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Multimodal prehabilitation service for patients with colorectal cancer: the challenges of implementation

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ABSTRACT

Prehabilitation has been shown to improve outcomes for patients undergoing major surgery; benefits include reductions in length of hospital stay and postoperative complications. Multimodal prehabilitation programmes lead to improved patient engagement and experience. This report describes implementation of a personalised multimodal prehabilitation programme for patients awaiting colorectal cancer surgery. We aim to highlight the successes, challenges and future direction of our programme.

Patients listed for colorectal cancer surgery were referred for initial prehabilitation assessment. The prehabilitation group were assessed by specialist physiotherapists, dieticians and psychologists. An individualised programme was developed for each patient, aiming to optimise preoperative functional capacity and enhance physical and psychological resilience. Clinical primary outcome measures were recorded and compared with contemporaneous controls. For those undergoing prehabilitation, a set of secondary functional, nutritional and psychological outcomes were recorded at initial assessment and on completion of the programme.

61 patients were enrolled in the programme from December 2021 to October 2022. 12 patients were excluded as they received less than 14 days prehabilitation or had incomplete data. The remaining 49 patients received a median duration of 24 days prehabilitation (range 15–91 days). The results show statistically significant improvements in the following functional outcome measures after prehabilitation: Rockwood scores, maximal inspiratory pressures, International Physical Activity Questionnaire Score and Functional Assessment of Chronic Illness - Fatigue Score. There was a lower postoperative complication rate in the prehabilitation group when compared with a control group (50% vs 67%).

This quality improvement project has 3 Plan–Do–Study–Act (PDSA) cycles. PDSA 1 demonstrates prehabilitation can be successfully imbedded within a colorectal surgical unit and that patients are grateful for the service. PDSA 2 provides the project's first complete data set and demonstrates functional improvements in patients undergoing prehabilitation. The third PDSA cycle is ongoing and aims to refine the prehabilitation interventions and improve clinical outcomes for patients undergoing colorectal cancer surgery.

WHAT IS ALREADY KNOWN ON THIS TOPIC?

⇒ Prehabilitation has shown promise in improving clinical outcomes for patients undergoing major surgery and multimodal programmes enhance patient experience and engagement. Multimodal prehabilitation schemes are resource intensive and optimal patient selection, duration and components are yet to be agreed on. Prehabilitation programmes often exist as proof-of-concept studies, with wider implementation often limited by the challenges outlined above.

WHAT THIS STUDY ADDS?

⇒ This quality improvement programme shows patients undergoing prehabilitation while awaiting colorectal cancer surgery experience a statistically significant improvement in functional status, feel more psychologically prepared for surgery and experience fewer complications.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY?

⇒ This study demonstrates that a comprehensive, multimodal prehabilitation scheme can be embedded into the time-limited preoperative pathway for patients awaiting colorectal cancer surgery. We hope this report provides an insight for teams embarking on similar prehabilitation schemes, helping to align prehabilitation services across the NHS.

INTRODUCTION

Prehabilitation has been shown to improve outcomes for patients undergoing major surgery[1 2] including reduced length of hospital stay and postoperative complications.[3–5] In addition to physical benefits, prehabilitation offers an opportunity to provide psychological support to patients adjusting to life changing cancer diagnoses, thus enhancing their preparedness for major surgery.[6] The COVID-19 pandemic has resulted in physical and psychological deconditioning of the population.[7] An estimated 18 000 excess deaths from cancer in the UK have resulted

from service disruptions secondary to the pandemic.[8] To 'beat the backlog' the Centre for Perioperative Care have made strong recommendations calling for funding to develop integrated perioperative care pathways placing greater emphasis on patient preparation for surgery.[8]

Prehabilitation services are endorsed by the National Institute for Health Research, Royal College of Anaesthetists and Macmillan Cancer Support who have produced joint guidance on the implementation and delivery of multimodal prehabilitation programmes.[9] Locally, it is a priority of the South East London Cancer Alliance (SELCA) to deliver prehabilitationm, which complements the National Health Service (NHS) long-term plan towards integrated, personalised care for patients. Despite these endorsements and guidelines, it is acknowledged the delivery of prehabilitation is difficult; the interventions employed are variable and challenging to evaluate, resulting in only low certainty evidence to suggest prehabilitation may improve postoperative outcomes.[10–13] Proposed effective prehabilitation programmes are both labour and resource intensive, requiring multidisciplinary teamwork and robust patient engagement.[1] As such, optimal patient selection, intervention design and programme duration are yet to be determined.[13]

This paper describes an approach to delivering multimodal prehabilitation, addressing the physical, nutritional and psychological needs of colorectal cancer (CRC) surgical patients. Psychological preparation for major changes in health and treatment status is a vital component of illness adjustment which impacts on treatment outcomes and quality of life (QOL).[14 15] This project takes an active and holistic approach to prehabilitation, informed by psychological theories of illness adjustment, health behaviour optimisation and psychological well-being.

This paper recognises three main benefits of a prehabilitation service.

Benefits to patients

The prehabilitation service is likely to optimise patients' preoperative functional capacity and engagement in their care. In line with Macmillan prehabilitation guidelines, we hope to benefit patients with cancer undergoing surgery by focusing on three main processes: personal confidence and coping with the consequences of surgery; physical and psychological resilience; and improved long-term health.[9]

Benefits to the trust

The service will benefit the surgical directorate by shortening hospital lengths of stay and reducing readmissions through a reduction in postoperative complications and improved functional baseline. The prehabilitation service should produce clear cost-saving benefits for the Trust and can be expanded to serve patients in other surgical specialties.

Benefits to the region

This report will describe the development and implementation of an individualised multimodal prehabilitation service for patients referred for CRC surgery, helping to align prehabilitation services across the region and NHS.

Plan–Do–Study–Act cycles

The first Plan–Do–Study–Act cycle (PDSA 1) aimed to restructure the perioperative pathway to optimally prepare patients for CRC surgery, transforming 'waiting' time into 'preparation' time.[1] The second PDSA cycle ran from December 2021 to October 2022 and provided the first complete data set, allowing comparison of functional and clinical outcomes in patients with CRC who received prehabilitation. The third PDSA cycle is ongoing and aims to refine the prehabilitation intervention and improve clinical outcomes.

Aims

Key aims for this project (PDSA 1 and 2) are to determine:

1. The feasibility of a multimodal, individualised prehabilitation service for patients with CRC.
2. How to effectively enrol new patients with cancer into the service to maximise prehabilitation duration within stringent cancer treatment timelines.
3. How to structure and fund the large, complex administrative requirements of the service.

Aims for this report

1. Highlight the challenges of setting up a multimodal prehabilitation service.
2. Provide insight for other Trusts embarking on similar prehabilitation schemes.
3. Align prehabilitation services across the NHS, to improve the quality, data collection and evidence base for prehabilitation.

METHODS

Context

The Trust provides quaternary level CRC surgical services to a population of two million people across south London and southeast England. Annually 150 patients undergo surgery for CRC including complex open procedures and robotic surgery. Our team piloted an individualised multimodal prehabilitation service for patients undergoing CRC surgery.

The intervention: team and workflow

This project was a collaborative effort spanning multiple directorates. The team included surgeons, anaesthetists, dietitians, physiotherapists, psychologists and clinical nurse specialists (CNS). The time allocations for core team members were:

- CNS 0.6 WTE (whole time equivalent).
- Physiotherapist (band 7) 0.6 WTE.
- Dietician (band 6) 0.4 WTE.
- Psychologist 0.4 WTE.

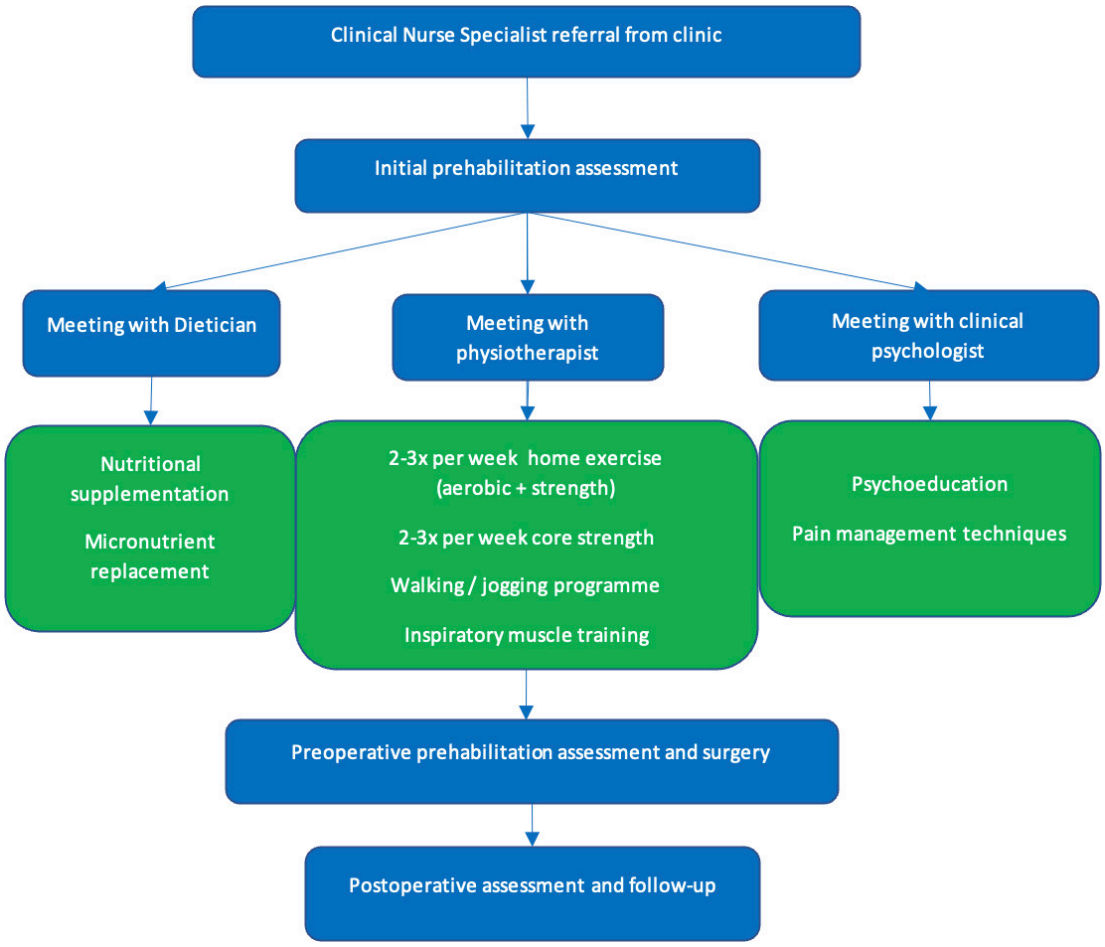

Figure 1 Prehabilitation intervention pathway.

The role of the CNS was crucial for communication and smooth running of the prehabiliation day. The CNS also acted as a link person to contact if there were ongoing concerns or questions from the patients. Fortnightly multidisciplinary meetings facilitated clinical workflow and allowed an iterative approach to developing the pathway.

The intervention: prehabilitation pathway

After the surgical plan was finalised, patients were invited to an initial prehabilitation assessment with a dedicated multidisciplinary team (MDT) comprising a senior physiotherapist, dietitian and clinical psychologist. Assessments were conducted face to face but could be delivered remotely if necessary. Reasons for non-participation were also recorded. The interventions were carefully designed to minimise patient visits to hospital during the prehabilitation phase (see figure 1).

The intervention: physical component

The oncology physiotherapist conducted an assessment including existing symptom burden, medical history, current physical activity, fitness levels and self-efficacy. The intervention was an individualised exercise programme based on the UK Chief Medical Officers' physical activity recommendations as well as a core strength and an inspiratory muscle training programme. Patients were encouraged to use an exercise diary and smart technology to measure steps or heart rate. When required activity monitors (Fitbit 4 watches) were offered to wear for the duration of the prehab period. Patients were followed up weekly with a phone call to review the programme and recommend treatment progression.

The interventions: nutritional component

Patients were reviewed by a specialist gastrointestinal surgery dietitian. Nutrition screening was undertaken using the Patient Generated Subjective Global Assessment (PG-SGA) short form. An individualised dietary plan was agreed according to the patient's nutritional risk, current symptoms and surgical procedure planned. Outcome measures taken at baseline and reassessed immediately prior to surgery.

The intervention: psychological component: psychological interventions

Team focused psychological component

Key psychological concepts of behaviour change, coping and well-being were embedded within the team wide delivery of prehabilitation. Staff received training in key psychosocial models of health behaviour change including Prochaska *et al* model of behaviour change[16]

and Leventhal *et al* 'common sense model'.[17] These concepts influenced the interaction with patients, the scheduling of key interventions and consultations to promote psychological adaption.

Patient focused psychological component

The psychological intervention aimed to promote preparedness for surgery through individualised assessment and review of psychosocial factors which may impact on treatment outcomes and quality of life. The assessment and interventions are informed by key psychological models of adjustment, integrative therapeutic modalities and motivational interviewing.[18–20] A history of patients' psychological needs was undertaken including formal mental health diagnosis, comorbid health conditions and the patient's current symptom burden. Following this assessment, the patient was supported to identify adaptive coping strategies and advised about alternative strategies. Interventions included distress management skills; recognition of emotions; thought modification, cognitive reframing; and psychoeducation on physiological arousal associated with anxiety.

Measurable outcomes

Clinical data collection included demographic data, duration of prehabilitation and surgical intervention. Clinical outcomes measures were length of hospital stay, Clavien Dindo complication rates, unplanned admission to ICU, 30-day readmission and Days Alive Out Of Hospital 30 (DAOH30).

Functional outcome measures were collected to allow comparison of patient's functional status before and after prehabilitation. These measures included a Rockwood Frailty score, Sit to stand 60, maximal inspiratory pressure (MIP), International Physical activity Questionnaire (IPAQ), and Functional assessment of Chronic Illness therapy-Fatigue (FACIT-F), European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLQ-C30) and Gereral self efficacy score. QOL and self efficacy were not reported in this report.

Nutritional outcome measures taken at baseline and reassessed immediately prior to surgery included: PG-SGA score, body mass index, weight loss, nutritional biochemistry, mid-upper arm circumference and handgrip strength (HGS). Other than HGS, these results are not presented in this report.

Psychological outcome measures focused on evaluating patients' acceptance of the multimodal prehabilitation service. Patients underwent bespoke structured telephone interviews at 3 months post-discharge to gather feedback about the experience of prehabilitation and their psychological preparedness.

A timeline of data collection can be found in table 1.

Control group

To assess the impact of prehabilitation on the primary clinical outcomes, a group of 49 patients who underwent CRC surgery at the trust during the same period formed the control group. The control group composed of patients who were not referred for prehabilitation, declined or were deemed inappropriate due to insufficient time prior to surgery. The control group provided data for comparison for the surgical outcomes; no data were collected from the control group for comparison

Table 1 Data collection measurement timeline

Anticipated time frames	Event	Measurement	Tools
Day 0	Listed for CRC Surgery CNS Referral to Prehab	Demographics Diagnosis Treatment plan	Age, anthropometrics, diagnosis, enrolment decision
Day 7	Initial Prehab Assessment	Objective measures	Rockwood frailty score, Sit to stand 60 s, MIP, HGS, BMI, weight loss, MUAC
		Patient reported measures	PG-SGA score, FACIT-F, IPAQ, QOL, self-efficacy
Day 30	Pre-operative assessment	Objective measures	Rockwood frailty score, Sit to stand 60 s, MIP, HGS, BMI, weight loss, MUAC
		Patient reported measures	PG-SGA score, FACIT-F, IPAQ, QOL, self efficacy
Day 35	Post-operative assessment	Surgical and clinical details	Diagnosis, surgical complexity, complications and intensive care admissions
Days 60 and 120	Post-discharge follow-up	Satisfaction survey	Patient centred survey at 30 or 90 days post op

Representative data collection schedule, including tools and measures.
BMI, body mass index; CNS, clinical nurse specialist; CRC, colorectal cancer; FACIT-F, Functional Assessment of Chronic Illness - Fatigue Score; HGS, handgrip strength; IPAQ, International Physical activity Questionnaire; MIP, maximal inspiratory pressure; MUAC, mid-upper arm circumference; PG-SGA, Patient Generated Subjective Global Assessment; QOL, European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire.

of baseline functional, nutritional or psychological outcomes.

Analysis

The pilot phase (PDSA 1) ran from February 2021 to November 2021 and established the feasibility and design of the service. However PDSA 1 data were incomplete and did not allow for complete analysis between prehabilitation and control groups. The second PDSA cycle ran from December 2021 to October 2022 and provided the first complete data set. The following statistical tests were used to compare outcomes between the prehabilitation and control groups, depending on data type and distribution: Mann-Whitney for Rockwood Scores, Students Paired T-Test for Sit-to-stand 60 and the FACIT-F score, Wilcoxon Rank for MIP and Chi-X for IPAQ and Clavien Dindo scores.

RESULTS

Participants and controls

Ten months of data was collected with 94 patients referred during the time period. Of the 94, 4 patients declined prehabilitation and 29 were unable to participate in prehabilitation for the following reasons: insufficient time frame (n=17) due to last minute changes, travel constraints (n=5), emergency hospital admission (n=2), transfer of care to private sector (n=2), limited prehabilitation clinic availability (n=1), work commitments (n=1) and other (n=1).

Sixty-one patients were successfully enrolled into the prehabilitation service and 49 of these had complete data sets for analysis. Participants had an average age of 63 years (range 36–84 years) and a sex ratio of 58% male to 42% female. The control group had a similar profile with an average age of 63 years and a sex ratio of 44% male to 55% female. These are consistent with the demographics expected for patients with CRC. There was no statistical difference between the groups in terms of socioeconomic deprivation scores. The prehabilitation group had a slightly greater proportion of complex surgeries compared with the control group (45% vs 38%).

Duration of prehabilitation

The median duration of prehabilitation in the 49 patients was 24 days with a range of 15–91 days.

Comparison of functional outcomes

Patients who underwent prehabilitation showed statistically significant improvements in all measured functional outcomes, except for Sit-to-Stand 60 (table 2.) The number of people moving from 'low' to 'moderate' on the IPAQ demonstrates an increase in the proportion meeting UK Chief Medical Officers' physical activity guidelines.

Comparison of clinical outcomes

Comparison of clinical outcomes demonstrated a reduction in overall complication rates for the prehabilitation group when compared with a contemporary control group, however this failed to reach statistical significance via analysis of the Clavien Dindo scores (p=0.06). There was no benefit for the prehabilitation group in any of the other outcomes analysed (table 3)

Table 2 Comparison of functional outcomes

Functional outcome	Before prehab	After prehab
Rockwood Frailty Score	3.3	2.65 (p=0.002)
Sit-to-Stand (Reps in 1 Min)	28.7	31.6 (p=0.08)
Maximal inspiratory pressure	61.36	66.6 (p=0.0069)
IPAQ	Low=18	Low=9
	Moderate=8	Moderate=18
	High=5	High=5 (p=0.034)
FACIT-F	38.2	41.6 (p=0.014)

There were statistically significant improvements in all measured functional outcomes, except for Sit-to-Stand.
FACIT-F, Functional Assessment of Chronic Illness Therapy – Fatigue; IPAQ, International Physical activity Questionnaire.

Comparison of psychological outcomes

Seventeen patients agreed to give verbal feedback via structured telephone interviews at 3 months post-discharge. Feedback about the experience of prehabilitation and their psychological preparednessand demonstrated that all bar one patient were satisfied with their experience, and found attending the service generally helpful and valuable to them.

> "I wished it was longer time [in prehabilitation clinic]. I felt well looked after by team. And felt that they were very thorough and professional. I highly recommend." Prehabilitation patient.

Patients' psychological preparedness results demonstrated a majority of patients hold positive regard for this prehabilitation programme. Patient responses conveyed enhanced coping mentality; 88% felt more confident in preparing for surgery, 71% felt more able to cope with surgery and 59% felt more at ease about the forthcoming surgery with reduced emotional burden.

DISCUSSION

Summary of key findings

This project has achieved its primary aim to demonstrate an individualised, multimodal prehabilitation service can be successfully delivered to patients in a quaternary level CRC surgical centre (aim 1). We have demonstrated it is feasible to enrol and prehabilitate patients with cancer across a large geographical area within the tight cancer treatment timelines (aim 2). We have developed a

Table 3 Comparisons of clinical outcomes

Clinical outcome	Prehabilitation group	CRC control group
Length of stay	Median 12 days	Median 10 days
Complication rate	50%	67%
Clavien Dindo Score	0=24	0=15
	1=4	1=6
	2=9	2=23
	3a=3	3a=2
	3b=4	3b=2
	4a=2	4a=1
	4b=0	4b=1
	5=1	5=0
		(P=0.06)
Unplanned intensive care admission	7 (14%)	0
30-day readmission rate	4 (8%)	0
Days alive outside hospital at 30 days	Average 19.5 days	Average 20 days (p=0.08)

Results from PDSA 2 cycle did not demonstrate any statistically significant differences in clinical outcomes.
CRC, colorectal cancer; PDSA, Plan–Do–Study–Act.

structured approach to overcome the logistical complexities involved in delivering a prehabilitation service and will continue to refine and improve the programme (aim 3).

Patients enrolled in the prehabilitation service were satisfied and felt better prepared for surgery. There were statistically significant improvements in all functional outcomes, except for Sit-to-Stand 60. When compared with a contemporary control group, prehabilitation demonstrated a lower postoperative complication rate (50% vs 67%). However, PDSA 2 data do not demonstrate a benefit in the other clinical outcomes (length of stay, Clavien Dindo Scores, DAOH30 data and readmission rates). This lack of difference may have been the result in the inequality of complexity of surgery between the control and the intervention group. Data collection is ongoing (PDSA 3) and we are hopeful that an increase in patient numbers and refinement of the interventions will maximise patient benefits and, in time, produce measurable clinical benefits.

This programme attempts to minimise health inequalities by prescribing each patient an individualised prehabilitation regimen to suit their personal circumstances and access to technology. Interventions were tailored according to patient needs and ability. Furthermore, the combination of face to face and home-based interventions reduced inequity and allowed a greater number of patients to access the service from a large geographical area.

Challenges and limitations of data collection

Data collection has been a significant challenge for the project. Complete data sets were difficult to achieve due to the multiple demands on patient time and early starts to surgery. Time constraints allowed little time for preoperative measurements, patients undergoing surgery early on Monday morning were a particular challenge. Furthermore, it was not possible to standardise the location or timing of tests, for example Sit-to-stand 60 test locations ranged from the surgical unit, ward or the patient's home. The challenge in collecting standardised Sit to stand 60 may have caused a lack of significant effect.

Through the course of PDSA 1 and 2, we have developed and refined a robust data collection process to ensure patient data are obtained at the appropriate stages of the patent pathway. We expect data from PDSA 3 to be larger and more complete, enabling more thorough analysis.

The PDSA 2 data set includes a higher number of complex surgical patients in the prehabilitation group when compared with the control group (45% vs 38%). It is likely the greater complexity of surgery performed on the prehabilitation group had a negative impact on clinical outcomes. We expect that as more data are collected, the disparity in surgical complexity between the groups will diminish, and the confounding impact on measurable outcomes will become negligible.

Barriers to successful prehabilitation

National cancer waiting times standards dictate that patients with cancer should undergo their operation within 31 days of decision to operate.[21] This limited window for prehabilitation is often reduced further by administrative delays awaiting radiology reports, pathology results and MDT decisions. Further delays also result from the logistical challenges of recruiting, consenting and enrolling patients into the service. During this pilot 30% (n=29) of referred patients were unable to complete a minimum of 14 days of prehabilitation before undergoing surgery, this represents a major challenge to the success of the service. The challenge remains to enrol patients as early as possible to maximise prehabilitation duration, without overburdening the patient with additional information, hospital visits and appointments.

We plan to improve prehabilitation duration in PDSA cycle 3 by recruiting patients into the service earlier in their cancer pathway. One potential solution is to recruit patients directly from the CRC MDT meeting, when the patient has received a cancer diagnosis. However, there are disadvantages of earlier patient recruitment; such as intervening before an established treatment plan, competing clinic appointments and potential information overload.

Data collection is ongoing, initial data from PDSA cycle 3 show patients are being recruited earlier and are receiving a longer duration of prehabilitation before their cancer surgery. We expect longer prehabilitation duration to improve clinical outcomes but we will continue to monitor for the potential negative impacts of earlier recruitment.

Recognising prehabilitation as a treatment

Prehabilitation is not recognised by NHS England as a 'treatment' for cancer, consequently it is not possible to delay surgery without breaching their national 31-day guideline. Until a standardised prehabilitation programme can be nationally implemented and the benefits recognised it will not be possible to use prehabilitation as part of a treatment time and delay the surgery.

Enhancing prehabilitation interventions

The project continues to improve through digital technology, using activity monitors to incentivise patients and smartphones to disseminate exercise plans.[22] Funding has been secured for biweekly virtual exercise classes which will enable a greater number of patients to participate in ability appropriate physical prehabilitation sessions. These virtual sessions will enable assessment of patients' functional progress.

We are collaborating with other prehabilitation providers in the region to help align our services and improve our innovations through shared experience.

Securing the future of prehabilitation

The success of this service is dependent on a stable financial platform to secure the equipment, clinic rooms and staffing levels. This project received funding from SELCA allowing the service to develop. However, at present, there is no financial tariff for prehabilitation, making it more challenging to develop and progress prehabilitation services. Prehabilitation services need to be recognised and appropriately funded to ensure the potential benefits for patients and Trusts are realised.

Future aims for the service (PDSA cycle 3)

1. Finesse the service to maximise the benefits to patients, producing larger data set to allow measurable improvements to functional, psychological and clinical outcomes.
2. Expand the service to other surgical specialties and non-surgical patients with cancer.
3. Secure long-term Trust funding and financial stability.

CONCLUSION

This project has demonstrated that an individualised, multimodal prehabilitation service can be delivered to patients with CRC in a quaternary level CRC surgical centre. Initial results are encouraging, and we are optimistic that ongoing data collection, and refinement of the interventions will maximise patient benefits and, in time, produce statistically and clinically significant outcomes. By embedding psychological concepts of health behaviour change in the patient pathway and clinical interactions, we elevate prehabilitation beyond purely functional approach; delivering a holistic, value-led service welcomed by patients and colleagues alike. We hope this report provides an insight for teams embarking on similar prehabilitation schemes, helping to align prehabilitation services across the NHS.

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Contributors HB: primary author and coeditor; AF: data analysis and coeditor; AW: data analysis and coeditor; ZA-N: lead clinical psychologist, author, data collection and analysis; IV: lead physiotherapist, author, data collection; NP: idea conception and design; RB: lead dietitian, author, data collection; AR: patient recruitment and liaison; AH: funding coordinator; AH: lead colorectal surgeon; MI: patient recruitment and liaison; PB: prehabilitation advisor; HB: project lead, coeditor and guarantor.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This project was registered in June 2021 with our Trust as a service evaluation project under the Theatres, Anaesthesia and Perioperative (TAP) directorate (Registration number 12408). Ethical approval was deemed not necessary under the Trust guidelines. The prehabilitation service was offered to all patients for colorectal cancer surgery who met the 14-day minimal criteria for prehabilitation.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. Data can be obtained by email request.

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