. NAC reduces fitness as assessed by cardiopulmonary exercise testing (CPET). We aim to demonstrate improvement in CPET test performance in patients undergoing a 15-week 'prehabilitation' programme during and after NAC, compared with those receiving 'standard care'.

Methods: A single-centre, parallel-arm randomised controlled trial was conducted in patients undergoing NAC for OG cancer. Patients were assigned to a 15-week prehabilitation programme comprising twice weekly supervised aerobic and resistance training, a thrice weekly home exercise plan, and 6 Medical Coaching sessions (Prehab), or standard care (Control). CPET was performed at baseline (before NAC; test 1), 2 weeks following NAC completion (test 2), and during the preoperative week (test 3). The primary outcome (anaerobic threshold (AT)) is powered for 48 patients (24 per group). Secondary outcomes include peak oxygen uptake (pVO_2) and work rate (WR).

Results: Since December 2016, 46 patients have been recruited, with a 15% drop-out rate (7/46). All patients received NAC. To date, complete dataset is available for 27 subjects (Prehab $n=15$; Control $n=12$). Groups were matched for baseline demographics and AT/ pVO_2 /WR ($p=ns$): Mean AT 13.3 ± 2.91 ml/kg/min, pVO_2 797.85 ± 168.04 ml/min/m², and WR 148.63 ± 40.18 watts).

Effects of NAC (Tests 1 to 2): All subjects had a mean decline in AT (Prehab -1.41 ml/kg/min vs. Control -1.69 ml/kg/min) with no difference in WR decline (Prehab -9.87 watts vs. Control -9.66 watts; $p=0.98$). At test 2, there was a trend towards pVO_2 improvement with Prehab ($+20.2$ ml/min/m²) whereas pVO_2 in Controls deteriorated (-81.98 ml/min/m²; $p=0.06$).

Effects of NAC and 5-week 'recovery period' (Tests 1 to 3): There was a tendency towards a smaller AT decrease from baseline with Prehab subjects (-0.6 ml/kg/min) compared with Controls (-1.5 ml/kg/min; $p=0.30$). Compared with Test 1, Prehab patients demonstrated a non-significant trend towards improvement in pVO_2 ($+20.2$ ml/min/m²) and WR ($+1.86$ watts) following a period of recovery. Controls observed a decrease in both parameters (pVO_2 -16.48 ml/min/m², WR -3.5 watts).

Conclusion: A prehabilitation programme is feasible during and after NAC. Interim analysis demonstrates a trend towards return of baseline pVO_2 in patients receiving prehabilitation. Trial completion is warranted and the full dataset will be available by June 2018.

P_03

PREP: The Preoperative Risk Education Package. An online educational resource for primary care clinicians to encourage community based prehabilitation prior to major non-cardiac surgery

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Introduction: Effective prehabilitation prior to major surgical intervention requires coordinated working across healthcare sectors. Full utilization of the preoperative window from referral relies upon primary care clinician engagement. Awareness of perioperative risk factors is a key prerequisite. A national survey undertaken by our group (unpublished data) identified variability in clinician knowledge and understanding of the perioperative implications of unhealthy behaviours, lifestyle factors and chronic health conditions that elevate surgical risk. This underlined the need for a dedicated educational initiative for this key group of clinicians. Our aim was to create an open-access, online educational toolkit for primary care designed to encourage and support both community based prehabilitation of patients prior to major non-cardiac surgery and more efficient working with secondary care.

Methods: The PREP concept was robustly evaluated through the UK Academic Health Sciences Network 'bright ideas' programme prior to development. Our multidisciplinary development team of anaesthetists, general practitioners, animators and web designers developed a focused, online educational resource targeting the major lifestyle factors and under recognized chronic health conditions that influence perioperative risk and are amenable to prehabilitation. In addition, we created a 2-minute animation surrounding the prehabilitation concept that both introduces the resource and can be utilized as a stand-



alone tool to raise clinician awareness.

Results: PREP takes approximately 30 minutes to complete and highlights seven key risk factors. These are: Smoking, alcohol excess, physical inactivity and poor fitness, anaemia, cognitive impairment, frailty and malnutrition. A primary care relevant case study frames each risk factor. Prevalence in surgical populations, perioperative impact and practical strategies for facilitating prehabilitation are presented. Users have the opportunity to consolidate their knowledge using multiple-choice questions and obtain a formal record of their continuing professional development activity. Early feedback from roadtesting primary care clinicians has been very positive and the resource has undergone evaluation by the UK Royal College of Anaesthetists (RCOA) Perioperative Medicine Leadership Group and representatives from the UK Royal College of General Practitioners (RCGP).

Conclusion: PREP is a dedicated prehabilitation educational resource targeted specifically at the primary care sector. To the best of our knowledge, it is the first resource of its type. It has significant scope for expansion to encompass other risk factors and functions to facilitate prehabilitation in the community. This represents a major step towards raised awareness amongst a vital group of clinicians and enhanced collaboration for patient benefit and improved outcomes in the perioperative setting. We are undertaking a formal national evaluation of the impact of the resource on clinician practice.

P_04

Perioperative care, postoperative outcomes and prehabilitation in patients with colorectal cancer undergoing elective surgery

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Introduction: Colorectal cancer (CRC) is the second most common diagnosis of cancer in the Netherlands (incidence 2017: 13,597).¹ For most patients with localized CRC, the treatment consists of resection, with or without (neo) adjuvant chemo(radio)therapy.² The disease and the (neoadjuvant) treatment may decrease cardiorespiratory fitness, which can increase the risk of postoperative complications³ and a delayed postoperative recovery of physical functioning. In this perioperative trajectory, prehabilitation – here physiotherapy – seems of importance, which is studied nationwide, as well as in a cohort with patients with CRC at the Maastricht University Medical Center.

Methods: Hereto, 1) variation and uniformity of daily perioperative physiotherapy practice for CRC in Dutch hospitals was studied by a national survey amongst all hospitals; 2) the association between preoperative variables (e.g., age, comorbidities, exercise capacity, muscle strength, and nutritional status) and postoperative outcomes was studied as a first step for risk-prediction, and 3) the feasibility and preliminary effectiveness of a preoperative exercise training during neoadjuvant chemoradiotherapy (NACRT) was determined by evaluating program-adherence, adverse events, exercise capacity, muscle strength, and fatigue.

Results: The survey study with a response rate of 79% (65/82 eligible hospitals) identified three classes of practice of which respondents in class I (25%) and II (29%) are more likely to report to provide preoperative physiotherapy interventions compared to class III (46%). Besides that, there is a 50% chance that respondents in class I provide prehabilitation, compared to 17% chance for hospitals in class II. The second study (n=75) showed that more comorbidities (odds ratio (OR) 1.604), a worse functional exercise capacity (in meters, OR 0.995), a lower physical activity level (in min/day, OR 0.994), and a higher level of perceived fatigue (OR of 1.047) were associated with a delayed postoperative recovery of physical functioning. A better preoperative functional exercise capacity was associated with a lower OR (OR 0.995) for non-surgical complications. The physical exercise program during NACRT was feasible and safe; nine out of thirteen patients (69%) completed the program without adverse events. Additionally, leg and arm muscle strength increased significantly ($P<0.001$), whereas functional exercise capacity remained the same.

Conclusion: Firstly, Dutch clinical physiotherapy management shows three classes of daily practice for patients who undergo elective colorectal resection, in which some hospitals perform a preoperative assessment and prehabilitation, some only provide a preoperative assessment, and some merely provide postoperative physiotherapy care. Future change in pre- and postoperative physiotherapy management is recommended to implement evidence-based state-of-the-art physiotherapy and to improve uniformity. Secondly, there is an association between preoperative parameters of physical fitness and postoperative outcomes in patients with CRC; however, a prediction model has to be developed in a next step. Finally, preoperative exercise during NACRT is feasible, safe and seems effective in improving physical fitness during NACRT.



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P_05

Role of Tapentadol/Ketoprofene association in control of perioperative pain in hip arthroplasty in fast track surgery: real life evidence

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Background: Hip arthrosis is often cause of chronic pain. The treatment of preoperative chronic pain can improve the performance status of the patient in terms of preoperative rehabilitation and of post-operative recovery. Tapentadol PR belongs to the new MOR-NRI drug class featuring the combined effect on neuropathic and nociceptive pain components and is particularly suitable in the treatment of chronic pain. We evaluated its efficacy and tolerability in moderate-severe chronic pain in patients undergoing total hip surgery according to the fast track rehabilitation model, comparing it with the standard treatment oxycodone/naloxone with ketoprofen.

Methods: Single center retrospective observational study on 211 THA patients either receiving tapentadol 50mg/BID 10 days before surgery and 100mg/BID post-surgery or oxycodone/naloxone 5mg/2,5mg 10 days before surgery and 10mg/5mg after surgery, plus ketoprofen 100mg/BID only post-surgery. Supplemental analgesic doses were provided in case of inadequate pain control (paracetamol 1gr or morphine 0,1mg/kg sc).

Results: Compared to the standard treatment, pain intensity at rest (NRS) and upon movement (mNRS) were significantly lower in the tapentadol group at all times ($p < 0.001$), with mNRS < 1.9. Moreover, supplemental analgesic was needed in less than half patients compared to control, and the number of collateral effects was lower: 30% and 50% less, respectively, for nausea and vomiting at the first day postoperative, and 50% less constipation at the fourth day postoperative.

Conclusions: The use of tapentadol in THA 10 days before surgery reduces chronic pain improving the mobility of the patient, preserving muscle tone and promoting an effective post-surgery rehabilitation. The gradual increase in dose reduces the collateral effects as nausea e vomit and permit to the patient a rapid recovery according to ERAS (enhanced Recovery After Surgery) criteria.

P_06

The effect of a prehabilitation on acute postoperative physical activity in patients undergoing radical prostatectomy

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Introduction: Early ambulation and higher levels of physical activity (PA) early after major abdo-thoracic surgery are associated with lower risk of readmission and faster recovery compared to those with less PA. Prehabilitation has been shown to improve postoperative physical function and reduce surgical complication rates; however, it is not known if patients who prehabilitate demonstrate increased PA in the acute out-patient period after surgery that may reflect faster recovery and reduced risk of postoperative complications. Therefore, we sought to determine if prehabilitation (PREHAB) versus a control condition stimulated differences in PA in the week after discharge in men undergoing radical prostatectomy (RP).

Methods: This is a secondary analysis in a subsample of n=39 from a larger two-arm randomized controlled trial of PREHAB in men undergoing RP for prostate cancer at two university hospitals in Canada. Nineteen participants awaiting RP were randomized to PREHAB and n=20 to control for the duration of their surgical wait-time (4-8 weeks). PREHAB consisted of home-based, moderate intensity aerobic and resistance exercise 3 to 4 days per week plus pelvic floor muscle exercises. PREHAB participants received exercise bands, a stability ball, an exercise mat, and an exercise log book to support their exercise program. Participants in the control arm completed pelvic floor muscle exercises only. Both groups were



provided with accelerometers during their in-patient stay and instructed to wear them on their wrist for seven days following discharge. Total PA volume, including light, moderate and vigorous PA were extracted from accelerometers and analyzed for within and between-group effects. Within-group differences between day 1 and day 7 during outpatient care was calculated for both groups using paired samples t-tests. Mean between-group difference in total daily PA level over the first out-patient week were calculated using independent t-tests.

Results: Both study arms were equivalent across demographic and disease-specific variables. Although similar PA volumes on the first day after discharge were observed ($p = 0.971$), only the PREHAB group demonstrated significant increases in physical activity at the end of the first week following discharge (control: $+66.2 \pm 156.4$ min; $t(19) = -1.89$, $p = 0.07$; PREHAB: $+81.3 \pm 132.3$; $t(18) = -2.78$, $p = 0.02$). Mean total PA volume was similar between groups on the first day after discharge (PREHAB = 456.9 min ± 119.7 , control = 464.6 min ± 166.6 ; $t(34.5) = -0.16$, $p = 0.869$).

Conclusions: The PREHAB group demonstrated a significant increase in daily PA level within the first week following hospital discharge whereas the control group did not. Total mean daily PA level was not different between PREHAB and control in the week following hospital discharge.

P_08

Future proof care: prehabilitation at home, optimized with data and monitored by professionals

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Introduction: The future sustainability of our healthcare systems is being challenged by the aging population, the increase of lifestyle related diseases (obesity, diabetes) and prevalence of chronic illness. This leads to an increase in demanded care: more (complex) patients, with a limited number of healthcare professionals and limited resources. Meeting these challenges requires smart innovations, that enable upscaling without increasing the burden on society and health care organizations.

Within the SAMMI project we translated this to our challenge: to limit unnecessary burden by avoiding surgery related complications related to bad physical condition, and improving the speed of recovery after surgery, without increasing the budget or time in which healthcare professionals are being involved.

Methods: To meet this challenge we designed SAMMI (Smart App for Movement and Medical Interventions), a platform for remote monitored and individualized home training for prehabilitation. Independent training and smart use of data are key elements in the system, consisting of a patient app connected with sensors and a home trainer, linked to a dashboard for the healthcare professional. (see figure)

Results: The patient exercises with SAMMI at home, with the predefined schedule that is automatically adjusted to the individual patient's ability on that particular moment (figure, step 1). Training data (training finished, duration, power, heart rate, recovery) comes back to the dashboard (step 2). This serves for remote monitoring by the physician (step 3), extrinsic motivation for the patient, and to extend the patient's physical profile to finetune automated training adjustments. The professional might optimize the overall program, depending on the training output (step 4). Collection of this training data enables smart optimizations even during the training session. Combining overall coordination of the professional with automated and highly individualized training session optimization allows very efficient and effective prehabilitation programs. The data could further serve better automated training programs for future patients and better patient selection (based on expected improvement in physical condition). The system will be ready for clinical testing in the near future.

Conclusion: Societal changes force smart innovations in healthcare. Prehabilitation should be implemented as smart as possible, using data and available technology to ease adoption and minimize additional burdens on already limited resources. With SAMMI we show a personalized, effective, and scalable way of smart innovation for surgical prehabilitation.





P_09

Examination of the Effects of a Multimodal Training Program on the Uterus Myomatosus Operation according to the ERAS Concept

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Introduction: The positive effect of physical exercise for rehabilitation after various surgical procedures has been known for a long time. To our knowledge, no randomized prehabilitation study of elective hysterectomy is available to date [1]. Prehabilitation is an unused area in elective hysterectomy, although a targeted training program can be easily implemented to cover a possible time delay to the surgical appointment. A hysterectomy is often followed by considerable interference in the activities of daily living, quality of life and performance. According to our hypothesis, physical training may positively influence the recovery time in terms of pain reduction, time back to work and patient satisfaction. Despite the generally limited clinical trial situation, the potential of prehabilitation is more likely to be considerable.

Methods: For this single center, longitudinal prospective study 90 patients will be randomized into either a control (n=45) or an intervention group (n=45), stratified to 'active or passive'. The primary objective of the two-arm cohort study is to investigate group differences in the ERAS concept with regard to the pain intensity (NRS, German Pelvic Floor Questionnaire, 16-step NRS and PONV), dose of medication (analgesia requirement 24 hours after surgery) and the quality of life (SF12, PPP-33 and EQ-5 D). Further targets are the number of days of incapacity for work, metric or ordinal characteristics in different areas (secondary endpoints) and compared between the groups. The intervention group carries out a six-week combined high-intensity resistance, endurance and a homebased pelvic floor training (IRT, HIT and PFMT). The control group receives the same therapeutic attention and performs a low-intensity activity (LIA) program with the same homebased pelvic floor training over the same period of six weeks. After initial pelvic floor education, the patients perform homebased pelvic floor training five days a week, which is recorded in a training diary.

Results: Intensive resistance training (IRT) stimulates protein synthesis and creates an anabolic, anti-inflammatory muscle environment and an anti-inflammatory overall metabolic system. A highly intensive endurance training (HIT) improves the energy metabolism by inhibiting lipid retention and intensifies lipolysis, among other things by an increased mitochondrial function.

Pelvic floor muscle training (PFMT) reduces the risk of postoperative dyscoordination with corresponding negative consequences for continence. Prehabilitation in combination with early rehabilitation is more cost-effective than conventional rehabilitation alone. The expected results of this trial are a faster recovery to daily routine and higher patient satisfaction what should reduce the community health cost.

Conclusion: Surprisingly, in elective hysterectomy for fibroids, prehabilitation is not used, although the surgical procedure is well planned in advance and is after cesarean section the most common gynecological surgery. Prehabilitation could bring many benefits to patients, health professionals and the health system in general.

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P_12

Responsive Prehabilitation- Medway SPEP

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Introduction: Initiatives to improve patient outcomes through pre-operative education and intervention are being recognised in the health care settings. Healthcare organisations are establishing prehabilitation services based on pre-existing service models.

We suggest in accordance with the ethos of collaborative decision making, Prehabilitation needs to move in the direction of being patient led rather than simple adoption of pre-existing models. This strategy would be tailored to the needs and expectation of the local population.

Methods: We conducted a pre-operative patient questionnaire survey of their expectations and needs form an education programme to improve post-operative outcomes. We launched our programme following our initial survey incorporating physiotherapy, nutrition and life style advise, psychological support. It was very well received.

Based on patient feedback and insight form peer patient members into our prehabilitation service, we



developed links with public health. We have incorporated healthy lifestyle advice especially smoking cessation and alcohol moderation in our programme.

We were guided by patient requests, and developed a series of educational videos and embedded them in our Trust's website.

Further feedback has led to focus on prehabilitation diaries to maintain patient motivation.

With a view to minimise costs on a financially stretched service and improve accessibility, we have kept majority of the educational tools in the form of electronic resources.

We plan quarterly review and adaptation of our prehabilitation service based on the needs of our local community.

Results: Patient feedback has been highly encouraging. 100% of the attendees find our model inclusive, relevant and accessible. 100% of attendees would recommend our model to fellow patients.

Conclusion: Patient involvement in the design of prehabilitation service is the key to keep engagement and compliance with the education programme for patients awaiting major surgery.

As clinicians and healthcare providers we may need to reconsider our approach to multimodal prehabilitation. In order to have "buy in" from the patients, we need to listen to their needs.

Prehabilitation service had to be adaptive and responsive to the feedback and the education needs of every community vary based on health literacy and local issues.

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P_13

Patient optimisation for Coronary Artery Bypass Graft (CABG) - an accelerated prehabilitation programme may improve cardiorespiratory fitness, strength and motivation before surgery

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Introduction: Studies have investigated prehabilitation for cardiothoracic surgery and shown an association with improved outcomes^[1,2]. Preoperative inspiratory muscle training (IMT) can reduce the incidence of postoperative pulmonary complications^[3,4]. Evidence for prehabilitation prior to Coronary Artery Bypass Graft (CABG) remains limited by the size and heterogeneity of trials, but enthusiasm for the concept is growing. Studies have predominantly included interventions lasting at least four weeks. In our institution, the process of listing for surgery dictates that the time between consultant decision and surgery is limited. An accelerated prehabilitation programme was therefore trialed with one patient awaiting CABG to see if objective improvements in fitness could be found in two weeks.

Methods: A 70 year-old patient with stable angina, hypertension and previous stroke was listed for CABG and consented to complete a two-week exercise prehabilitation programme - consisting of supervised and unsupervised exercise sessions and daily IMT. Resting heart rate, blood pressure, oxygen saturations, grip strength and cardiorespiratory fitness (using 6-minute walk test) were assessed at baseline and completion.

Results: Following the period of prehabilitation, improvements were seen in grip strength, resting oxygen saturations and cardiorespiratory fitness (table 1). Qualitative measures of patient motivation also demonstrated patient satisfaction with the intervention.

Conclusions: The original aim had been to recruit a larger cohort of patients, but organizational and funding limitations hampered efforts to collect more robust evidence regarding the positive impact of prehabilitation. Experimental data suggests that rapid adaptations in skeletal muscle and exercise performance can be achieved within two weeks^(5,6). Whilst we acknowledge the limitations of drawing conclusions from a single case, we have shown that an accelerated prehabilitation pathway is feasible and potentially beneficial to patients in our institution. The multidisciplinary relationships formed during this trial will facilitate successful implementation of a formal prehabilitation service in the future.

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	O ₂ Saturations	Grip strength (kg)	6MWT (metres)	MET
Baseline	94	25R 10L	250	3
Completion	97	28R 14L	420	6

Caption 1: Table 1: Objective measurements at baseline and completion

P_14

The Role of Cardiopulmonary Exercise Testing in Oesophago-gastric Cancer Surgery: Evaluation of a single-centre experience

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Introduction: Cardiopulmonary exercise testing (CPET) is an objective measure of functional capacity adapted to predict post-operative morbidity. CPET may also identify optimisable cardio-respiratory comorbidity prompting treatment modification or specialist referral. The role of CPET in patient optimisation before oesophago-gastrectomy is yet to be evaluated. This study aims to assess the utility of CPET in altering management and optimising patients prior to oesophago-gastrectomy.

Methods: All patients who underwent pre-operative CPET and two phase oesophago-gastrectomy (January 2012 to January 2018) were included. All changes in patient management brought about by CPET findings were evaluated. In addition, the role of validated risk-stratifying CPET parameters (anaerobic threshold (AT), VO₂ peak and FEV1) in predicting post-operative complications was assessed.

Results: 236 patients underwent surgery. Median AT and VO₂ peak were 11.95(7-24)ml/kg/min and 773(403-1552)ml/min/m² respectively. 46% (109/236) of patients (VO₂ peak >800ml/min/m²) were graded 'low risk', 42% (99/236) 'intermediate risk' (VO₂ peak= 600-800ml/min/m²), and 12% (28/236) 'high risk' (VO₂ peak<600 ml/min) for developing post-operative cardio-pulmonary complications. Based on CPET findings, management plans were altered in 84 patients (36%). Cardiac comorbidity was identified in 55 patients (23%) with immediate alteration of cardiac medications in 9% (21/236) and another 11% (27/236) requiring specialist cardiology review. Medication for respiratory optimisation was initiated in 3% (7/236) and formal respiratory review sought in 5% (12/236).

'Intermediate' and 'high risk' patients had similar rates of overall complication (63% vs 63%, p=1.00), cardio-pulmonary complication (48% vs 47%, p=0.17), anastomotic leak (11% vs 15%, p=0.33) and 90-day mortality (6% vs 4%, p=0.40) compared with 'low risk' groups. CPET variables (AT, VO₂ peak, FEV1) did not predict complications, length of critical care or overall stay on Receiver Operating Characteristic curves (AUROC<0.5) and multivariate logistic regression models.

Conclusion: CPET findings changed management in 36% of patients, enabling optimisation before oesophago-gastrectomy. 'Confounding by intention' is a bias reducing strength of association between test result and post-operative complications due to the propensity to intervene on the basis of the test. This study highlights the possibility that the high intervention rate may explain the poor correlation between test results and post-operative outcome.



P_15

Nutritional Prehabilitation in surgical Hepatopancreaticobiliary (HPB) cancer patients

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Introduction: Cancer patients suffer from weight loss and muscle wasting at diagnosis, and this is especially prevalent in pancreatic and other hepatobiliary cancers. Patients with malnutrition have increased complication rates and length of stay after surgery. Despite this being well documented in the literature patients often receive no support preoperatively. Our aim was to evaluate the feasibility of optimising nutritional status and symptoms in patients as part of a multidisciplinary team prehabilitation service improvement project.

Methods: All HPB cancer patients that were deemed to have resectable disease and had at least 14 days to allow for meaningful pre-operative prehabilitation were eligible. Baseline assessments were completed at the initial prehabilitation appointment and individualised treatment plans were advised by a specialist dietitian. Patients were subsequently reviewed by telephone at least once and measurements were repeated within one week of surgery.

Weight history, body mass index (BMI), Patient Generated Subjective Global Assessment Short Form (PG-SGA SF) ©FD Ottery 2015 v3.22.15, Handgrip strength (HGS) and a modified Gastro-intestinal Symptom Rating Scale (GSRS) were measured. The GSRS was used as a marker of malabsorption to detect the success of pancreatic enzyme replacement therapy in appropriate patients.

Results: 54 patients met criteria to be included in the data; of these 37 also had physiotherapy exercise based prehabilitation. Median prehabilitation duration was 34 days (Range 14-165 days).

Baseline assessment showed malnutrition was prevalent with 70% losing $\geq 5\%$ and 33% losing $\geq 10\%$ of their weight leading up to diagnosis. PG-SGA SF score was 7, with triage recommendations suggesting a score ≥ 4 requires dietetic intervention. A HGS of $\leq 85\%$ of normal has been reported as suggesting protein malnutrition, and this was found in 43% of our patients.

At review assessment all nutritional outcomes had improved. Median weight change improved from -6.9% to +1.9% ($p=0.0001$), and only 4% of patients lost $\geq 5\%$ of their weight. Median handgrip improved from 26.4 to 30.6kg ($p=0.0001$), with only 19% now scoring $\leq 85\%$ of normal. Median PG-SGA SF reduced to 0 from 7 ($p=0.0001$) and GSRS improved from 12.5 at baseline to 5 at review (0.0022).

Conclusions: In this study nutritional outcomes and symptoms were improved during the prehabilitation period for HPB surgical cancer patients following dietetic intervention. Further work is needed to see how the whole prehabilitation program impacts on post-operative complications, length of stay and recovery.

P_16

Positioning on port films for radiation: variability presents an opportunity for prehabilitation

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Introduction: The positioning of patients receiving pelvic radiation is of unique importance because of the proximity of crucial anatomical structures. Despite the use of patient immobilization techniques, residual setup errors after translational correction can still range from 1.8-5.6 mm compared to initial positioning. Radiation therapy can cause late effects on the pelvic musculature and bones. The five-year cumulative prevalence of insufficiency fracture after pelvic radiation has been reported as high as 45%. In this retrospective study, we looked at 20 subjects who had pelvic radiation and quantified the degree of variation in their daily positioning.

Methods: A retrospective review was performed of 20 subjects treated with pelvic radiation therapy within the past 5 years. All subjects received a minimum of 20 fractions and maximum of 25 fractions of external beam radiation treatment to the pelvis. The positioning variation was quantified by measuring the sacral slope on the subject's port film radiographs taken daily prior to radiation treatment and comparing this angle to the sacral slope angle measured on the initial simulation CT image.

Sacral slope is an objective measurement calculated on radiographic images. Measurements were taken independently by two investigators, and the average of the two individual reads was calculated. The overall variation for each subject was calculated, as well as the weekly average variation for each subject.

Results: There was a moderately positive correlation between the two readers ($r=0.73890$, $p=0.0002$). Daily measurement of sacral slope showed demonstrable variation within and across subjects. When daily



port film angles were compared to the simulation CT angle, the average variation across all 20 subjects was 2.27° (±1.43°). The average variation among patients ranged from 1.22°-5.09°.

The weekly average variation across all subjects was calculated and plotted to look for trends in degree of positioning variability across the entirety of a subject's treatment. There was a significant difference between the week 1 average and the week 4 average ($p < 0.05$), between the week 1 average and the week 5 average ($p < 0.05$), as well as a significant difference between the week 2 average and the week 5 average ($p < 0.05$).

The absolute difference in sacral slope measurement from one treatment day compared to the prior day was calculated. There was a moderately positive correlation between the two readers ($r = 0.66959$, $p = 0.0012$). Variation from one treatment to the next was demonstrated across subjects. The average variation across all 20 subjects was 2.05° (±1.47°). The average variation among patients ranged from 0.97°-3.21°.

Conclusion: We report variation in sacral slope measurements across 20 subjects receiving pelvic radiation therapy. An attempt to reduce this variation may increase efficacy and tolerability of treatment. Pelvic relaxation via a consistent exercise regimen presents an opportunity to improve patient alignment. Interventions to diminish the variability of the sacral slope angle have important implications for prevention of adverse gastrointestinal, urogynecologic, and musculoskeletal adverse effects. Phase 2 of this study, looking at the variability of sacral slope with two pelvic exercises prior to daily radiation treatments is currently underway at our center.

P_17

Pre operative Education and Optimising the Lower limb Arthroplasty Patient - Improving Patient Experience at a National Centre

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Introduction: The 2020 Workforce Vision states that we will respond to the needs of the people we care for and adapt to new, improved ways of working (Scottish Government, 2011). This project aligns with the policy and the Enhanced recovery principles of 'promoting patients and carers being more informed about management of their care'. (Scottish Government, 2013). As a national centre, providing a service to the whole of Scotland, has its own unique challenges. Some patients attend a 'one stop shop' where indicated and this means the department has to be innovative and inspire others to ensure an effective service which impacts on the quality and effectiveness of pre operative information. Patient pre op education has been shown to reduce anxiety (Spalding, 2003) and with the drive for reducing length of stay the pressure to disseminate all relevant information requires an innovative process.

Aims:- To develop an innovative process of delivering Joint school at a National Centre to increase the number of patients attending to 70% of those undergoing hip and knee joint replacement surgery.

To facilitate patients to complete a pre operative exercise regime – "better in-better out"

To improve patient satisfaction

To deliver a quality service to facilitate retention of information

Methods: The study was submitted through the local Clinical Governance process and no ethical approval was required. Mixed method research was employed using an anonymised questionnaire as a data collection tool. Baseline data was collected from the class which incorporated both hip and knee patients and ran once a day in the form of a power point presentation for 20 minutes, presented by the Rehabilitation Assistants.

Multiple stakeholders were engaged due to the complexity of the patient pathway. The class was changed to three times a day, separating hip and knee classes with an emphasis on practical content and lasted 15 minutes, the questionnaire was then repeated

Results: The baseline data indicated that patients preferred a more practical element including how to do stairs, exercises and dressing practice.

Following the implementation of the change ideas patients had less understanding of pain relief but had a better insight into exercises and hip precautions. The overall aim of increasing attendance to 70 % of patients who undergo hip and knee replacement has not been achieved but has shown a gradual increase and the average attendance is 51.8%. Data has been analysed to look at physiotherapy length of treatment comparing patients who attended a class, to those who did not.

Conclusion: Early results show a trend of decreased length of stay for those attending the class. Further investigation into the reasons for non attendance is required. The questionnaire was not validated.

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P_18

The PreColo Study : A three stage cost-effectiveness study to guide nationwide implementation of prehabilitation in colon cancer surgery in older patients

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Introduction: Prehabilitation has shown promising results in colon cancer surgery. Probably elderly patients benefit most of prehabilitation because of their decreased muscle mass, low gait speed and poor nutritional state which are all associated with postoperative complications. However, there is still a lack of data supporting (cost-)effectiveness of prehabilitation in colon cancer surgery in older patients. Therefore the Dutch guidelines still restrict prehabilitation to research settings. At the same time, practice variation in colon cancer surgery care is variable and several clinics have implemented prehabilitation despite the guidelines.

In the three part PreColo study we will answer the question 1. how the practice and the availability of prehabilitation impacts on the efficiency with which hospital can provide colorectal cancer surgery care in older patients (75 years and above), 2. whether prehabilitation is cost-effective in individual patients and 3. what are barriers and facilitators for further prehabilitation implementation.

Methods: The first part of this study (study I) includes a multicenter observational study in at least 24 hospital and uses questionnaires and existing data sources. Whether or not prehabilitation is available in a participating hospital is based on a predefined definition of prehabilitation. The care as given to patients 75 years and above in a participating hospital will not be changed for the study. Of the participating hospitals structure, process and outcome data related to prehabilitation and colon cancer surgery will be registered.

The second part (study II) includes a prospective multicenter observational cost-utility study following older patients with and without prehabilitation in the current best practices with questionnaires and data from the hospital information system. We aim for a sample size of 250 patients for prehabilitation and 250 for the control arm.

The third part (study III) includes a qualitative study which will consists of in depth interviews with surgeons, internist/geriatricians, physiotherapists, patients and caregivers. In each group 5-15 interviews will be carried out. Additionally we will execute participatory observation during the prehabilitation process in 5-15 older persons across different hospitals.

Results: Study I: Main endpoints are technical efficiency (ratio representing how a given set of inputs is used to produce output) and service factors (e.g. prehabilitation) that determine this technical efficiency. A two-stage Data Envelopment Analysis will be executed.

Study II: Main study endpoints are health related quality of life (HRQL), QALY's (EQ-5D-5L) and costs based on health care consumption registration during hospitalization and 6 months after surgery. In case of non-inferiority of HRQL effects, a cost-minimization analysis will be carried out. Business impact analyses will be carried out on four different rates of prehabilitation implementation.

Study III: Main study endpoints are appreciation of prehabilitation, the themes that play in collaboration of geriatric and colon surgery groups in shared colon cancer care, and the prehabilitation barriers and facilitators in daily practice.

Conclusion: This study will quantify the cost-effectiveness of current prehabilitation in Dutch colon cancer surgery in patients 75 years and above and will guide decisions on nationwide implementation.



PreColo



P_20

Is the incremental shuttle walk test a useful predictor of post-operative outcomes following oesophagectomy?

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Background: Oesophageal cancer is the ninth most common cancer in the UK, with 12,000 new diagnoses annually (National Oesophago-Gastric Cancer Audit 2017). Curative treatment involving an oesophagectomy is associated with significant postoperative morbidity, reduced functional capacity and reduced quality of life (Gemmill et al., 2015). Pre-operative assessment of cardiorespiratory reserve could play an essential role in helping risk stratifying patients and predicting post-operative morbidity. Cardiopulmonary exercise testing is considered the gold standard assessment however is expensive and not always accessible. One alternative objective measure is the incremental shuttle walk test (ISWT), which has suggested patients walking less than 350 meters are at increased risk of post-operative morbidity and mortality (Murray et al., 2007).

Objective: We aimed to evaluate whether mobilising <350 on the ISWT was associated with increased incidence of post-operative pulmonary complications and poorer clinical outcomes in patients undergoing oesophagectomy

Methods: We recruited 47 consecutive patients from January 2017 to March 2018 who were undergoing an oesophagectomy for oesophageal cancer at a large UK teaching hospital. Patients performed an ISWT at pre-screening clinic 1 week prior to surgery. Post-operatively patients received standardised care as part of an enhanced recovery protocol. Post-operative outcomes included incidence of pulmonary complications (Melbourne Group Scale), ICU and total hospital length of stay (LOS), re-admission rates to ICU and time to mobilise 30 meters.

Results: Nine patients (19%) failed to walk 350m on the ISWT and were twice as likely to develop PPC's in comparison to those who walked > 350m (see table. 1). The ability to walk > 350 m was also associated with quicker time to mobilise over 30 metres and shorter stays in both ICU and hospital.

Conclusion: In conclusion, a walking distance of less than 350m in the ISWT did appear to correlate with poorer post-operative outcomes. An appropriately powered trial is required to confirm these finding and validate the ISWT as a stratification tool. Future research should explore the role of prehabilitation in improving pre-operative functional capacity and ISWT distance to improve post-operative outcomes.

Table 1. Outcomes

	Incremental shuttle walk distance	
	> 350m	< 350m
n	38	9
Post-Operative Pulmonary complications	9 (24%)	5 (56%)
Median ICU Length of Stay (days)	4	6
Median Total Hospital Length of stay (days)	11	18
Readmissions to ICU	1	0
Mean time to mobilise \geq 30 metres	3.1 days	5.1 days

Caption 1: Table 1 - outcomes

P_21

Pbm monitoring and feedback program in orthopedic patients undergoing eras protocoll for total hip and knee arthroplasty

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Introduction: Patient blood management (PBM) measures have been shown to be effective in reducing transfusions , reducing length of stay ,increasing patient outcome. As the introduction of guidelines in our center, a monitoring and feedback program was established. The aim of our study was to show the effectiveness of such measures in reducing transfusions and cost in orthopedic patients undergoing total joint replacement of hip and knee.



Methods: designed a prospective, interventional cohort study with a 2-year time frame (January 10, 2016 to December 12, 2017). In total, 2361 patients aged 18 years or older were included. The PBM monitoring and feedback program was introduced on January 11, 2015, with the subsequent issuance of weekly reporting. For all nosology that underwent hip replacement surgery and knee replacement we want to identify the level of Hemoglobin and Ferritin to pre admission and level of hemoglobin and ferritin at admission. We structured daily e-mail (Monday to Friday) with automatic send to anesthesiologists and internists with the list of inpatient and pre hospitalized the day before each day of recording. For each of the patients thus identified it is exposed hemoglobin and ferritin registered in pre hospitalization. For each of them is also detected by the fact that an iron infusion was made in pre hospitalization. For the group of hospitalized the day before instead the list serves as a warning to anesthesiologists on patients on the day they are about to go into surgery.

Results: Within the first year of introduction, transfusion of all allogeneic blood products per 1000 patients was reduced by 38% (red blood cell units, -34%; platelet units, -2%; and fresh-frozen plasma units, -2%; all $p < 0.001$) leading to direct allogeneic blood product related savings of more than 70.000 euro. The introduction of our PBM monitoring and feedback program was a significant independent factor in the reduction of transfusion probability ($p < 0.001$).

Conclusion: PBM monitoring and feedback program was highly efficacious in reducing the transfusion of allogeneic blood products and transfusion-related costs

P_22

Preoperative Exercise Therapy Preventing Postoperative Complications following Complex Abdominal Wall Reconstruction: A Feasibility Study 'The PREPARE-study'

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Introduction: In the past decade, complex abdominal wall reconstructions (CAWR) are advanced. More patients are eligible for this major elective abdominal wall surgery. Patients often tend to have multiple significant comorbidities, complicating the recovery after reconstruction. CAWR increases the risk of developing respiratory complications, being a well-known complication after CAWR. This complication is associated with prolonged hospital stay, higher financial burden and increased morbidity and mortality decreasing the quality of life of these patients. Preoperative exercise therapy (PexT) consisting of cardiovascular- and strength training induces an improvement of physical capacity. Improving the physical capacity before surgery by PexT, is likely to give a better recovery and lower complication rate after surgery. In this study, we will survey the feasibility of PexT in patients undergoing CAWR.

Method: A feasibility study is performed. Ten patients waiting CAWR will be included. The intervention consists of a three month lasting exercise program consisting of cardiovascular-, strength and respiratory muscle training.

Patient demographics, number of adverse events and training outcomes (including physical capacity (VO₂max) and health-related quality of life (HRQoL)) are documented.

Results: An interim-analysis is performed. Six patients are included of which four finished the total training program. All four completed the intervention (>80%) without occurrence of any adverse events.

The average improvement of VO₂max was 5,45 ml/kg/min. HRQoL increased with an average of 7,5 points, of which most improvement in the dimension of mental health and vitality.

Conclusion: PexT seems to be feasible in patients waiting for CAWR. We demonstrated a positive effect on the VO₂max and HRQoL. If PexT significantly reduces the occurrence of respiratory complications in CAWR future randomized research is necessary.

This research is a start for optimization of the preoperative preparation in all CAWR, potentially resulting in less complications.

P_23

The feasibility of wearable fit devices to support a programme of prehabilitation in patients undergoing oesophagectomy

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Introduction: Poor pre-operative fitness has been associated with increased risk of post-operative morbidity and mortality (Zingg et al, 2011). Patients with locally advanced oesophagogastric cancer in the



UK undergo neoadjuvant chemotherapy (NAC) prior to surgery (Cunningham et al, 2006). NAC reduces an individual's functional capacity (West et al, 2016) and potentially increases their risk of developing post-operative complications. There is increasing evidence to support prehabilitation including cardiovascular exercise in improving post-operative outcomes (Bott et al, 2017). Wearable fit devices could play an integral role in helping patients guide exercise intensity and improve motivation and adherence with prehabilitation programmes. The acceptability of wearable devices in a surgical cohort has not yet been explored.

Objective: Can patients awaiting oesophagectomy use wearable fit devices as part of prehabilitation to help improve compliance and pre-operative outcomes?

Method: A single centre, prospective, non-randomised feasibility study was performed. Consecutive patients admitted to a large UK tertiary hospital undergoing elective oesophagectomy between September 2017 and March 2018 were approached to participate in prehabilitation on completion of NAC. Prehabilitation was a 4 week program of unsupervised, home based exercise involving a 20 minute circuit of cardiovascular and strengthening exercises (see Weblin et al 2017 for details of intervention). Patients were provided with a heart rate monitor and watch at their initial assessment post NAC, and completed 1 supervised session with a physiotherapist. Exercise intensity was set at a target of 50-70% of heart rate reserve (Karvonen, 1957). Patients were asked to complete the circuit a minimum of 4 times weekly and record compliance in a patient diary. Patients received weekly telephone calls to troubleshoot and improve adherence. Patients were then reassessed in pre-screening clinic 1 week prior to surgery. Physical, non-physical and clinical outcomes were recorded. In addition patients underwent a semi-structured interview to ascertain their perceptions about the wearable fit device at pre-screening clinic.

Results: 10 patients were recruited to prehabilitation post NAC and provided with a heart rate monitor and watch. All patients recorded good adherence to the prehabilitation program in their patient diary having achieved the minimum of 4 x a week. Patients stated that the watch was easy to use, reliable and beneficial for guiding exercise intensity. With prehabilitation, patients had an improvement in pre-operative functional capacity (Incremental Shuttle Walk Test) and perceived health status (EQ-VAS) and a reduction in both anxiety and depression (Hospital Anxiety and Depression Score) (Table 1). No adverse events were recorded.

Conclusion: The use of wearable fit devices pre-operatively seems feasible and appeared to aid compliance with prehabilitation. Improvements in pre-operative outcomes were observed with prehabilitation in patients awaiting oesophagectomy who had undergone NAC. An appropriately powered trial is required to confirm these findings.

	Pre – Prehabilitation (n=10)	Post Prehabilitation (n=10)	Difference
ISWT (meters)	475	600	+ 125 (26%)
EQ-VAS	62	76	+ 14
Anxiety	4.5	3.8	-0.7
Depression	4.6	3	-1.6

*All values are displayed as mean

Caption 1: Table 1

P_24

Transition in perioperative care for patients opting for major abdominal surgery: a multi-level perspective

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Introduction: Healthcare moves towards a predictive, personalized, preventive, and participatory approach (P4 health).¹ Perioperative care in this respect concerns the conceptual model of fundamental changes in clinical practice (e.g., preoperative risk-assessment, prehabilitation), culture (e.g., the prevailing perspectives), and structures (e.g., ward infrastructure).² Such a transition nationwide requires



changes in the current healthcare regime (e.g., current clinical practice) and thereby creates a window of opportunity for experimenting with system innovations at several niches performed by multiple actors (e.g., patients, health care providers) pressuring the incumbent regime.³ The aim of this mission-oriented research program is to give a preliminary insight into the first phase of transition in perioperative physiotherapy for patients undergoing hepatic or pancreatic resection.

Methods: To study the healthcare transition in perioperative physiotherapy practice in the Netherlands along with the (medical and functional) course of individual patients over time, a mixed-methods framework with a multi-level perspective is being performed. First, a cross-sectional survey concerning the perioperative physiotherapy management for major elective abdominal surgery was performed in Dutch hospitals to establish the regime and to analyze the differences between the nowadays advised state-of-the-art physiotherapy and the national clinical practice 'state-of-the-art' perspective. Secondly, at niche level at the Maastricht University Medical Center, the transition towards a proactive perioperative care pathway for patients opting for elective hepatic or pancreatic resection is being performed in multiple stages with continuous monitoring. A mixed-methods approach integrating quantitative data and ethnographic qualitative data is used for process evaluation.

Results: In the current regime, three classes of physiotherapy clinical practice were identified in Dutch hospitals (n=65, 79%), in which class I (progressive, 25%) and class II (moderately progressive, 29%) both provide preoperative risk assessment, but differ in providing prehabilitation. Class III (conservative, 46%) mainly focused on postoperative rehabilitation. At the niche level, preliminary quantitative perioperative data of 96 patients who underwent hepatic resection showed that American Society of Anesthesiologists grade III (odds ratio (OR): 2.349), worse exercise capacity (in watts, OR: 0.992), and self-reported physical activity level (in metabolic equivalent of task (MET), OR: 0.806), were associated with increased time to functional recovery. Additionally, a better exercise capacity (in watts, OR: 0.989), functional mobility (in meter, OR: 0.969), and self-reported physical activity level (in METs, OR: 0.576) were associated with lower risk for non-surgical complications. The qualitative process evaluation established the beneficial effects of building a multidisciplinary team of healthcare providers and patients, in shared decision-making, risk assessment, and prehabilitation in a single subject trial with a patient who is at high-risk for adverse outcomes after pancreaticoduodenectomy.

Conclusion: Several niches, progressive perioperative physiotherapy practices, are developed in the current Dutch physiotherapy regime. The preliminary results showed that patients might benefit from an optimal preoperative physical fitness level before hepatic and pancreatic resection. Although transition takes many years, this study produces new knowledge about factors that influence the implementation of perioperative care innovations in professional environments.

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P_25

Transthyretin as a biomarker for nutritional status during investigation for colorectal cancer

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Introduction: Malnutrition and low fat-free mass negatively impacts physical function, oncologic treatment tolerance and increases the risk of postoperative complications. In colorectal cancer malnutrition might be overlooked as overweight and loss of muscle mass without concurrent major weight loss is common. When measuring body composition is not possible plasma levels of transthyretin may be helpful, but there is no clear answer to whether it is useful in patients with cancer. The aim was to investigate if transthyretin can be used as a biomarker for nutritional status regarding the proportion of fat free mass in adult individuals undergoing investigation for colorectal cancer.

Methods: In a cross-sectional study with 15 individuals with suspected colorectal cancer body composition (bioelectric impedance spectroscopy) and plasma levels of transthyretin and C-reactive protein (CRP) was measured. Malnutrition was assessed according to ESPEN's diagnostic criteria from 2015. The relationship between transthyretin and CRP and fat-free mass index (FFMI) was analysed via linear regression and Fischer's exact test was used for the association with malnutrition.

Results: A significant negative relationship was found between CRP and transthyretin ($p = 0,03$). No connection with transthyretin was detected for malnutrition, while a tendency towards significance was noticed between transthyretin and FFMI ($p = 0,059$). Subgroup analysis ($n=10$) with individuals without inflammation ($CRP < 15$ mg/l) showed a significant association between transthyretin and FFMI ($p < 0,001$)



as well as with malnutrition ($p = 0,03$).

Conclusion: This study is one of few to investigate the relationship between transthyretin and FFMI in colorectal cancer. The results highlights the importance of taking inflammation into account when assessing nutritional status. At $CRP >15\text{mg/l}$ transthyretin should not be used as a marker for malnutrition, but may be useful in conditions without inflammation. Transthyretin may be a useful biomarker for nutritional status, defined as FFMI, in colorectal cancer. Hence also indicating individuals in need of prehabilitation. However, more research is required to confirm this relationship.

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P_26

Early Termination of Cardiopulmonary Tests in People with Cancer: Frequency, Reasons, and Implications for Exercise Prescription

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Introduction: Exercise prescription in clinical populations, such as those with cancer, commonly involves target intensities based on cardiopulmonary exercise test (CPET) results. However, a variety of reasons appear to prevent patients from reaching true physiological maximum (i.e. $VO_{2\text{max}}$) during CPETs, potentially resulting in inadequate exercise dose and compromising intervention efficacy. In this study we explored and identified the nature of CPET termination as it pertains to physiological and non-physiological reasons in people with cancer.

Methods: Data from participants completing CPET from research studies in our laboratory were obtained via a retrospective chart review. The CPET was completed using the modified Bruce treadmill protocol and a commercially available metabolic cart with a mouthpiece and supportive headgear for gas collection and analysis. CPET protocols adhered to American Thoracic Society recommendations, with the exception that they were not medically supervised, there was no electrocardiography, and patients were not required to abstain from their medication regimen prior to testing. $VO_{2\text{peak}}$ ($\text{mlO}_2/\text{kg}/\text{min}$) and anaerobic threshold (AT; $\text{mlO}_2/\text{kg}/\text{min}$ via V-slope method) were ascertained. $VO_{2\text{max}}$ was considered 'met' in participants that a) demonstrated a plateau in oxygen consumption despite increased workload, or b) demonstrated two of the following three criteria: rating of perceived exertion (RPE) $\geq 9/10$, respiratory exchange ratio (RER) ≥ 1.15 ; and/or heart rate (HR) of 95% of age-predicted maximum (220-age). Participant-described reasons for test termination were collected and classified as: i) volitional peak; ii) discomfort with testing equipment precluding test continuation; iii) physical discomfort; and iv) symptom limited. Frequency of each reason for test termination were tabulated and percentages per reason of termination among all tests. Mean $VO_{2\text{peak}}$ and VO_2 at AT values were calculated for each termination group. Between-group comparisons on VO_2 values were calculated using independent samples t-test.

Results: N=44 participants provided data for up to three CPET exposures within the context of their study requirements (total of 78 CPETs assessed for this study). 86% of all CPETs were terminated prior to achieving $VO_{2\text{max}}$ criteria. Early discontinuation was attributed to equipment discomfort (49.3%), volitional peak (35.8%), and physical discomfort (14.9%). Reasons for CPET termination in participants who met $VO_{2\text{max}}$ criteria were volitional peak (45.5%), physical discomfort (36.4%), and equipment discomfort (18.2%). The mean difference in relative $VO_{2\text{peak}}$ ($\text{mlO}_2/\text{kg}/\text{min}$) for those reaching $VO_{2\text{max}}$ end criteria versus those that terminated CPET early at one, two, and three exposures was +11.6 ($p=0.02$), +8.1 ($p<0.01$), and +6.9 ($p=0.02$), respectively. Participants who discontinued the CPET in the absence of $VO_{2\text{max}}$ criteria were 20 years older ($p<0.001$) than those who attained $VO_{2\text{max}}$ criteria.

Conclusion: In our sample of people with cancer, $VO_{2\text{max}}$ criteria was met less than 15% of the time with equipment discomfort and volitional limits described as the reason for early test termination in 86% of CPETs. Age, equipment, motivation, and medical supervision are important considerations to ensure



validity and reliability of CPET in people with cancer. In the absence of achieving VO_{2max} end-criteria, alternate intensity scales may be more appropriate for exercise prescription, such as RPE.

P_27

Improving the preoperative status of patients undergoing major surgery using a mobile application

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Introduction: Lifestyle risk factors like smoking, excessive alcohol consumption and physical inactivity are associated with more perioperative complications and delayed postoperative recovery. Despite the growing body of evidence for prehabilitation interventions, implementation of multimodal preoperative lifestyle interventions in daily care practice remains challenging.

Preparation of patients for major surgery may be optimized by the use of eHealth. A preoperative eHealth program is easily accessible at any time and place and can spread information over time. This may enable patients to take an active role in their preparation towards the surgery. For this reason the mobile application “Beter Voorbereid” (better prepared) is developed. The aim of this study is to share knowledge and experiences in developing an e-Health intervention within the field of prehabilitation to increase the chance of successful (inter)national implementation.

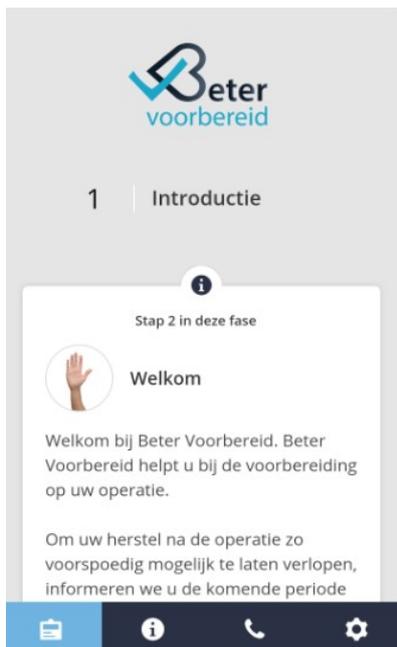
Methods: During a Hacking Health weekend (Leiden, 2016) a multidisciplinary team consisting of physiotherapists, anesthesiologists, IT specialists, teachers and patients collaborated to ‘Hack Prehabilitation’. The starting point of the team was to develop an eHealth application to 1) inform patients about important preoperative life style risk factors, 2) to give them concrete advise on desired preoperative life style and 3) to reach patients with different coping styles. An iterative process following the CeHRs Roadmap. This roadmap consist of following stages: Contextual Inquiry, Value Specification, Design, Operationalization, Summative Evaluation. During the first phase, contextual inquiry, the team shared their experience and scientific knowledge about the prospective users and their context (the patients). During the second phase, value specification, patients’ needs and wishes where gathered during interviews and their digital skills were tested. In the design phase, scientific knowledge and gathered experiences were incorporated in the desired application: the mobile application “Beter Voorbereid”. The fourth and fifth phase, operationalization and summative evaluation, are planned in 2018.

Results: The application “Beter Voorbereid” follows the patient journey and uses a personal timeline to provide information spread over time. The app uses a set of questions to map modifiable lifestyle risk factors for delayed postoperative recovery (smoking, alcohol use, diet, physical activity and physical functioning) in patients undergoing major surgery. Additionally, the eHealth application provides insight in the coping strategies of individual patients and tailored preoperative lifestyle advise is provided. Patients only receive information relevant for their situation. The way this advice is provided is aligned with the type of coping strategy used by the patient. Furthermore, the patient can use the eHealth application to make an appointment with a local physiotherapist to improve the physical fitness under supervision when indicated.

Conclusion: The “Beter Voorbereid” app is a promising e-Health tool to improve pre-operative health status and to enhance postoperative recovery. Knowledge and experiences in developing e-Health interventions within the field of prehabilitation should be shared. To test its usability and its effectiveness on postoperative recovery a pilot study (second half of 2018), followed by a multicenter RCT (2019) will be performed.



Caption 1: Introduction App Beter Voorbereid



Caption 2: Example App Beter Voorbereid

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Peri-operative time course of physical functioning during neoadjuvant chemoradiation and the risk of postoperative complications in patients undergoing esophagectomy

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Introduction: Neoadjuvant chemoradiation is the curative treatment of choice in patients awaiting esophagectomy. However, chemoradiation can have deleterious effects on physical functioning and esophagectomy is associated with a high risk of postoperative complications. Literature suggests that the change of physical functioning during chemoradiation may be a better indicator of postoperative recovery compared to physical functioning measured at a single time point. However, little is known regarding the association of the impact of chemoradiation on physical functioning and the incidence of postoperative complications.



To explore the time courses of physical functioning, body composition and nutritional status during chemoradiation and to evaluate whether these changes are associated with the risk of postoperative complications.

Method: A longitudinal observational cohort study. Patients who received neoadjuvant chemoradiation followed by esophagectomy between September 2016 and March 2017 at the University Medical Center Utrecht were included. Physical functioning, body composition and nutritional status were measured before and after neoadjuvant therapy. The relation between the course of physical functioning, body composition and nutritional status and postoperative complications was analyzed with multiple regression analysis. Pearson correlation coefficient was used to assess the relation between each variable.

Results: Preliminary results shows that muscle strength seems to remain stable during chemoradiation (handgrip strength (n=44) 34.66kg (SD 11.67) to 34.09kg (SD 10.96) p=0.334; leg extension (n=43) 382.44N (SD 82.34) to 383.86N (SD100.91) p=0.906, both measured with hand held dynamometers). Exercise capacity, measured with the steep ramp test, (n=41) decreased significantly with a mean difference of -11.38 (SD28.69) from 142.41 Wmax (SD 44.59) to 132.68 Wmax (SD 52.89) p=0.015.

Conclusion: The outcomes of this study will provide important insights in the relation between changes of physical functioning during neoadjuvant therapy and postoperative complications. This may provide further direction in the development of prehabilitation guidelines in patients awaiting esophagectomy.

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A Patient centred Healthcare Improvement Project - introducing Pre-operative Incentive Spirometry to reduce Post-operative Pulmonary Complications in Major colorectal surgery

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Background: The incidence of Postoperative Pulmonary Complications (PPC) in upper abdominal surgery varies from 17 to 88%¹. We discussed the postoperative death of an 86-year-old woman due to pneumonia after laparoscopic right hemicolectomy at our regular Quality and Safety meeting. We reviewed the evidence for Incentive Spirometry (IS) in reducing PPC. The quality of evidence is low for the effectiveness of IS in preventing PPC when introduced postoperatively¹. Hulzebos et al, however, found that preoperative Inspiratory Muscle Training, incorporating IS, significantly reduced PPC in patients undergoing coronary artery bypass grafting². Therefore we decided to introduce IS preoperatively and to continue it postoperatively in patients undergoing elective major colorectal surgery as a healthcare improvement project.

Methods: Institutional Research Board approval was obtained to study the impact of preoperative Incentive Spirometry in colorectal surgical patients. Respiratory physiotherapists trained nurses from the preassessment clinic and the surgical ward on the IS device (Leventon Tri-ball flow controlled Respiratory Exerciser: Reference 259-12000). Patients were taught how to use the IS device at the preassessment clinic and given an information leaflet to read at home. Patients practised IS at home and were encouraged to bring the device with them when admitted for surgery. They were encouraged to use IS regularly after surgery, supported by the ward staff. Apart from the introduction of IS, the perioperative care pathway remained unaltered. Data on respiratory complications and resource utilisation were collected (prospectively) in the year preceding, and the year following the introduction of IS.

Results: Data from 132 patients undergoing surgery in the year prior to IS (August 2015-2016) were compared to that of 182 patients after the introduction of IS (August 2016-2017). Patients were comparable in terms of age (68.7 v 71.5 years), incidence of Chronic Obstructive Pulmonary Disease (7.6% v 6.6%), smoking (6.8% v 7.8%) and mean Assess Respiratory risk In Surgical patients in Catalonia score (35.6 v 40.1). Median length of hospital stay was reduced after the introduction of IS {7 (Inter Quartile Range 5-9) vs 6.5 (Inter Quartile Range 5-8) days}. We also observed a 4.5% reduction in the incidence of pneumonia (6.1 % to 1.6%) and a 4% reduction in unplanned Critical Care admissions due to pneumonia (4.5% vs 0.5%) in spite of about 10% increase in open surgeries (66.7 v 76.4%). The results were presented in the combined anaesthetic and surgical departmental meeting.

Conclusions: This patient centred Healthcare Improvement Project suggests that introducing preoperative Incentive Spirometry reduced the incidence of PPC in patients undergoing elective colorectal surgery in our institution.

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P_30

Enhanced Surgical Medicines Optimisation Service (ESMOS) - An innovative pharmacy service to improve outcomes in surgical patients

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Introduction: Over 300 million patients globally undergo non-cardiac surgery each year (1), with high risk patients undergoing major surgery being at increased risk of post-operative complications (2). The Enhanced Surgical Medicines Optimisation Service (ESMOS) was introduced at our hospital site, a large 1200 bedded tertiary referral centre in September 2017 following a successful pilot study with the aims of the service being to improve patient outcomes and reduce length of stay in elective surgical patients.

Methods: The purpose of this study is to evaluate the efficiency and impact of the recently introduced ESMOS service. In a prospective study, data was collected from patients undergoing Hepatopancreatobiliary, Colorectal, and Upper Gastro-intestinal and Vascular surgery over a six month period. Demographic details along with the interventions made by a specialist enhanced recovery pharmacist during the patient journey i.e. pre-, peri-and post-operatively were recorded. Pre-operatively, these included optimising the control of any pre-existing medical conditions pharmacologically, correcting anaemia, encouraging smoking cessation, ensuring appropriate antibiotic prophylaxis and thromboprophylaxis. Post-operatively, examples of interventions included optimising pain control, post-operative nausea and vomiting and managing electrolyte disturbances.

Results: Data from a total of 114 patients was recorded between September 2017 and March 2018. There was overall better management of peri-operative complications in the patients under the ESMOS service, which resulted in a median length of stay of 8 days, a reduction of approximately 2.5 days less than the baseline data where patients had not received the ESMOS service (Wilcoxon signed rank test, $p < 0.05$).

Conclusion: In recent years, medicines optimisation has been high on the health and social care agenda to ensure safe and effective use of medicines and the best possible patient outcomes (3). The ESMOS service is an innovative service which has demonstrated its positive impact in surgical patients. This is by ensuring they are in the best possible state for surgery pre-operatively and with more active pharmacist involvement post-operatively leading to improved patient outcomes.

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P_31

Preoperative psychological interventions to promote behavioural recovery in patients with a high anaesthetic risk: a systematic review

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Background: In the United Kingdom high anaesthetic risk surgical patients (those pre-disposed to complications because of for example, pre-existing conditions), have increased chance of irreversible disability or death; accounting for 80% of perioperative mortality (1). Psychological preparation for surgery under General Anaesthetic (GA) can improve postoperative outcomes in a general population (2,3). Powell et al (2016) suggested benefit on postoperative pain, negative affect, length of stay and behavioural recovery. However, psychological optimisation by Preoperative Assessment Services remains outside usual care and to date no systematic review has been undertaken relating to high-risk GA patients. Arguably, the best indicators of postoperative recovery for this high-risk group are behavioural recovery and quality of life (QoL).

Aims: Are preoperative psychological interventions effective for improving behavioural recovery outcomes for high-risk anaesthetic patients, compared to standard care alone?

Are preoperative psychological interventions, effective at maintaining or improving QoL at one-month or



more post-surgery compared to standard care alone?

Methods: Twelve databases were searched until November 2017. Published Randomized Controlled Trials of adults undergoing elective surgery were included if outcomes were examined one-month to one-year postoperatively. Reference lists and forward citation searching followed. No language or date restrictions were imposed. Findings were pooled using continuous: d (hedges g) outcome type, and narrative synthesis was undertaken where meta-analysis was unsuitable. Eppi-reviewer4 software was used to manage the review (4).

Results: Eleven papers (n=1272) met eligibility criteria. Seven papers were appropriate for meta-analysis; the remainder were narratively reviewed. Findings demonstrated no effect on behavioural recovery from any psychological intervention; control was favoured (SMD- 0.46, 95% confidence interval (CI) 0.16-0.76). QoL was not improved by psychological interventions either (SMD- 0.50, 95% CI -1.69-0.69 for total QoL and SMD- 0.64, 95% CI 0.00-1.28 where QoL expressed as mental and physical) Narrative synthesis demonstrated psychological interventions did not positively influence behavioural recovery, however mental and physical QoL was significantly improved in the intervention group of one paper for up to six-months postoperatively. There were high levels of heterogeneity relating to surgery and intervention types, reasons participants were high-risk, outcome measurement tools and outcome timepoints measured. There were insufficient studies to determine the most effective intervention type.

Conclusion: Evidence suggested no improvement in behavioural recovery or QOL of high-risk anaesthetic patients when psychological interventions were delivered preoperatively. The quality of evidence was low, and no practice recommendations can be made. There is a need for further high-quality research examining larger samples of this patient population.

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Structured prehabilitation for high risk urology surgery: a proof of concept case report

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Introduction: Evidence shows that personalised prehabilitation may improve post-operative clinical outcomes and hasten return to pre-operative levels of function following major surgery^{1,2}. Medway Maritime Hospital is a 588-bed district general hospital in the United Kingdom where major general, vascular and urological surgery is undertaken. Although high risk patients are reviewed by consultant anaesthetists and undergo cardiopulmonary exercise testing (CPET), no formalised process exists for patients who may benefit from pre-operative intervention to increase fitness for surgery. We describe the implementation of a prehabilitation programme at Medway, assessing the impact on perioperative mortality of a high risk patient.

Methods: An 81-year-old male with a background of cerebrovascular disease, pulmonary embolism and bladder transitional cell carcinoma was referred to the prehabilitation unit following CPET performed to assess fitness for cystectomy. We provided basic nutritional information (prioritising unprocessed/minimally processed food, plus correct protein intake³), home-based respiratory muscle training instructions (utilising an inexpensive device), and supervised cycle ergometer interval training. This training intervention comprised twelve 30-minute sessions over four weeks, consisting of an unloaded 5-minute warm-up, four alternating sets of low and high intensity exercise, and a final 5-minute unloaded cooldown. CPET, blood tests and estimation of 30-day post-operative mortality⁴ were conducted before and after the intervention.

Results: The intervention was well tolerated with good patient compliance. Pre and post intervention spirometry, CPET and laboratory data are summarised in table 1. Two Kg of weight loss was achieved with BMI reducing from 30.9 to 30.1. Spirometry values improved post-intervention with increases in FVC, FEV1 and PEF. Results of CPET testing were largely unaltered with similar values for the anaerobic threshold, peak VO₂ and maximum heartrate; however minute ventilation and maximum load both increased post-intervention. Blood tests demonstrated a reduced serum creatinine and an increased serum albumin and haemoglobin post-intervention. The patient's predicted 30-day mortality was reduced from 11.5% to 6.6%.



Conclusion: A structured prehabilitation programme may have the potential to reduce perioperative mortality risk in high risk surgical patients in a UK hospital with no pre-existing set-up. Although oxygen uptake was unaltered, the improved spirometry results as well as the increase in minute ventilation and maximum workload imply increased efficiency, whilst the increase in serum albumin and haemoglobin suggest a benefit from dietary advice. We plan to enrol further patients and continue to review the impact on perioperative mortality.

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Table 1:

Parameter	Pre-Intervention	Post-Intervention
FEV1 (L)	2.41	2.55
FVC (L)	3.62	3.82
PEF (L/min)	411	510
FEV1/FVC (%)	67%	66%
VO ₂ /Kg Anaerobic Threshold (ml/min/kg)	10.3	10.2
VO ₂ /Kg Max (ml/min/kg)	14.1	14.3
Maximum HR (bpm)	138	146
Ventilation (L/min)	64	75
Maximum Load (W)	90	114
BMI (Kg/m ²)	30.9	30.1
Creatinine (µmol/L)	126	110
Albumin (g/L)	39	44
Haemoglobin (g/L)	130	144
Predicted Mortality (%)	11.5%	6.6%

Caption 1: Table 1 - Results

P_33

The use of Liver shrinking diet in obese and fatty liver patients undergoing oesophago-gastrectomy

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Introduction: Oesophago-gastrectomy (OG) for cancer is technically challenging in obese patients. A Liver shrinking diet (LSD) is a pre-operative low calorie diet commonly used prior to bariatric surgery which can reduce liver volume by 20% in two weeks, decrease intra-abdominal adiposity and thereby make surgery easier to perform. A LRD may similarly make OG surgery less technically difficult in the obese but concerns remain about its safety in patients with cancer. This study aims to assess the safety of the liver shrinking diet in the pre-operative setting for obese patients or those diagnosed with fatty liver, undergoing two phase oesophago-gastrectomy.

Methods: All patients with a body mass index (BMI) greater than 28kg/m² undergoing oesophago-gastrectomy between January 2012 and January 2018 were identified. Under supervision of specialist dietitians, a two-week carbohydrate sparing low calorie diet (1000 kcal/day) was given to patients with high BMI or large fatty liver seen on staging laparoscopy. Weight of patients before and after the diet was recorded. A matched cohort of patients who did not take the LSD was identified. They were compared to the LSD patients in terms of peri-operative outcomes.

Results: 25 patients who were on the liver shrinking diet (LSD) were matched to 50 patients who did not have LSD (non-LSD) with similar median age (65 vs 63 years; p=0.7), body mass index (31.6 vs 31.5



kg/m²; p=0.2) gender distribution (male : female=21:4 vs 41:9; p=0.7). 86% of LSD and 84% of non- LSD patients underwent neoadjuvant chemotherapy. Following 2 weeks of the diet , patients lost a small but significant amount of weight (3.3 kg, p<0.003). Stage I, II & III cancers were seen in 45%, 23% and 32% in LSD group and 22%, 32% and 44% in the non LSD group. Lymph nodes retrieved were similar in both groups (LSD vs non LSD): 43 (16 -89) vs 48(12-89).In both groups, serial post-operative phosphate levels, an indication of refeeding syndrome was not different (p=0.7). There was no difference in critical care stay (5 days for both, p=0.4), overall hospital stay (17 vs 11 days; p=0.2), complications (68% vs 62%; p=0.8), anastomotic leak (16% vs 12%; p=0.7) or 90 day mortality between LSD and non- LSD patients respectively.

Conclusion: Liver shrinking diet can be used safely prior to oesophago-gastrectomy for patients with a fatty liver and in obese patients.

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More subcutaneous adipose tissue at diagnosis is associated with lower mortality in early-stage colorectal cancer patients

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Introduction: Obesity is a risk factor for colorectal cancer (CRC). Paradoxically, some studies suggest that overweight and obesity may be associated with improved overall survival, although findings are not consistent. The aim of the current study was to investigate the association between total adipose tissue (TAT), visceral adipose tissue (VAT), or subcutaneous adipose tissue (SAT) and overall mortality in early-stage (stage I-III) CRC patients.

Methods: TAT, VAT and SAT were assessed among 2,016 early-stage CRC patients, diagnosed between 2006-2015, utilising pre-operative Computed Tomography (CT) scans of the level of the 3rd lumbar vertebrae. TAT, VAT and SAT were divided into gender-specific tertiles. Adjusted Cox proportional hazard models were used to evaluate the association between, TAT, VAT, SAT and overall mortality.

Results: During a median follow-up time of 51 months (range 0-121 months), 558 patient (28%) died. Mean age of the study population was 67.9 years, 42% were women. Patients with more SAT had a statistically significant lower risk of dying (SAT Tertile 2 vs SAT Tertile 1: HR 0.74, 95% CI 0.60-0.91; SAT Tertile 3 vs SAT Tertile 1: HR 0.79, 95% CI 0.63-0.99), while no associations were found for TAT and survival (TAT Tertile 2 vs TAT Tertile 1: HR 0.83, 95% CI 0.68-1.02; TAT Tertile 3 vs TAT Tertile 1: HR 0.96, 95% CI 0.79-1.17) or for VAT and survival (VAT Tertile 2 vs VAT Tertile 1: HR 0.89, 95% CI 0.71-1.09; VAT Tertile 3 vs VAT Tertile 1: HR 0.98, 95% CI 0.80-1.10).

Conclusion: In this large scale study, more SAT was associated with lower mortality in early-stage CRC patients, while no significant associations were found for TAT or VAT.

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Usefulness of design thinking to assess scalability of a prehabilitation service in Catalonia

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Background:The concept of human-centered design, as well as the design thinking (DT) strategies, was originated in the field of ergonomics, computer science and artificial intelligence. The early view of DT has evolved over time being applied beyond the human-computer interaction and has been adopted more widely to indicate a design process focused on the needs and preferences of the end-user. More recently, DT is being applied in healthcare to adapt or improve clinical processes and to enhance service workflow definition.

The efficacy of prehabilitation to reduce surgical complication has been demonstrated. Mainstream deployment of the prehabilitation service at Hospital Clinic de Barcelona is showing effectiveness and potential for cost-savings. However, there is a need for service workflow refinement to facilitate its regional



scalability (Catalonia). To this end, DT methodologies have been considered appropriate to co-design strategies for large-scale deployment.

Methods: Previous undertaking of the DT sessions (5-hour duration each), two main actions were conducted: i) a survey aiming to gain insight into the organizational aspects of the prehabilitation unit among the professionals directly involved in its management, as well as other healthcare professionals having direct contact with the prehabilitation patients; and, ii) five in-depth face to face interviews with patients and caregivers who underwent prehabilitation.The first DS session (Immersion) focused on gaining further insight on actionable factors of the prehabilitation service (creative focus) in order to achieve optimization of the service workflow, its sustainability and to design a successful strategy for regional deployment of the service. The second session (Ideation) aimed to generate, evaluate and develop both ideas and plans to solve the creative focus identified in the first session. Finally, the third session (Validation) aimed to consolidate concepts and define a viable strategy for regional deployment and sustainability (business model) of the service workflow.

Results: The profiles of the attendees at the sessions were the following: healthcare professionals and managers, designers, health-technology agents, business school representatives and policy makers (table 1). We identified the need 'to provide an accessible, off-site and round-the-clock service that the patients must be able to use autonomously while being monitored'. Specificities identified included the need for a personalized work plan, access to collaborating centres, remote monitoring and access to a case manager. The technologic aspects prioritized were an adaptive case management approach and an intelligent patients' assistant (Chatbot). The business model envisages use of private facilities financed by savings of prehabilitation.

Conclusions: DT methodologies seem suitable to co-design integrated healthcare services facilitating its deployment and adoption.

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Enablers and barriers in preparing older patients for a hospital admission with cardiac surgery

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Background and aim: Given the growing number of vulnerable, older cardiac surgery patients, the preadmission nursing PREDOCS program to reduce the incidence of postoperative delirium, depression pressure ulcer or infection was developed and tested on clinical effects in twelve former studies. Important working mechanisms of the PREDOCS program regard a tailor-made approach for each patient and their family. Before the working mechanisms of such a complex multicomponent intervention can be implemented, enablers and barriers should be elucidated in different clinical settings.

Methods and materials: In a mixed-methods study in twelve cardiac surgery centers in the Netherlands including over 1,000 cardiac surgery nurses, the Medical Research Council (MRC) guidelines concerning implementation were followed, using the Behaviour Change Wheel as a conceptual framework for effectively change the behaviour on the levels of 'sources of behaviour', 'intervention functions' and 'policy functions'.

Results and conclusion: Although, in different centers occur different approaches, there are similarities. On the level of 'sources of behaviour' the opportunities were created in all centers and physical and psychological capability were trained. However, in the majority of the centers motivation among nurses was threatened by their daily workload, making heavy demands on their reflective ability. On the level of 'intervention functions' training, modelling, education, enablement and environmental restructuring were much better received by the nurses than persuasion, restrictions and coercion. Nevertheless, on the level of 'policy categories' in most centers regulation and guidelines work better than service provision and environmental and social planning.

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Face-to-face and individual internet-based Mindfulness-Based Cognitive Therapy are cost-effective compared to Treatment As Usual in reducing psychological distress in cancer patients

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Introduction: Mindfulness-Based Cognitive Therapy (MBCT) has increasingly been offered in hemato-oncological settings as treatment for psychological distress. Recently, the effectiveness of internet-based MBCT (eMBCT) was investigated. Compared to Treatment as usual (TAU), patients reported significantly



less psychological distress after both MBCT (Cohen's $d = .43$, $p < .001$) and eMBCT (Cohen's $d = .63$, $p < .001$). Moreover, the first studies demonstrate a tentatively positive view of the economic potential of MBIs. However, an economical evaluation of eMBCT for distressed cancer patients is yet to be conducted. The aim of the current study is to evaluate the cost-utility of MBCT and eMBCT in compared to treatment as usual (TAU).

Methods: Inclusion criteria were: a) a cancer diagnosis, any tumor type or stage, at any time in the past, on or off treatment; b) a score of ≥ 11 on the Hospital Anxiety and Depression Scale (HADS); c) computer literacy and internet access; d) ability to attend MBCT both face-to-face and online; and e) good command of the Dutch language. Exclusion criteria were: a) severe psychiatric morbidity such as suicidal ideation and/or current psychosis; b) change in psychotropic medication dosage within a period of three months prior to baseline; c) current or previous participation in ≥ 4 sessions of an MBI. In total, 245 cancer patients were randomly assigned to MBCT ($n=77$), eMBCT ($n=90$) or TAU ($n=78$).

An economical evaluation with a time-horizon of 3 months was conducted from the societal perspective in the intention-to-treat (ITT) sample. Healthcare utilization was assessed in an interview. Outcomes were expressed in EuroQol-5D: Quality Adjusted Life Years (QALY). Cost-utility from the societal perspective was calculated as the incremental sum of healthcare costs and productivity losses over change in QALY. The payer perspective only included healthcare costs.

Results: Intervention costs ranged from 299 for MBCT to 331 for eMBCT. Preliminary, unpublished data from this study indicate an increase in quality of life, as well as a cost saving from a societal perspective after MBCT compared to TAU, with an average cost saving of EUR 2689 (based on a spread of EUR 4589 to EUR 790) in Group MBCT and an average cost saving of EUR 2465 (based on a spread of EUR 4311 to EUR 618) in eMBCT.

Conclusions: This study indicates an increase in quality of life compared to conventional care, as well as a cost saving from a social perspective after MBCT and eMBCT compared to TAU.

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Healing Optimization through Pre-operative Engagement (HOPE): A Retrospective Review in Upper Gastrointestinal Surgical Oncology Patients

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Introduction: Patients diagnosed with upper GI tract cancers of the esophagus and pancreas are at a high risk of developing protein calorie malnutrition, inflammatory states, and concomitant loss of lean muscle mass leaving them frail and in poor functional condition. Many of these patients suffer from pancreatic

enzyme deficiencies or maldigestion. In the presence of frailty and malnutrition, there is an increased risk of postoperative complications, morbidity, and mortality. Therefore, a simple, effective multimodal preoperative optimization program was developed to 1) improve protein-rich nutrition with specific immuno-supportive recommendations, 2) treat maldigestion in pancreatic or GI disorders, 3) assign activity-based interventions, and 4) perform disease specific education with stress reduction interventions.

Methods: Program instructions to walk a total of 30 minutes per day for a minimum 5 days per week, and to ingest 25g grass-fed whey protein isolate high in leucine and BCAAs, 2,000 IU Vit D, and 2,000 mg omega-3 daily. At each appointment, individualized disease/surgery specific education and stress management strategies were completed. In the presence of maldigestion, patients were instructed to ingest pancreatic enzymes with meals. Intervention measurements were performed using standard serum lab tests (prealbumin and fat-soluble vitamins), grip strength and timed up and go. Test values were obtained at the initial consult, and at 2 week intervals for a total of 4 weeks prior to surgery.

Results: In this small retrospective study, 8 patients (3 males and 5 females) with digestive cancers, a



mean age of 73 years, and mean BMI of 26.43 were reviewed. Fat soluble vitamins, prealbumin, weight, grip strength, and timed up and go were measured. Paired T tests results compared values at the consult and 4 week mark. Statistically significant improvements were found in prealbumin (p value <0.02), Vitamin A (p value <0.04) and grip strength (p values <0.04). Nearly significant improvement in timed up and go was observed (p value 0.056). Positive results of the interventions indicated improved functional strength and nutritional/inflammatory markers. All patients had surgery without complication or delay.

Conclusion: A 4 week multimodal prehabilitation program for upper GI cancer patients that includes protein rich immunonutrition, correction of pancreatic enzyme insufficiency (if applicable) and stress reduction techniques can be effective in improving markers of nutrition status, inflammation and functional capacity. This informed the development of a formalized study and allowed patients that were previously deemed too frail to proceed with resection.

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Study protocol of a pilot single arm pre-post study to assess the preliminary effectiveness and feasibility of a preoperative home-based exercise prehabilitation program on preoperative cardiorespiratory fitness in high-risk patients scheduled for hepatic or pancreatic resection

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Background: There is currently no evidence regarding the effectiveness and feasibility to improve the preoperative level of cardiorespiratory fitness during home-based exercise prehabilitation in high-risk patients undergoing hepatic or pancreatic resection, whereas mortality and morbidity rates, particularly in the older and more frail patients, are high after these resections. Therefore, the primary aim of our study is to evaluate the preliminary effectiveness of a four-week *home-based* preoperative physical exercise training program in improving preoperative cardiorespiratory fitness in high-risk patients scheduled for elective hepatic or pancreatic resection. Secondary study aims are to evaluate 1) feasibility, 2) effects on the immune system, 3) effects on other CPET parameters, 4) individual response profiles on progression in cardiorespiratory fitness, 5) effects on quality of life, and 6) postoperative course.

Methods: In this multicenter ($n=3$) study with a pretest - posttest design, patients with a hepatic or pancreatic tumour that opted for elective resection will be recruited. Eligible patients must have a veterans-specific activity questionnaire score ≥ 7 metabolic equivalents, and should be willing and able to perform a maximal cardiopulmonary exercise test. To ensure to select the high-risk fraction of this surgical population, the ventilatory anaerobic threshold should be <11 mL/kg/min for final inclusion. A planned total of 24 high-risk patients will participate in a four-week (three sessions per week) *home-based* exercise prehabilitation program. The partly supervised home-based preoperative physical exercise training program consists of goal setting and thereupon titration of interval training and endurance training on a cycle ergometer, combined with functional task exercises. The primary endpoint of the study is the preliminary effectiveness (preoperative improvement of cardiorespiratory fitness).

Discussion: The effects of a *home-based* exercise prehabilitation regimen using a cycle ergometer are unknown in high-risk patients opting for hepatic or pancreatic resection. An improved cardiorespiratory fitness might translate into better preoperative condition and consequently in less complicated postoperative outcomes and a reduced demand on care resources (e.g., reduction in length of stay, decrease in associated hospital resources).

Trial registration: Medical Ethics Committee of Twente, Enschede, the Netherlands (NL59702.044.16, April 21, 2017); Netherlands Trial Register (NTR; NTR6282).



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Multimodal prehabilitation versus regular care in colorectal cancer patients to improve functional capacity and reduce postoperative complications (PREHAB trial) - The first international randomized controlled trial for multimodal prehabilitation

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Aim: After surgery for colorectal cancer, up to 50% of patients develop one or several postoperative complications. The number and severity of complications are closely related to preoperative functional capacity, nutritional and psychological state, and smoking behavior. Recent evidence shows that intervention in the preoperative period might improve postoperative outcome. This study will determine the impact of multimodal prehabilitation on patients' functional capacity and postoperative complications.

Methods: This international multicenter, prospective, randomized controlled trial will include 708 patients undergoing colorectal surgery for cancer. Patients will be allocated to the intervention group (group 1, 4 weeks of prehabilitation), or the control group (group 2, standard care). Both groups will be treated in accordance with ERAS guidelines. The primary outcomes for measurement will be functional capacity (assessed using the six-minute walk test (6MWT)) and postoperative status determined with the Comprehensive Complication Index (CCI). Secondary outcomes will include health-related quality of life (HRQoL), length of hospital stay (LOS) and a cost-effectiveness analysis.

Conclusion: Multimodal prehabilitation is expected to enhance patients' functional capacity and reduce postoperative complications. It may result in increased survival and improved HRQoL. This is the first international multicenter study to investigate multimodal prehabilitation for patients undergoing colorectal surgery for cancer.

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Making patients fit for surgery: introducing a four pillar multimodal prehabilitation program in colorectal cancer

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Background: After surgery for colorectal cancer, up to 50% of patients develop one or several postoperative complications. The number and severity of complications are closely related to preoperative functional capacity. Recent evidence shows that intervention in the preoperative period might improve postoperative outcome. This study investigated feasibility and safety of a multimodal prehabilitation program for colorectal cancer patients.

Methods: We recruited 50 patients undergoing elective colorectal surgery for cancer. Patients were randomly assigned to the intervention group (n=20, prehabilitation) or control group (n=30, standard care). We evaluated patient adherence and satisfaction, adverse events and functional capacity.

Results: No significant adverse events occurred. After prehabilitation, significant improvements were observed in six-minute walk test, as well as in CPET variables. Also, we observed that 86 percent of patients in the intervention group recovered to baseline functional capacity within four weeks after surgery, versus 40 percent in the control group. Program evaluation revealed a high attendance rate (88%) and high level of patient satisfaction.

Conclusion: Multimodal prehabilitation is feasible and safe to implement in daily practice, increases patient satisfaction and improves functional capacity. Further research is needed to relate the potential of prehabilitation to postoperative morbidity and mortality. This will be investigated in a worldwide randomized controlled trial (NTR5947).