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Evaluation of Prehab2Rehab

A process and outcome evaluation to understand the impacts of the Prehab2Rehab programme

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The Central Evaluation Team has been established within the Research and Evaluation Division within the Research, Data and Digital Directorate at Public Health Wales. The team supports the design and delivery of robust evaluation across PHW and its wider strategic partners.

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ACRONYMS

ASA	American Society of Anaesthesiologists
CNS	Clinical Nurse Specialist
EQ	Evaluation Question
ERAS	Enhanced Recovery After Surgery
GP	General Practitioner
HPB	Hepatobiliary Pancreatic
MCAR	Missing Completely At Random
PHW	Public Health Wales
PSM	Propensity Score Matching
UHB	University Health Board
Upper-GI	Upper-Gastrointestinal
WIMD	Welsh Index of Multiple Deprivation

Plain English Summary

Background

Programmes to get patients ready for surgery to treat cancer can improve how they respond to the surgery and how quickly they recover from it. These programmes are referred to as prehabilitation. They offer patients different support such as exercise classes, guidance on a healthy diet or support with managing stress to improve their overall health, before and immediately after surgery.

The Prehab2Rehab Programme

Cardiff and Vale University Health Board created the Prehab2Rehab programme to help cancer patients prepare for treatment such as surgery, chemotherapy or radiotherapy. Patients are offered a service that meets their own specific needs which may include exercise classes, guidance on their diet and support with their mental wellbeing. The goal is to help patients recover more quickly and stay healthy after treatment, reducing hospital stays, complications, and repeat visits to the hospital.

Evaluation Purpose

This evaluation aimed to understand how well the Prehab2Rehab programme is meeting its goals.

Study Design

We spoke to 14 health care professionals who work on the programme as well as 15 people with the lived experience of either taking part in the Prehab2Rehab programme or not taking part in the programme. We also used information on 351 cancer patients to assess if taking part in the programme had any impact on how long patients stayed in hospital after the surgery, complications after surgery as well as going back into hospital after surgery.

Findings

We found that patients who participated in at least three exercise sessions of Prehab2Rehab stayed in the hospital about 3 days less than those who did not. We also found that most patients were happy with the programme and said it helped them make healthy changes to their lifestyles before surgery. It also gave them emotional support by being part of a group of people going through the same experience. However, some patients found it hard to take part in Prehab2Rehab because of how unwell they were or because of feeling sad, anxious or stressed. Some patients also lacked transport to get to where the programme was offered. Healthcare professionals thought it was a good programme but suggested some areas of improvement for the future, including improving the rehabilitation side of the programme to help patients maintain healthy changes after surgery.

Conclusion

Evidence suggests that the programme reduces the length of hospital stays after surgery in those who take part in at least three exercise sessions. Improvements in how the programme is delivered could make it better than it currently is.

Executive Summary

Background

Cancer prehabilitation describes interventions designed to improve an individual's physiological and psychological resilience prior to surgery. There are various stressors associated with cancer surgery and resilience to those stressors can be dependent on modifiable risk factors. Multimodal prehabilitation interventions that influence these risk factors are gaining popularity in attempts to improve postoperative outcomes for cancer patients and the wider system.

The Prehab2Rehab Programme

The Cardiff and Vale University Health Board has developed Prehab2Rehab, a suite of resources and support to promote and facilitate prehabilitation for cancer patients undergoing treatment. Patient needs are determined across exercise, nutrition, and wellbeing. Based on this need, the Health Board's prehabilitation specialist therapist team prepares patients ahead of any treatment. They provide a personalised series of resources, guidance on healthy behaviours, exercise classes and psychological therapy dependent on the patient's need. The programme is thought to have the potential to improve patient recovery from cancer treatment and promote sustained health behaviours around exercise, diet, and wellbeing. In turn, the improved patient recovery can reduce the use of health system resources due to fewer days spent in hospital recovering, fewer complications, and fewer repeat admissions/emergency department visits post-treatment.

Evaluation Purpose

This evaluation sought to assess the extent to which, and how, the Prehab2Rehab programme contributed to its intended goals and objectives. This report collates findings from both a process and outcome evaluation of the programme. This evaluation consisted of five objectives:

1. To capture the reflections of service providers on how the programme works in practice.
2. To understand the acceptability, facilitators and barriers to patients engaging in the programme.
3. To understand the programme's impact on the health outcomes of patients.
4. To understand the programme's impact on the health behaviours of patients.
5. To detail lessons learned and make recommendations for the future implementation of prehabilitation programmes in Cardiff and the Vale, across Wales and internationally.

Study design

A process and outcome evaluation study design was applied to answer the evaluation questions, applying the following data collection and analytical methods:

Process Evaluation

One-to-one, semi-structured interviews were conducted with staff (n=14) and patients (n=15) with experiences of Prehab2Rehab. Interview data was analysed through a process of thematic analysis.

The process evaluation also involved secondary data analysis to help understand programme implementation.

Outcome Evaluation

Data from Cancer Network Information System Cymru and Prehab2Rehab programme data were linked to build a full dataset of 351 cancer patients in Cardiff & Vale University Health Board between 2019-2024. These datasets provided information including cancer type and staging, attendance to prehab appointments, complications, readmissions, and mortality. The majority of patients were patients undergoing colorectal cancer surgery. Several statistical approaches were utilised to analyse the data, including descriptive analysis, inferential statistics and Propensity Score Matching (PSM) analysis.

Summary of Main Findings

- Patients who participate in three or more exercise sessions of Prehab2Rehab have a statistically significant shorter length of hospital stay (mean control group= 8.67 days, mean intervention= 5.44 days, p<.000). This equates to ~3 days shorter length of post operative hospital stays. However, there was a significant interaction by age, with younger patients tending to benefit more from the treatment in terms of shorter hospital stays compared to older patients (interaction coefficient = –0.03, 95% CI: –0.05 to –0.01; $p = 0.05$).
- There was no significant difference in likelihood of complications or hospital re-admission within 30 days between those participating and those who did not participate in the programme.
- Less than half of patients eligible for the programme participated in Prehab2Rehab. However, there was no evidence of a difference in uptake across population groups (age, sex, deprivation) for attending any Prehab2Rehab session or attending three or more exercise session.
- Patients reported that Prehab2Rehab is engaging and provides the knowledge and motivation needed for most patients to make healthy changes to their lifestyle as they approach treatment/surgery. Patients who engaged with Prehab2Rehab reported noticeable improvements in their physical and mental health, as well as improvement in their diet, which they felt would not have occurred in the absence of the programme
- The programme is acceptable to most patients, although some patients experience barriers to engaging with aspects of prehabilitation such as physical capacity, mental health and transport.
- An unintended positive outcome of the programme was identified with patients reporting that taking part had provided them with a new social network and peer support.
- Staff identified issues with the programme's staffing and governance models, as well as the reliance on GPs, surgeons and Clinical Nurse Specialists (CNSs) to refer to Prehab2Rehab. Staff suggested simplifying the leadership model to ensure their time is maximised and promoting the benefits of Prehab2Rehab more widely to staff across the cancer pathway.
- Both patients and staff feel that a more formal rehabilitation offer, structured similarly to the prehabilitation they receive, is needed to ensure lifestyle changes are sustained post-treatment.

Recommendations Identified

Based on the evaluation findings, recommendations are made for the development and future delivery of Prehab2Rehab across four areas:

- Implementation - The evidence in Cardiff and Vale UHB demonstrates a positive impact for patients programme could be scaled up and rolled out in other Health Boards beyond Cardiff and Vale UHB. This would increase the number of patients who receive help to maintain or improve their health whilst waiting for surgery which, based on the evaluation findings, help reduce the length of stay post-surgery. The programme could be optimised to ensure that all patients who agree to Prehab2Rehab have at least three exercise sessions. Evidence from this evaluation suggests that at least three are needed to observe a benefit on length of hospital stay.
- Governance – the leadership model could be simplified, with steps taken to empower patient-facing staff to identify, suggest and implement improvements to the service, systematically capture the impact of any changes, while maintaining the core elements of the programme.
- Practice – Patients and staff suggested an enhanced rehabilitation offer could extend the benefit into recovery. Furthermore, more robust, thorough processes for capturing data are needed to understand Prehab2Rehab's impact across all outcome measures and inequalities.
- Promotion – wide dissemination, communication and engagement about benefits of prehabilitation including those identified in this evaluation to staff and patients across the cancer pathway may increase referrals to/levels of engagement with Prehab2Rehab among eligible patients.

Conclusion

- Evidence from this study in Cardiff and Vale UHB suggests that the Prehab2Rehab programme is achieving the primary goals of reducing patients' length of post-treatment stay in hospital. This is likely to improve patient flow in the hospital and improve hospital efficiency.
- The programme is having a positive impact on most patients, however adjustments in the management of the programme could ensure more efficient development and delivery of Prehab2Rehab. There are potential greater gains with refinement and development of the "rehabilitation component" of Prehab2Rehab to ensure lifestyle changes are sustained among patients post-treatment.

Introduction and Background

Background

Cancer prehabilitation describes interventions designed to improve an individual's physiological and psychological resilience prior to a major stressor, such as major surgery (1). There are various stressors associated with cancer surgery, including surgical trauma, physiological consequences of anaesthesia, poor nutritional reserves, and psychological distress (1). Resilience to those stressors can be dependent on modifiable risk factors, including smoking/alcohol use, malnutrition, poor physical activity, and poor psychological preparedness (1). Multimodal prehabilitation interventions that influence the above risk factors are gaining popularity in attempts to improve postoperative outcomes for cancer patients and the wider system (1). In the 2022 programme for transforming and modernising planned care and reducing waiting lists in Wales (2), Welsh Government made commitments to programmes of prehabilitation and rehabilitation, stating that a "standard prehabilitation approach to improve outcomes" would be developed.

Description of Prehab2Rehab

As part of their Keeping Me Well rehabilitation resource (3), the Cardiff and Vale University Health Board developed Prehab2Rehab, a suite of resources and support to promote and facilitate prehabilitation for cancer patients undergoing treatment (4). Patients are referred to Prehab2Rehab via one of three routes:

1. Primary Care – General Practitioner refers patient to Prehab2Rehab upon suspicion of cancer (e.g. presentation of cancer symptoms).
2. Secondary Care A – Following a confirmed diagnosis of cancer, patient is referred to Prehab2Rehab by a Consultant or Clinical Nurse Specialist.
3. Secondary Care B – Patient is referred into Prehab2Rehab following emergency/incidental finding of cancer.

Following referral, patients undergo a comprehensive health review, conducted by the Prehab2Rehab optimisation team, where their needs are determined across exercise, nutrition, and wellbeing. This is done by assessing a patient's glycaemic control, nutritional risk, current medications, anxiety, frailty, smoking status and exercise status. Following this, patients are categorised as Universal (low-risk), Targeted (moderate-risk) or Specialist (high-risk) and, based on their needs, the Health Board's prehabilitation specialist therapist team prepares patients ahead of any treatment. Low-risk patients are signposted to resources on the Keeping Me Well website and provided exercise and nutrition advice (3-4). Higher-risk patients may undergo further assessments (6-minute walk test, handgrip strength, functional capacity, maximum inspiratory pressure, fatigue, body composition) and are invited to attend exercise classes, appointments with dieticians and appointments with the Health Board's psychological therapists dependent on their need. Due to the nature of the programme, there is no set timeline or certain length of time the programme is offered

to patients. For example, interventions in other disciplines may have a set 12-week programme for a participant to complete. However, for Prehab2Rehab, patients are invited to take part up until their surgery date, which could be, for example, in two weeks or six months. Figure 1 depicts the flow of patients throw Prehab2Rehab.

Based on previous research on prehabilitation, the programme is thought to have the potential to improve patient recovery from cancer treatment and promote sustained health behaviours by offering multi-modal prehabilitation that is acceptable and feasible for patients (5). In-turn, the improved patient recovery can reduce the use of health system resources due to fewer days spent in hospital recovering, fewer complications and fewer repeat admissions/emergency department visits post-treatment. Additional detail around the theory that underpins how and why Prehab2Rehab is expected to work is available in the Theory of Change diagram (6) (Appendix A), which was developed alongside Prehab2Rehab stakeholders at the outset of the evaluation.

Figure 1: Prehab2Rehab Patient Flow Diagram

Methodology

Purpose of evaluation and evaluation questions

Purpose

The Prehab2Rehab programme provides support to promote and facilitate prehabilitation for cancer patients undergoing treatment. Through this, the programme aims to improve a patient's pre-surgical health and lifestyle, with expected post-surgical outcomes for patients including fewer complications, reduced recovery time and sustained lifestyle improvements. The outcomes are expected to lead to the long-term goal of the Prehab2Rehab programme which is to improve patient flow, improve capacity and reduced costs to the healthcare system. Further details can be found in the Theory of Change for Prehab2Rehab (6) (Appendix A).

Aims, objectives, and evaluation questions:

The **aim** of this evaluation was to understand the impact of Prehab2Rehab on patient, provider, and system benefits.

Under this aim, there are five **objectives**:

1. To capture the reflections of service providers on how the programme works in practice.
2. To understand the acceptability, facilitators and barriers to patients engaging in the programme.
3. To understand the programme's impact on the health outcomes of patients.
4. To understand the programme's impact on the health behaviours of patients.
5. To detail lessons learned and make recommendations for the future implementation of prehabilitation programmes in Cardiff and the Vale, across Wales and internationally.

Based on the objectives above, the evaluation aimed to answer the following evaluation questions (EQ):

Acceptability/feasibility (Objectives 1 and 2)

EQ1: What are the reflections of service providers on the prehabilitation process employed?

EQ2: To what extent is the Prehab2Rehab programme feasible and acceptable to patients?

EQ3: What are the facilitators and barriers to engagement with Prehab2Rehab for patients?

EQ4: Are acceptability and patient experience consistent across equality measures?

Patient outcomes (Objectives 3 and 4)

EQ5: Is Prehab2Rehab effective in enhancing patient outcomes?

EQ6: Is Prehab2Rehab effective in influencing patient lifestyle changes relating to health behaviours?

EQ7: Is the effect of Prehab2Rehab consistent across equality measures?

Evaluation approach

A mixed-methods approach, using multiple data collection methods, was used to answer the evaluation questions. A mixed-methods approach enables both identification of **if** Prehab2Rehab is bringing about its goals and **how and why** (or why not) the outcomes are being achieved.

Quantitative data investigated the uptake of Prehab2Rehab, differences in uptake and outcomes by demographics, and the effect of taking part in Prehab2Rehab by comparing differences in outcomes (i.e. length of stay, complications). Qualitative elements explored the reflections of patients and providers to attribute these changes to underlying mechanisms and identify potential areas for improvement.

Evaluation design

The evaluation consisted of two modules – a **process** evaluation and an **outcome** evaluation. The process evaluation explored how the programme works in practice by understanding the experiences of patients and providers of Prehab2Rehab. The outcome evaluation critically appraised the effectiveness of Prehab2Rehab to improve outcomes for patients diagnosed with Hepatobiliary Pancreatic (HPB), Colorectal, or Upper-Gastrointestinal (Upper-GI) cancers, with surgical curative intent. Various data collection and analysis methods were used across the two modules, with findings triangulated to collectively answer the evaluation questions.

Description of data

Process Evaluation Methods

One-to-one, semi-structured interviews were conducted with staff and patients with experiences of Prehab2Rehab, as well as patients who did not participate in the programme.

- Staff interviews (April – June 2024):
  - Due to the potentially identifiable nature of these interviews, no demographic data was collected, and exact staff roles were removed from interview transcripts.
  - 14 members of staff from the Cardiff and Vale University Health Board were interviewed. This sample included staff who directly deliver Prehab2Rehab (e.g. programme leads, clinicians, practitioners) and staff from the wider cancer pathway whose area of work links to the programme (e.g. surgeons/consultants, clinical nurse specialists, managers, GP representatives). Staff were recruited based on the stakeholders identified in the Theory of Change (Appendix A).
  - Interviews lasted roughly 45 mins and included pre-planned questions covering their

experience of delivering Prehab2Rehab. The topic guide included questions about their role, their feelings on the experience for patients, the facilitators and barriers to Prehab2Rehab and their reflections on the impacts and areas of improvement for the programme.

- Patient interviews (August – November 2024):
  - The inclusion criteria for the patient interviews were as follows:
    - Aged 18 or older,
    - Able to speak and understand English or Welsh,
    - Began receiving surgery for HPB, Colorectal or Upper-GI cancer since November 2021,
    - Treatment/surgery completed in last 12 months or scheduled/ongoing,
    - Eligible for Prehab2Rehab (i.e. above cancers only and not on a palliative pathway),
    - Cognitively able to consent (e.g. not with dementia).
  - 15 patients meeting the inclusion criteria were interviewed. This included patients who participated in the Prehab2Rehab programme (n=13) and some who did not (n=2). Of the 13 patients who had participated in Prehab2Rehab, there was a mix of patients who were classified as Universal (n=2), Targeted (n=4) and Specialist (n=7) (see Appendix A). Given the nature of the programme, the majority of interview participants had been treated through the Cardiff and Vale Health Board pathway (n=13). Patients were recruited through purposive sampling based on their participation in Prehab2Rehab and/or engagement with supporting organisations (e.g. Maggie's).
  - We recruited patients who met the eligibility criteria to the interviews through various approaches:
    - Patients whose contact details were held by Prehab2Rehab were contacted directly via email and/or post and asked to respond if they were interested in taking part in an interview.
    - Other organisations/networks (e.g. Maggie's; CAVUHB Upper-GI Support Group) shared information about the interviews and gave patients details to contact the Evaluation Team if they were interested.
    - A flyer was circulated by Prehab2Rehab clinicians and on wards which included details on how to contact the Evaluation Team if they were interested.
  - Patients received an information sheet about the study at least 24 hours before their interview. All participants gave written or verbal consent to participate.
  - Interviews lasted roughly 30 minutes and included pre-planned questions from an interview guide covering their capability, opportunity and motivation to participate in Prehab2Rehab, their experience of any sessions/appointments they attended and any impacts on their health, wellbeing, recovery or lifestyle. Interviews were conducted over the phone, Zoom or in-person at the participants' request. Participants were signposted

to Maggie's for further support post-interview if required.

- Due to the anticipated small sample size and to ensure individuals were not identifiable, no demographic data was collected on patients.

Secondary data analysis

Data provided for the outcome evaluation was analysed to provide some understanding about how the programme is being implemented. Full description of the data and the analysis process is in the outcome evaluation section.

Process Evaluation Analytical Approach

All semi-structured interview data were audio-recorded, transcribed and analysed through a process of deductive thematic analysis (7), using NVivo software. This process included familiarisation with the data, coding and defining themes. This process was led by JW, with codes and themes reviewed against the data by CG and AC. 10% of interview transcripts were quality assured through double coding led by CG.

Outcome Evaluation Methods/Analytical Approach

Data Linkage and Cleaning

Two de-identified data sets were utilised to build a full data set of cancer patients between 2019-2024 (since the inception of Prehab2Rehab). Audit data from Cancer Network Information System Cymru (CaNISC) was provided which included data on cancer staging, date of surgery, preoperative health (via the 6-category scaled American Society of Anaesthesiologists (ASA) grade[1]) type of cancer, and whether the patient had received chemotherapy or radiotherapy. Data were also included from the Prehab2Rehab programme (including the enhanced recovery after surgery dataset (ERAS), therapy datasets, and primary care data). Variables in this data included attendance to any prehab appointment, number of exercise sessions attended, age, sex, if the patient had complications, a re-operation, re-admission within 30 days, died within 90 days, if patient was mobilised post-op day one, and time from diagnosis to admission for surgery.

These two data sets were merged based on a unique patient identifier and resulted in a full data set of n=1907 (table of demographics of full sample is provided in Appendix B and well as descriptives of Prehab2Rehab attendance for the full data set in Appendix C). However, there was a high amount of missing data, and therefore many participants were not included in the final sample. Missing data

[1] The American Society of Anaesthesiologists (ASA) Physical Status Classification System is often used by UK anaesthetists to establish a person's functional capacity. ASA grades are a simple scale describing a person's fitness to be given an anaesthetic for a procedure. Further information on the classification can be found here and NICE guidance can be found here.

occurred in both the audit data as well as the Prehab2Rehab programme data. Missing data ranged from 67% missing (e.g. mobilised post-op day 1) to 0% missing (e.g. age, sex, type of surgery). Data availability by each variable is provided in Appendix D. Missing data are likely due to a combination of system limitations, clinical data entry practices, and lack of administrative capacity. Missing data may reflect the lack of integration between different cancer services and providers, as well as differing levels of scrutiny in the various datasets which could be due to time constraints or deadlines for audit data. These systematic limitations mean that missing data may occur randomly and be unrelated to patient characteristics or outcomes. As such, the missingness is likely to be missing completely at random (MCAR), meaning the probability of data being missing is unrelated to the observed and unobserved data. This assumption supports the use of complete case analysis without introducing bias into the results.

Several sensitivity analyses were run without using restricting variables (i.e. those with high amount of missing data) to assess the impact on the outcome. The results for these sensitivity analyses can be found in Appendix E. Following removal of the incomplete data, this resulted in a final data set of n=351 (18.4% of full data set). Table 1 below provides the demographic information for the sample of patients included in the outcome evaluation.

A sensitivity analysis was conducted comparing the full dataset (n=1907) to the final data set (n=351) to assess the extent to which the included sample (n=351) remained representative of the overall Prehab2Rehab population (n=1907). Given the level of missing data, it was important to evaluate whether the individuals retained in the complete case analysis differed meaningfully from those excluded. Overall, there were no differences in age or sex, however, post-operative length of stay was significantly lower in final data set (mean 9.95 days vs 6.95 days, p <.00). This difference is likely due to the larger distribution of colorectal cancer patients in the final dataset. The final dataset also had a larger distribution of individuals from the least deprived WIMD (an index that ranks areas' deprivation levels in Wales).

Descriptive analysis provided means and frequencies of the participant demographics and Prehab2Rehab outcomes. Prior to matching, statistical analysis was conducted using binary logistic regression, Mann-Whitney U test, and Kruskal-Wallis to further understand the data and any group differences prior to more in-depth statistical analysis test (see below). Statistical significance was indicated by a p-value of <0.05.

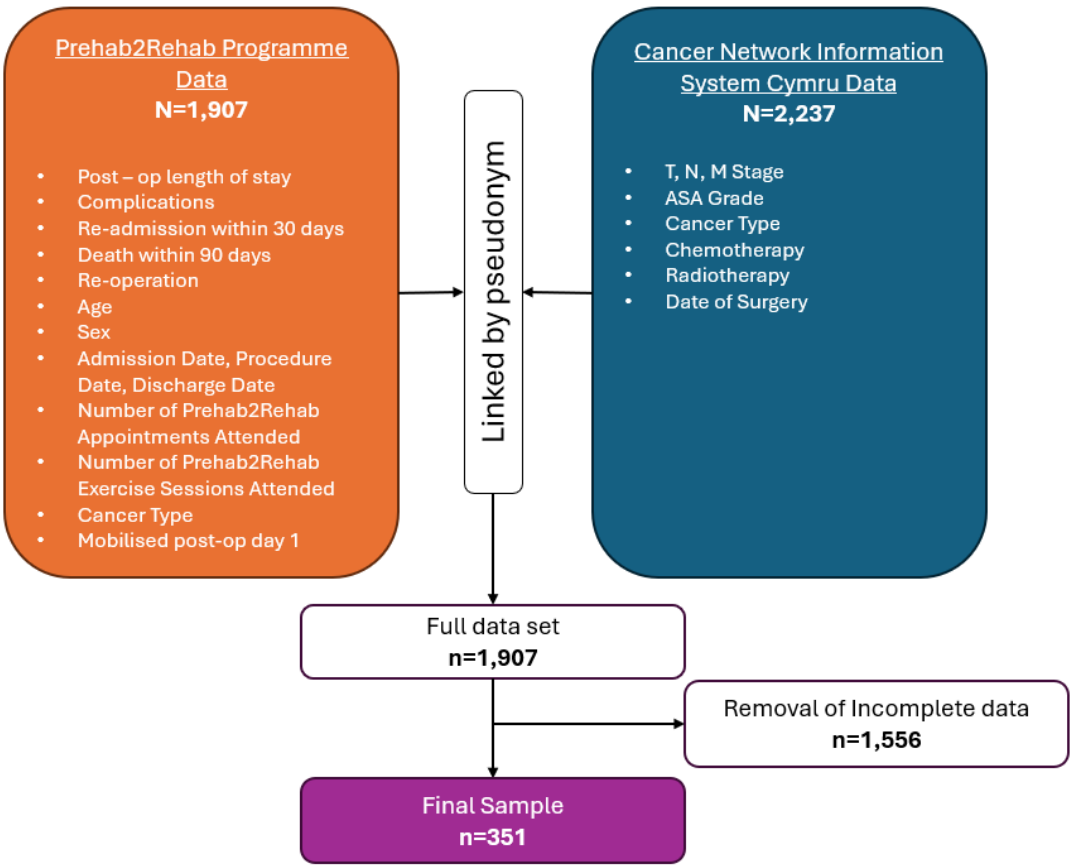

Figure 2. Overview of datasets utilised for quantitative analysis

Propensity Score Matching Analysis

The outcome evaluation examined the relationship between taking part in Prehab2Rehab (defined as attending 3 or more exercise classes) and length of postoperative stay using a PSM analysis of cancer patient data. Within the final dataset (n=351), two cohorts of patients were defined: the intervention group (those that attended three or more Prehab2Rehab exercise sessions) and the control group (those that attended less than three sessions) during the same period (2019-2024). The three-session threshold for the intervention group was established in collaboration with the Prehab2Rehab delivery team. This threshold was chosen to ensure consistency in treatment exposure while also maximising the sample size. By including participants who attended at least 3 sessions, we aimed to capture a meaningful treatment effect while maintaining a sufficient sample size for statistical analysis.

Based on our Theory of Change, the primary outcome of interest was length of postoperative stay in hospital. We also aimed to assess complications, re-admission within 30 days, re-operations, and death within 90 days. Based on analyses that have been run in previous studies (8), for each outcome we set a pre-defined threshold of approximately 30 observations to ensure sufficient data for

analysis. Outcomes with fewer than 30 observations were excluded from the analysis. Once the sample was matched, the number of re-operations (n<15) and deaths within 90 days (n<10) was too small to perform statistical analysis. To compare the difference in our outcomes between the intervention and control groups, we used PSM to reduce the effects of potential confounding factors on the comparison between those in the intervention group and those who were not.

Matching methods may be used as an approximation of a randomised design using the observed covariates and creating balance on these covariates in the groups being compared (9, 10). The intervention and control group were matched based on covariates. Covariates were selected based on theoretical relevance and prior research, reflecting factors that are likely to influence both the assignment to the treatment and the outcome of interest (8, 11, 12). Specifically, we included demographic characteristics (e.g. age, sex, WIMD quintile), baseline health conditions (e.g. ASA grade, cancer stage), and other relevant factors (e.g. time from diagnosis to admission). The rationale for including these covariates is that they are observed prior to the treatment and may affect both the likelihood of receiving the treatment and the eventual outcome (i.e. length of post-operative stay). These variables were measured at baseline and do not include post-treatment variables to avoid post-treatment bias. We also checked whether a covariate was strongly associated with treatment assignment. This was determined by running a series of multiple univariable linear regressions with sex, age, ASA grade, WIMD quintile, type of cancer, cancer stage, time in surgery, if they had chemotherapy or radiotherapy, anaemia, and time from diagnosis to admission as the predictor variables, and treatment assignment and length of postoperative stay as outcome variables. Based on the regression analyses, the following covariates were included in the PSM were: sex, age, ASA grade, WIMD quintile, if they had chemotherapy or radiotherapy, time in surgery, cancer stage, cancer type, and time from diagnosis to admission.

To determine the optimum matching method, several methods were tested to match the two samples using the R package MatchIt (13). These included 1:1 nearest neighbour matching without replacement, 1:2 nearest neighbour matching without replacement, 1:1 nearest neighbour matching without replacement with a calliper set to 0.1, optimal pair matching, and optimal full matching. The propensity scores were estimated using a multivariable logistic regression model. The balance statistics of these methods, specifically the standardised mean differences, the mean and maximum empirical cumulative density functions, as well as the remaining sample sizes were compared to help determine the optimal matching method. The most comparable balance was achieved with the 1:2 nearest neighbour matching without replacement resulting in 36 patients in the intervention group and 72 patients in the control group (Appendix F). A sensitivity analysis was also performed to compare those included in the matched sample to the full sample. No significant differences were found between the two samples.

A multivariable negative binomial regression was used to assess differences in post-op length of stay and a multivariable logistic regression was used to assess differences in complications and re-admission. Within the matched sample, the sample size was too small for the number of re-operations and deaths within 90 days to perform statistical analysis. To strengthen causal inference, a doubly

robust approach (14) was applied by adjusting for all propensity score covariates in the outcome model after matching. This method protects against confounding bias even if either the propensity score model or the outcome model is mis-specified.

To assess whether the effect of treatment varied across subgroups, we conducted effect modification analyses (15, 16) using regression models that included interaction terms between treatment and prespecified baseline covariates (e.g., sex, age, WIMD). After performing PSM to balance covariates between treatment groups, we fit outcome models to the matched sample based on the distribution of the dependent variable: multivariable logistic regression was used for binary outcomes, and multivariable negative binomial regression was used for count outcomes to account for overdispersion. Each model included the main effects of treatment and subgroup variables, the relevant interaction terms, and the covariates used in the PSM to adjust for any residual confounding. The statistical significance of the interaction terms was used to determine whether the treatment effect differed meaningfully across subgroups.

Data Quality

It is worth noting the challenges with the quality of the quantitative data that was used in this evaluation:

1. Prehab2Rehab, being a multi-model programme where the intervention received is based on patient needs, adds a level of complexity and challenges to the data. While Prehab2Rehab has different strands available to patients, including exercise classes, dietitian support, and mental health support, the personalised offer of Prehab2Rehab means that patients will only access the support that is relevant to them, meaning that patients who are categorised the same (Universal, Targeted, Specialist) may not receive the same intervention. Not only does this add challenges in firstly receiving data from the various strands of the programme, but it also means that the data available for each patient differs (e.g. some patients will have attended exercise classes, while others were not offered this).
2. The Prehab2Rehab programme is offered until the day of surgery. The length of time that patients have to take part before surgery varies making it difficult to ascertain dropout rate. It would have been more useful to have data on the number of sessions a patient is offered before surgery and how many they choose to attend however this data was not included in the datasets we received.
3. The ways of working in the Welsh NHS and cancer pathways do not currently support the collection of complete, linked data. At different points on the pathway, patient data is collected using different systems which, at present, do not link up. Equally, due to time pressures and the availability of IT equipment, patient-facing staff (such as Clinical Nurse Specialists) will often record hand-written notes which may never make it onto the online system to be linked with various other Prehab2Rehab-based data. Furthermore, the audit data from Cancer Network Information System Cymru, is only finalised once a year and is based on the previous year. This means audit data published

in 2024 will only cover data up until 2023. These challenges go some way to explain the gaps and limitations of the data used in this evaluation.

Time frame

The evaluation took place between October 2023 – November 2024. For the outcome evaluation, data was used from Jan 2019 - July 2024. The collection of primary data for the process evaluation occurred during the following time periods:

- Staff interviews: 18 April 2024 – 21 June 2024
- Patient interviews: 13 August 2024 – 27 November 2024

Information Governance and Ethics

This evaluation was approved by Public Health Wales' Research and Development Office. Given that the project was deemed an evaluation, ethical clearance was not necessary. A Data Protection Impact Assessment was approved by Information Governance Teams in both Public Health Wales and the Cardiff and Value University Health Board prior to the sharing or collection of any data.

Evaluation Findings

This section presents the findings/results from the process and outcome evaluation modules, followed by a discussion of the findings. Data from the process and outcome modules were triangulated to collectively answer these questions. The section concludes with a discussion which contextualises the findings within the current literature.

Description of the study participants

Table 1 below provides a demographic break down of the complete sample of patients included in the quantitative analysis. It is worth nothing that the majority of the sample (90%) were patients undergoing colorectal cancer surgery and lived within the Cardiff area.

Table 1.Demographic information for full sample (n=351)

	Frequency % (n)
Sex	
Male	55.8 (196)
Female	44.1 (155)
Type of Surgery	
Colorectal	90.3 (317)
HPB	9.6 (34)
Area	
Cardiff	96.6 (339)
Tertiary	3.4 (12)
Complications	
Yes	30.5 (107)
No	69.5 (244)
Death	
Yes	<1% (<5)
No	>99%
30 Day Readmission	
Yes	9.4 (33)
No	90.6 (318)
Re-operation	
Yes	10.5 (37)
No	86.0 (302)
Age[1]	65.75 (13.49) Median = 67.00
Post Surgery Length of Stay (days)[1]	7.29 (7.94) Median = 5.00
WIMD Quintile	
1 – Most deprived	17.0 (60)
2	10.8 (38)
3	9.9 (35)
4	15.1 (53)
5 – Least deprived	47.0 (165)
ASA Grade	
1	<.9 (<30)
2	57.8 (203)
3	33.3 (117)
4	<9 (<30)
Chemotherapy	
Yes	42.7 (150)
No	57.2 (201)

Radiotherapy	
Yes	10.3 (36)
No	89.7 (315)
At Least 1 Prehab Session (Any – e.g. nutrition, physio, mental health)	
Yes	46.2 (162)
No	53.8 (189)
Number of Prehab Appt Attended[1] (Any – e.g. nutrition, physio, mental health)	6.62 (7.92) Median = 5
3 or more Exercise Sessions (exclusively exercise sessions)	
Yes	10.3 (36)
No	89.7 (315)
[1]Mean (SD)	

Figure 3 below details the patient flow of uptake of Prehab2Rehab for the complete sample. Of the 351 patients included in the sample, 46% (n=161) attend any Prehab2Rehab appointment. 15% (n=52) of the sample attended an exercise session, with 11% (n=36) attending three or more exercise sessions.

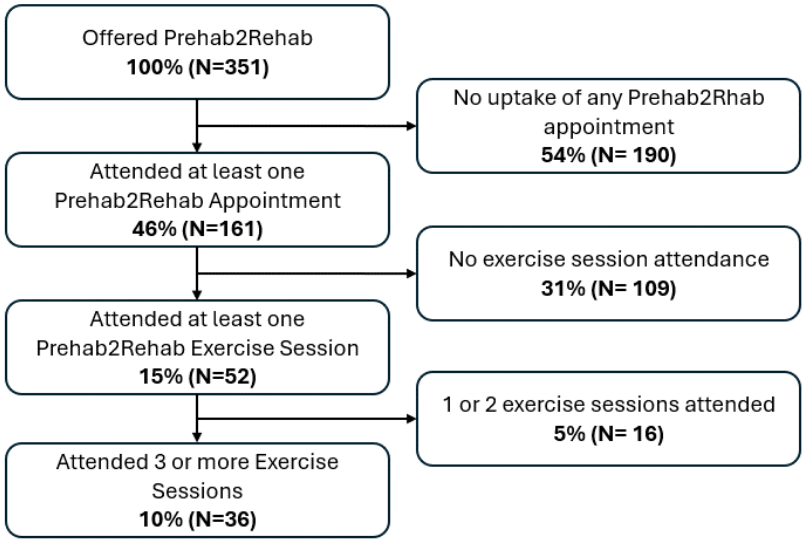

Figure 3. Prehab2Rehab Patient number flow for attendance of included sample

The rest of the results are aligned under each of the relevant evaluation questions below.

EQ1: What are the reflections of service providers on the prehabilitation process employed?

As part of the process evaluation, interviews were conducted with a range of staff involved in both the day-to-day delivery of Prehab2Rehab and relevant staff from across the broader cancer pathway. Across all these staff members, there was a generally consistent understanding of what prehabilitation is. The majority of staff cited "optimisation" across multiple domains including exercise, nutrition and emotional/mental wellbeing. Staff initially reflected that the referral process is effective for a large number of patients. However, at present, the process is heavily reliant on individual GPs, surgeons or Clinical Nurse Specialists (CNS) who value Prehab2Rehab and actively refer patients, meaning that some patients who could benefit may be missed.

> *"There can be multiple consultants who see their patients in multiple clinics and again, it's referring if they remember themselves, or a CNS, so it's sort of like relying on a person… I think if there was a standardised like mandatory, "this person is on a cancer pathway at this day, they get referred into these services", I think that would probably be more of an efficient way of doing it"* (Staff Participant 1).

There have been difficulties generating buy-in to the programme among these individuals, which may indicate why a significant proportion of eligible patients are not participating in the programme (as they may not be referred). Prehab2Rehab staff feel that the benefits of the programme could be promoted better.

> *"I think as a service, we don't shout enough about what we're achieving … if we could present to [other staff] … "these are our outcomes, we've reduced length of stay by this, we've reduced complications by this, etcetera", I think they'd see it and they'd buy into it a little bit more"* (Staff Participant 3).

Equally, staff acknowledged that Prehab2Rehab is subject to many of the challenges and pressures that are commonplace across the wider Welsh NHS. There was consensus among staff that governance structures, limited resources/funding, patient volumes, and disconnected digital and paper-based systems limit the effectiveness of the programme. Providers of Prehab2Rehab also discussed challenges associated with the staffing model of the programme, including the mix of full- and part-time staff. Staff feel that the rotational model of staffing within the programme puts additional pressure on full-time programme staff, meaning leaders are limited in the actions they are able to delegate. Equally, some staff identified specific posts and roles that they would like to see filled in Prehab2Rehab. A dedicated psychology role was the most cited, in order to ensure that the mental health support that patients receive is to the same standard as the exercise and diet support.

> *"I would like to see … that they have a dedicated psychology role within prehab teams… that psychologist could just focus on prehab and could influence service development, would be the leader in terms of psychological care"* (Staff Participant 7).

Staff involved in the day-to-day delivery of the programme felt that, at present, the various strands of Prehab2Rehab are largely siloed and that communication between the different elements is disjointed. However, these staff also felt that their opportunities to develop the service are limited due to the pressures of day-to-day delivery of the programme. They felt that their experience is being under-utilised with decisions sometimes made without consulting them. In order to make some of the larger-scale developments to the service – including connecting the different strands – front line staff feel that they need greater connection with programme leads/decision-makers and dedicated time to commit to service development.

> *"It should be acknowledged that service development is part of our role and we should probably have some set aside time that is for service development"* (Staff Participant 5).

The interviews uncovered some specific developments to Prehab2Rehab that staff felt would enhance the effectiveness of the programme. Staff broadly felt that the predominantly face-to-face delivery of prehabilitation was the most appropriate approach, but did acknowledge that for some patients, there is a need to develop an additional online offer of exercise and dietary support. Among patient-facing staff, there was consensus that the post-operative or rehabilitation side of the programme should be developed.

> *"We do get some patients come back and say, "what's next for me now? What can I do next?", and I feel that's probably the biggest thing that I'd like to get sorted anyway at least is a rehab side of things… just like a six-week program … it would be nice to say, "you can come back and we'll have, like a rehab side of things""* (Staff Participant 12).

Lastly, staff expressed that the complexity of the leadership model of Prehab2Rehab provides challenges to the delivery and development of the service. This complex leadership model may be the cause of the disconnect between service-providers and decision-makers and presents additional workload challenges for those service-providers.

> *"I think there are far too many leaders in this … that [leadership resource] needs to be cleaned up in my professional opinion, because it has almost tripled my workload on weeks where I've been asked to do different things for different people, and I feel like it is the most inefficient part of the service is actually the management of it"* (Staff Participant 5).

EQ2: To what extent is the Prehab2Rehab programme feasible and acceptable to patients?

Attendance to an intervention can be an indicator of the acceptability of the intervention. The poor data quality made it difficult to ascertain the proportion offered, uptake and completion of the service. However, within the final dataset, 46% (n=162) of patients who were offered the programme attended a Prehab2Rehab appointment of any kind. 31% of patients (n=51) attended 1 or 2 appointments (16.0% and 15.4% respectively), with 16% (n=26) attending 10 or more appointments (range 10-34). Of those 162 who attended any Prehab2Rehab appointment, 33% (n=52) attended at least one exercise session with 9% (n=16) attending one or two sessions and 22% (n=36) attending three or more sessions. Additionally, 15% (n=49) were classed as specialist and therefore received additional physiotherapist support. There were no data on how many appointments were offered to each patient and whether all offered appointments were utilised by patients.

A separate dataset held by the Prehab2Rehab team that was not able to be linked to the dataset used for analysis, provided an overview of why patients did not attend Prehab2Rehab. Overall, 10% of patients were either declined from Prehab2Rehab or declined to take part. The most common reason was that the patient was out of area and was transferred to their local prehab team (4%). Additionally, 2% declined to take part, with notes suggesting the patient didn't feel they needed Prehab2Rehab or didn't want to travel due to the distance. Furthermore, 1% of patients did not have enough time between referral and treatment date.

Patients who took part in any aspect of Prehab2Rehab had a broadly consistent understanding of what prehabilitation is and what it aims to achieve. These patients provided feedback on how feasible and acceptable they found the programme. All the Prehab2Rehab participants (13/13) who took part in the interviews received some form of exercise guidance from the programme. Patients who attended prehabilitation exercise classes had broadly positive experiences, citing the supportiveness of the staff and the benefits of face-to-face exercise guidance. There were mixed opinions on the intensity of the classes – some patients expected to be "pushed harder" while others felt they needed additional rest breaks. However, all patients interviewed felt that the exercise classes were tailored to their ability and physical capabilities.

> *"There were a couple of people in the group who were a lot older, far less mobility and I did see that the physiotherapist would very much adapt it to them. You could go at your own pace. There was a lot of encouragement, so although it was a group class, there was a degree of individualisation"* (Patient Participant 12).

Some interviewed patients received guidance to participate in exercise at home and in their own time, rather than attend the structured exercise classes. While it was acknowledged that this was an accessible alternative for patients with comorbidities such as anxiety, there was less clarity on correct

execution of the exercises among these participants than those who attended the classes.

> *"I don't know if I'm doing them right … you can't do much else other than look at the sheet and hope you're doing it right … I would have loved something like [an exercise class] or sending you to a gym so they can show you what you're supposed to do"* (Patient Participant 3).

Quantitative data found that 16% (n=50) of patients were classified as either targeted or specialist for dietary input and were offered additional support. Of those interviewed, most (8/13) had received dietary guidance and felt satisfied with the information they received and were able to make informed choices about their diet in the lead up to treatment. However, some patients felt that they needed additional guidance that was less generic and more tailored to their needs and preferences.

> *"You can't just say "rely on high calorie squash" if it makes you ill. You can't say "have the milkshake" if you can't stand milk … I think it's got to be more personal too … there's none of that sort of practical thing I found. It was a bit too textbook".* (Patient Participant 14).

None of the interviewed patients, nor those included in the quantitative data, received formal support for their mental health. However, most of the interview patients knew that it would have been available should they have needed it. Broadly, the majority of patients interviewed had positive experiences of Prehab2Rehab and felt that all information they received was clear and well-explained. However, some patients felt that at certain stages, there was a lack of empathy and understanding from programme staff.

> *"Maybe it could be a bit more centred around that person when they're talking to you about what you've been through … I just felt they didn't have much empathy … You're just treated a little bit like you're a case that's coming in … but it'd be quite nice if it could be a bit more personalised perhaps"* (Patient Participant 5).

Due to only 45% (n=143) of the sample taking part in Prehab2Rehab and given the self-selecting nature of participation in the study, it is important to acknowledge that some patient perspectives may have been missed. In the staff interviews, some staff identified that there had been occasional resistance to Prehab2Rehab from patients as an additional ask alongside the many other appointments and processes received post-diagnosis.

> *"Patients have multiple appointments to attend, and they find it almost a full-time job having a diagnosis and so they want to just get on with their treatment … so then to ask them to go to exercise classes, I think for some it takes time for them to understand the importance or the value of it"* (Staff Participant 1).

EQ3: What are the facilitators and barriers to engagement with Prehab2Rehab for patients?

Both staff and patients discussed the facilitators, motivators, and barriers to engaging with Prehab2Rehab that they had experienced. The most cited facilitator among patients was the support of family and friends, as patients relied on people around them to assist with travel, motivation, and encouragement to continue engaging in prehabilitation behaviours. Equally, patients cited available time as a key facilitator. Patients who were retired, signed-off from their occupation, or had flexible working arrangements prior to treatment found it easier to engage with prehabilitation.

> *"I was working, but not a lot of hours then … I genuinely would have gone more if I could have, but again, I've got a job that lets me go. Some people probably may not be able to do it"* (Patient Participant 14).

A number of practical facilitators to Prehab2Rehab also emerged. For patients who took part in the exercise classes, access to a car or reliable public transport was key to their engagement. For those who participated in home-based exercise, a safe outdoor environment was needed to enable them to exercise in their own time. A patient's preexisting lifestyle before the diagnosis was also a facilitator. Those that had positive attitudes towards exercise and were regularly physically active found it easier to engage in the prescribed exercises.

The key motivator to engage in Prehab2Rehab was an understanding of the benefits, having been clearly explained to patients by Prehab practitioners. Many patients understood that prehabilitation could improve their recovery and surgical outcomes, and this served as motivation.

> *"The way it was described, in terms of the end result, which is, you know it is there to help prepare you to make you better prepared than you would have been for the operation and indeed to help speed your recovery and who wouldn't want both of those if you're going into an operation?"* (Patient Participant 1).

Some patients suggested that the routine of regular exercise classes, the structure provided, and the group setting served as motivation to engage in prehabilitation. Some patients explicitly stated that they *"wouldn't have exercised on [their] own"* (Patient Participant 14) without the classes. Similarly, some patients directly praised the staff for motivating them to exercise, stating that the class leaders contributed to their engagement with prehabilitation.

About half of the interviewed participants stated that they experienced no barriers to prehabilitation. However, some barriers did emerge for others through the patient interviews. Some patients found

that they were not physically capable of consistently engaging with the prescribed exercises either in classes or at home. As well as physical health, a patient's mental health could be a barrier to engaging.

> *"Because of the anxiety side of it, I didn't want to do it … some days I've got anxiety, some days I'm so depressed I don't want to see what's outside"* (Patient Participant 2).

In the same way as transport could be a facilitator, for patients living outside of Cardiff, the requirement to travel to appointments and exercise classes was a barrier, as well as practical considerations such as parking. This is supported by the quantitative data, where only 3% (n=10) of the sample lived outside of Cardiff. In the additional Prehab2Rehab dataset discussed in EQ2, one of the most common reasons why patients declined the service was that they did not want to travel. This was also reinforced by the staff interviews, where specific occasions of travel being a barrier were discussed.

> *"The biggest one I've come across really is transport issues … Some people are keen to get involved, they really want to, but it's just a case of, say they live in the Vale and they can't get back and forth easy, a taxi's going to cost them a lot of money"* (Staff Participant 12).

Although it did not emerge from the patient interviews, staff acknowledged that there could be barriers if an online offer of prehabilitation support was delivered. The differences in digital literacy and access to technology across Wales could cause issues for some patients wishing to engage with online prehabilitation.

EQ4: Are acceptability and patient experience consistent across equality measures?

The quantitative data was used to investigate if certain demographic groups were more or less likely to attend Prehab2Rehab. Results indicate that, within the complete dataset, there were no significant differences in odds of attending any Prehab2Rehab appointment for sex, age, type of cancer, and WIMD quintile. Comparisons across demographic groups were also investigated for attending an exercise session. Similar results were found for attending three or more exercise sessions, with sex, age, and WIMD quintile reporting similar odds of attending. However, those with colorectal cancer had greater odds of attending three or more exercise sessions (p=.001, b= 2.156, 95% CI: 1.377-3.376) compared to the other two types of cancer.

Due to the lack of demographic data collected relating to patient interviewees (e.g. age, ethnicity, disability status), we are unable to draw conclusions around the acceptability of the programme across equality measures. However, staff provided some anecdotal reflections that may be worth investigating further in the future. Some staff acknowledged that, anecdotally, the demographic of patients who access Prehab2Rehab does not reflect the diversity of the community.

> *"I really don't know why, but we don't tend to have many patients that aren't kind of White British. We get, you know, the odd handful, but mindful of where we're living in Cardiff, you know, multi kind of ethnicity city, we don't seem to get that many patients through"* (Staff Participant 3).

Others reflected on the reasons why this may be the case and provided thoughts on specific barriers that underrepresented groups may face to engaging with the programme.

> *"If you are disabled or English isn't your first language or you know, if there are any communication issues, hearing impairment, that sort of thing, that can cause some barriers to accessing the service"* (Staff Participant 13).

EQ5: Is Prehab2Rehab effective in enhancing patient outcomes?

Using PSM methods, we aimed to explore the association between attending Prehab2Rehab exercise sessions and post-operative length of stay. Results indicate that those who attend three or more exercise sessions, had a shorter post-operative length of stay of approximately 3 days (mean control 8.67 days, mean intervention= 5.44 days, p=.001) (Table 2). Further analysis was run with the matched sample to explore the relationship between attending Prehab2Rehab exercise sessions and having a complication and being re-admitted within 30 days (bi-nary yes/no). However, no significant difference (p>.05) was found between those who attended the programme and those who did not on complications or re-admission.

Several sensitivity analyses were run without using restricting variables (i.e. those with high amount of missing data) to assess the impact on the outcome. All tests still found a significant difference in post-op length of stay as well as no significant difference for complications. The results for these sensitivity analyses can be found in Appendix E.

Overall, the evidence suggests that taking part in Prehab2Rehab exercise sessions leads to better post-operative length of stay (~3 days).

Table 2. Results from propensity score matching negative binomial regression to compare days post-op length of stay (n=102)

	Mean (SD) Days	Coefficient (95% CI)	P Value	Incidence Rate Ratio (95% CI)
<3 exercise sessions	8.67 (9.43)	-	-	-
3 or more exercise sessions	5.44 (2.21)	-0.38 (-0.64 - -0.12)	0.001	0.68 (0.52-0.89)

SD: Standard deviation; CI: confidence interval

The process evaluation findings support these findings and may go some way to explaining how and why Prehab2Rehab appears to have a positive impact on patients' length of stay post-treatment. The majority of patients interviewed expressed that they felt a noticeable improvement in their physical health and fitness by participating in the exercise classes.

> *"I did see the difference in my fitness, which we proved at the end of the four weeks because they did the hand fitness and the walking timed lap thing … even after four weeks, they saw the improvement … it absolutely worked"* (Patient Participant 9).

This was reinforced by the patient-facing staff who were interviewed, who were confident that Prehab2Rehab is improving patients' health and fitness, in-turn reducing their surgical risk.

> *"[Regarding the] direct patient outcomes, there is an improvement, so minimising weight loss or improving somebody's muscle mass or the six-minute walk test, those kind of real acute, you know, nitty gritty patient outcomes are really good"* (Staff Participant 1).

Moreover, staff reflected on some examples where engaging in Prehab2Rehab had directly contributed to a change in a patient's operable status, meaning that the exercise and dietary changes made had led to these patients moving from the palliative pathway to the curative pathway.

An additional impact of Prehab2Rehab on patients is around their mental health. The majority of patients who had attended exercise classes cited the psychological benefits of being around people going through similar experiences and treatment.

> *"There were two gentlemen in my exercise class, who I sort of struck up conversation with … that peer support of meeting people who were on that same very unusual journey was just phenomenal … that's one of the most important things for me was that peer support … it was good to be able to speak to people on this journey"* (Patient Participant 12).

Again, this was reinforced by patient-facing staff who felt strongly that patients benefit from the peer support and social connection provided by the exercise classes.

> *"It's just so much more than like exercise really. You know, it provides like that kind of safe environment where they can meet other patients that are going through similar things to them and you know, it's a massive psychological support as well"* (Staff Participant 11).

Similarly, the majority of patients suggested that engaging in Prehab2Rehab gave them a sense of purpose and something to work towards in the lead-up to the treatment they were receiving. Psychologically, patients reported feeling a sense of control over their health following diagnosis. Patients who did not participate in Prehab2Rehab did not identify this sense of purpose following diagnosis and in-turn did not feel in control of the management of their health before treatment.

> *"I felt on my own at that point … the trauma did knock me back … looking back, it might have been good to have somebody reaching out at that point … [with] Prehab2Rehab, at least you'd have professionals to talk to and engage with … the emotional side of it I would say would have had a huge impact"* (Patient Participant 11).

EQ6: Is Prehab2Rehab effective in influencing patient lifestyle changes relating to health behaviours?

Findings from the patient interviews indicate that Prehab2Rehab is likely to improve patients' awareness of the impacts that lifestyle behaviours can have on their treatment and recovery. Conversely, patients without the programme may feel uninformed.

> *"I went for my pre-op assessment … and that's the first point I knew that I was on an accelerated recovery. I didn't really know much about that at that point … so basically, I wasn't informed at that particular juncture of my journey"* (Patient Participant 11).

The primary behaviours that Prehab2Rehab seeks to influence are exercise and diet. Firstly, the majority of patients who received exercise guidance felt that their knowledge and attitudes towards regular exercise had improved. For patients who attended exercise classes, some stated that the classes had directly improved their confidence to exercise.

> *"It's just sort of like relit the fire, if you like … it just changes your mindset … Whereas before, I think "I haven't got time to do that", all of a sudden you've been given all this time to think about what you should be doing … And yeah, just everything from my diet and lifestyle. Everything needs to change"* (Patient Participant 10).

Conversely, patients who did not take part in/were not offered Prehab2Rehab expressed that they had made little or no changes to their exercise behaviours prior to treatment. These patients felt that a structured exercise class would have improved their motivation and ability to exercise prior to treatment.

All patients who received dietary guidance felt that they had been able to make positive changes to their diet in the lead-up to treatment. Again, patients who had not received Prehab2Rehab had not made significant changes to their diet before treatment and felt that the guidance that the programme offers would have enabled them to be better prepared.

These findings are reinforced by those from the staff interviews. Prehab2Rehab staff and leads are confident that the programme is likely to result in sustained health behaviours among patients beyond their recovery, by improving patients' knowledge, motivation and providing them a sense of purpose as they approach treatment.

> *"I think just broaching that subject with them and making them think about their life choices in terms of making healthier choices going forward … Even if our programme was failing in everything, I would keep it just simply for that because it doesn't get broached by doctors, it doesn't get broached by nurses, we know that, and by the time they've had the surgery and are cured of cancer, they're not thinking about healthy behaviours anymore"* (Staff Participant 5).

Despite these positive reflections from patients and staff on pre-treatment support, there is a clear gap in post-treatment support or rehabilitation in the current delivery of Prehab2Rehab. Consequently, some patients felt that the programme had little sustained impact on their health behaviours following treatment due to the lack of guidance around resuming exercise and maintaining diet changes. There is a clear need for the rehabilitation aspect of Prehab2Rehab to be developed, particularly to provide support and guidance to patients to build up their exercise levels again.

> *"How will I know what I can and can't do in terms of exercise after the operation? Is that something that the team will cover? I mean I can join [gym] and I've got the paperwork to do that, but I felt I had guidance in the prehab bit. Will I get something similar in rehab …having that kind of help and guidance would be good, I think"* (Patient Participant 1).

The referral to and discounted membership of gyms and leisure centres that Prehab2Rehab currently offers may be sufficient for some patients. However, the majority of patients interviewed felt strongly that, in order to make sustained lifestyle changes beyond treatment, the rehabilitation offer needs to be similarly structured to the prehabilitation in terms of the guidance and exercise classes.

> *"I would like to see a continuity of rehab on discharge … I think it would have been quite useful not only to have something formal and structured afterwards as a motivation, but also as somebody keeping an eye on, was I making the progress that I could? … It would have been good if when I was beginning to feel better and wanting to get moving, if there was the structure that there was with prehab"* (Participant 12).

The more structured rehabilitation that patients suggested could serve to both motivate patients to resume exercise and alleviate the worries of patients seeking to be active following their treatment. Also covered in EQ1, programme staff also feel that the rehabilitation side of Prehab2Rehab should be developed as a priority.

EQ7: Is the effect of Prehab2Rehab consistent across equality measures?

Due to various gaps in the data used in the outcome evaluation, we are unable to draw conclusive findings against all measures of equality for this evaluation question. Effect modification was assessed using interaction terms between treatment and prespecified subgroups in both logistic and negative binomial regression models applied to the PSM sample. For the negative binomial model assessing post-operative length of stay, a significant interaction was observed with age (interaction coefficient = –0.03, 95% CI: –0.05 to –0.01; $p = 0.05$), indicating that the treatment effect varied by age. The associated incidence rate ratio (IRR) for the interaction term was 0.97 (95% CI: 0.94–0.99), suggesting that the treatment effect on length of stay decreased with increasing age. This means that younger patients tended to benefit more from the treatment in terms of shorter hospital stays compared to older patients. No significant interactions were observed for sex or Welsh Index of Multiple Deprivation (WIMD) in this model.

In the logistic regression models evaluating the outcomes of post-operative complications and hospital readmission, there was no evidence of effect modification by age, sex, or WIMD. Interaction terms for each subgroup were not statistically significant in either model, indicating that the treatment effect was consistent across these patient characteristics.

Discussion of Findings

Staff highlighted Prehab2Rehab's reliance on individual staff, siloed working across strands, and disconnect between delivery staff and decision-makers. Previous studies have shown that successful prehabilitation services require co-operation across a multidisciplinary team (17), engagement across diverse professionals and strong leadership (18). It is also important that prehabilitation programmes are tailored to the needs of patients in order to improve their emotional and physical preparedness for treatment (19). The findings from this evaluation indicate that Prehab2Rehab is broadly feasible, acceptable and sufficiently individualised for most patients, which suggests that the programme is having success in changing patients' health behaviours prior to treatment. However, as identified through the interviews, there is a need to develop some areas of the prehabilitation offer to ensure individualisation for all patients, as well as an enhanced rehabilitation offer to support patients to sustain these lifestyle changes post-treatment.

Both the facilitators and barriers to Prehab2Rehab appear consistent with other research on prehabilitation programmes. Previous research has found that social support, knowledge of the benefits, and access to resources and time are key facilitators of prehabilitation (20), all of which were identified in this evaluation. The barriers to Prehab2Rehab are also consistent, with poor physical health, mental wellbeing, access to transport, time commitments, family/work commitments, and comorbidities all identified in this evaluation and previous research (21, 22). Developing the service to overcome these barriers and build on these facilitators will be important for Prehab2Rehab moving forward.

PSM results demonstrated that taking part in Prehab2Rehab (defined as attending three or more exercise sessions) led to a decrease in length of post-operative stay. This finding is consistent with other research, where various reviews (23) and evaluations (5) have indicated that prehabilitation has a significant impact on post-operative length of stay and reducing post-operative complications. Due to the missing data (see limitations) we carried out a complete case analysis, but the sample size was in line with other research studies in this area (24, 25).

Our qualitative data builds on this previous research, exploring how and why these impacts may come about. Patients who engaged with Prehab2Rehab reported noticeable improvements in their physical and mental health, as well as improvement in their diet, suggesting that Prehab2Rehab was effective in influencing patient lifestyle changes. Furthermore, previous research has identified that the exercise (26), nutritional (27), and wellbeing (28) elements of prehabilitation can significantly improve a patient's physical and psychological resilience prior to treatment. Programmes that encompass all of these elements have been found to reduce patient length of stay in hospital post-treatment (29) and improve their post-treatment functional capacity (30). As Prehab2Rehab includes all of these elements, the programme may be capable of having significant impacts on a range of post-operative outcomes. At present, the programme's impact on some areas is challenging to evidence due to issues with the data highlighted previously in the report. Robust, thorough and streamlined data collection processes are needed in order to evidence the extent to which Prehab2Rehab is effective

across all of its outcome measures.

Previous evidence suggests that people from minority ethnic groups, those from socio-economically disadvantaged backgrounds, and those with lower health literacy, are less likely to engage in cancer prehabilitation programmes. Additionally, these groups also tend to have worse post-operative outcomes (31). While we have been unable to draw conclusions pertinent to Prehab2Rehab across all domains of equality, our analysis did not find any significant differences in outcome measures by deprivation level or sex. While this is a promising early finding, further investigation is needed into the engagement and outcomes of Prehab2Rehab for patients across other equality measures such as ethnicity and disability status. At present, and given previous research into prehabilitation, we cannot assume that Prehab2Rehab is appropriate nor acceptable for all patients (32, 33).

Strengths and Limitations

The main strength of this evaluation is in the combination of multiple methods to answer the evaluation questions. Utilising quantitative data and statistical analysis to infer the impact of the programme, combined with interview data, this evaluation has been capable of capturing not only *what* impacts Prehab2Rehab is having, but also *how* and *why* these impacts may be being brought about. A further strength is the wide range of staff perspectives captured in the process evaluation. The process evaluation module engaged all the patient-facing staff roles within Prehab2Rehab but also had a broader scope to understand the perspectives of stakeholders from across the wider cancer pathway. This has enabled the evaluation to capture reflections on how the programme works for both staff involved in the direct delivery of Prehab2Rehab, and those whose areas of work could be impacted by the programme.

There are, some limitations to the evaluation that should be acknowledged. First, participation in the observational study introduced potential selection bias, as individuals who chose to participate may differ systematically from those who did not, particularly in terms of health status, healthcare access, or engagement with services. However previous observational studies, for example in assessing the effectiveness of Alcoholics Anonymous, have also encountered this type of bias (34) and have overcome this limitation by including relevant covariates. Second, although the final sample size was relatively small, given the MCAR assumptions, complete case analyses are least biased and are therefore the most appropriate findings to report. Third, while adjustments were made for known confounders, the observational data or registry data did not capture all relevant variables, such as lifestyle factors and sociodemographic information, raising the possibility of residual confounding. This was mainly due to data confidentiality and the data sharing agreement within the cancer registry. However, PSM can substantially reduce bias from known and observed variables. Although PSM was used to balance observed covariates between treatment and control groups, there is still a possibility of unmeasured confounding (35). Finally, the majority of patients included in the sample were undergoing colorectal surgery. This is important because this type of surgery tends to have a lower post-operative length of stay compared to Upper GI and HPB cancers (36, 37). While this is an important limitation to acknowledge, as Prehab2Rehab may have differing impacts on other types of cancer, the programme's impact on length of post-operative stay is promising.

Another limitation is the lack of demographic data pertaining to patient interviewees, meaning the evaluation has not been able to draw conclusions for Prehab2Rehab's impact across all measures of equality. There are also limitations pertinent to the patient interviews. These interviews were self-selecting in their nature which may have introduced some response bias. While we actively invited patients to interview, the burden was on the patients to come forward to participate. Therefore, perhaps only patients who felt they had a positive experience were motivated to participate, while those who had a negative experience may not have wished to discuss their reflections. Equally, the interviews were limited due to the inclusion criteria for participants based on both practical realities of the project and the inclusion criteria for Prehab2Rehab itself. Some groups, for example people whose first language was not English or Welsh, patients on a palliative care pathway and those with cognitive disabilities are therefore not represented in the interviews. These limitations suggest that caution is warranted when generalising the findings to broader populations or using them to inform policy without further validation.

Conclusion and Recommendations

Broadly, Prehab2Rehab is providing a generally positive patient experience that enables eligible cancer patients to make changes to their lifestyle in terms of exercise and diet in the build-up to treatment. The programme appears to be achieving some of the outcomes identified in the Theory of Change (6) (Appendix A). Prior to treatment/surgery, Prehab2Rehab participants have improved knowledge and confidence to be physically active and/or improve their nutrition. Post-treatment, patients have good treatment outcomes and a statistically significant reduction in their length of stay in hospital. In-turn, this may lead to improved patient flow and greater elective care capacity.

Prehab2Rehab staff feel that the programme is beneficial for patients and identified areas for potential improvement around the staffing model and provision of rehabilitation following treatment. The programme is generally acceptable to the patients interviewed, but the transferability of this finding is inconclusive. Family support, flexible working arrangements and suitable environments were seen as facilitators of prehabilitation, while patients are motivated to engage when they understand the benefits and are provided with the structure of exercise classes. Barriers to prehabilitation include a patient's physical capacity and transport needs. Patients who are able to engage in prehabilitation generally experience both physical and psychological benefits from the programme. Prehab2Rehab appears to positively influence patients' knowledge and attitude towards healthy behaviours, however a more structured rehabilitation offer could enhance patients' motivation and confidence to resume positive health behaviours following treatment. In-turn, this could result in another of Prehab2Rehab's desired impacts coming about by improving patient lifestyles and reducing new cases of cancer. Based on these findings, we provide a series of recommendations for Prehab2Rehab moving forward.

Recommendations

These recommendations are based on the collective findings of the process and outcome modules of the evaluation. They are presented in four sub-sections – *Implementation, Governance, Practice,* and *Promotion.*

<u>Implementation</u>

- Given the potential benefits to patients that have been highlighted in this report, Prehab2Rehab could be upscaled to ensure these benefits are available to all cancer patients:
    - To ensure that prehabilitation becomes part of normal practice and that Prehab2Rehab is open to all cancer patients in the region, the programme should be broadened to include all cancer sites within Cardiff and Vale UHB.
    - The findings encourage the rollout of Prehab2Rehab (and/or similar prehabilitation programmes shown to have a beneficial impact on patients) across all other Health Board regions in Wales. This will ensure equitable access to prehabilitation and its benefits,

regardless of where a patient lives.

- The evidence indicates that optimising the programme to ensure patients who engage with Prehab2Rehab participate in at least three exercise classes prior to their treatment could have the most positive effect on patients.

Governance

- Staff felt strongly that the complexity of the leadership model of Prehab2Rehab inhibits the delivery and development of the programme. To this end, the leadership model could be revisited and simplified where possible to ensure best use of clinicians' and practitioners' time.

- Furthermore, clinicians felt that they lacked the time and influence to make large-scale developments to the Prehab2Rehab service. To ensure that their clinical expertise and learning from patient-facing delivery are maximised, clinicians could be afforded protected time within their workplan to identify and make developments to the service. Equally, clinicians and practitioners should be consulted ahead of any changes to the patient-facing elements of Prehab2Rehab and the impact of any changes evaluated to ensure the benefit to patients outcomes is maintained.

- As a complex programme with multiple facets, it is perhaps unsurprising that staff feel that Prehab2Rehab is currently delivered in "siloes". To overcome this, efforts could be made to facilitate communication between the various strands of the programme to ensure joined-up working across Prehab2Rehab. This aligns with the previous recommendation where a clearer leadership model with explicit lines of accountability could encourage communication and collaboration across Prehab2Rehab's strands.

Practice

- Throughout both the staff and patient interviews, a number of areas of improvement on the offer were suggested. Key themes were:
    - Creating a dedicated psychology role within Prehab2Rehab to work alongside the exercise and diet specialists. This will ensure that the mental health support provision is in-line with these other prehabilitation elements to best prepare patients psychologically for their treatment. Equally, this may enable patients with comorbidities such as anxiety and depression to engage with other aspects of prehabilitation.
    - Collecting further patient feedback to ensure that the dietary guidance received is tailored to individuals. At present, some patients felt that the dietary guidance was generic and did not account for their needs and preferences.
    - Reviewing the ways in which guidance is communicated to patients to ensure that all patients receive an empathetic service that is tailored to their wants and needs.
    - Identifying opportunities to better support patients to exercise at home. For patients who do not attend the exercise classes, this could mean explaining the exercises to them at an earlier stage or producing videos to demonstrate the exercises.
    - Clearly articulating the importance and role of family and friends to support a patient

through prehabilitation. This was a key facilitator of engagement with prehabilitation and may encourage patients to bring family or friends to their prehabilitation appointments.

- A more structured offer of rehabilitation that more closely aligns with the prehabilitation offer could enhance the sustainability of lifestyle changes, as patients feel that they need guidance and support to resume their healthy exercise and dietary behaviours post-treatment.

- Developing and implementing more robust processes for collecting data would address the previously highlighted challenges with the quality of the data. More thorough and streamlined processes need to be put in place to capture the full picture of a patient's journey through the Prehab2Rehab programme, as well as the programme's impact on **all** of its desired outcome measures and across demographic measures of equality (such as age, sex, ethnicity, disability status etc.). While we acknowledge that wider Welsh NHS challenges may inhibit this, more complete data, with larger sample sizes, is needed to continue to capture Prehab2Rehab's impacts and ensure service developments are based on sound evidence.

Promotion

- Understanding the benefits of prehabilitation from an early stage emerged as vital to motivate patients to engage. Therefore, patient-facing staff throughout the cancer pathway and the programme should continue to clearly communicate the benefits of prehabilitation to patients' recovery and health.

- An unintended benefit of the exercise classes for many patients was the social connection with others going through similar experiences. Communicating this benefit more widely to both patients and cancer pathway staff could improve engagement with the programme.

- Taking opportunities to communicate the benefits of prehabilitation to staff across the wider cancer pathway could increase the level of engagement of these staff members with Prehab2Rehab. These staff may be engaged by benefits direct to the patient and/or the knock-on impacts on the cancer pathway and health service. Key findings from this report, as well as future reviews or evaluations of Prehab2Rehab, should therefore be disseminated as widely as possible among staff. This may increase the number of eligible patients referred to the service and in-turn increase uptake numbers.

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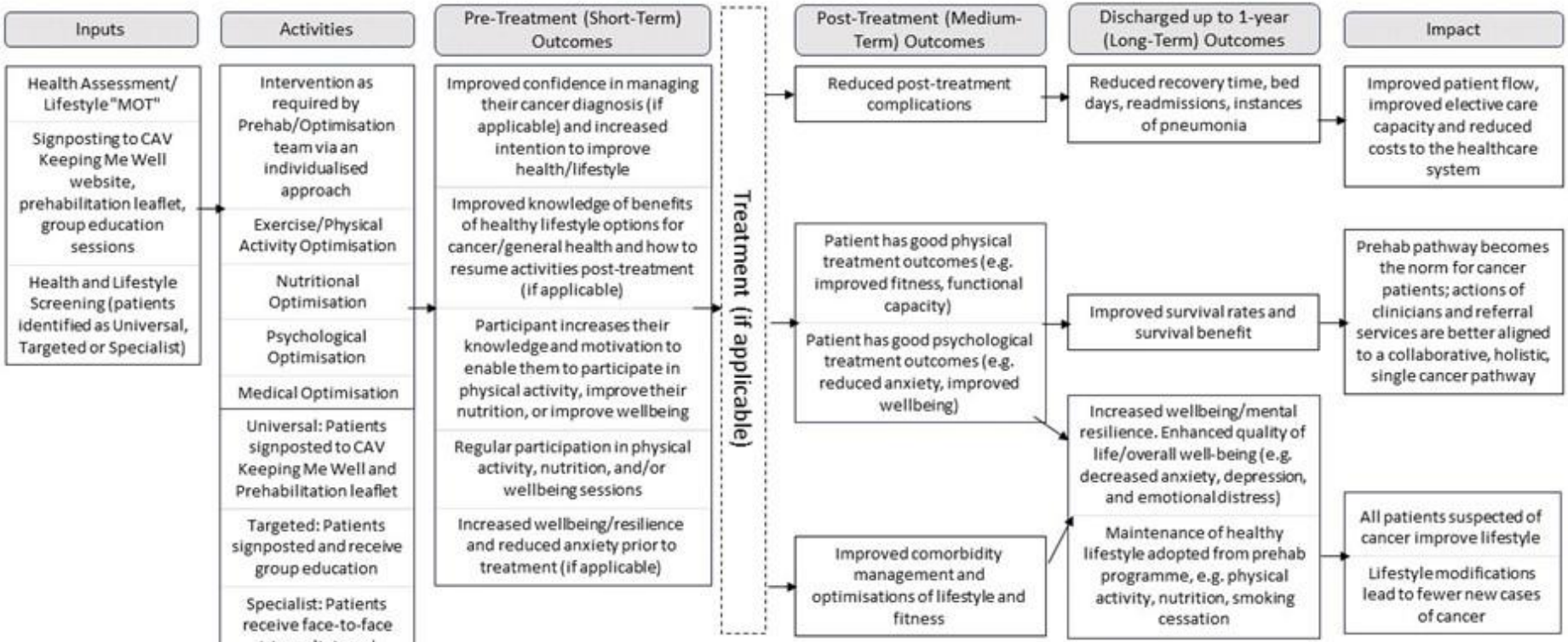
Appendices

- Appendix A: Theory of Change Diagram for Prehab2Rehab
- Appendix B: Demographic information for full sample
- Appendix C: Descriptive of full sample by attendance
- Appendix D: Data availability
- Appendix E: Sensitivity Analysis
- Appendix F: Propensity Score Matching 1:2 Nearest Neighbour Graph
- Appendix G: Descriptives of sample unmatched and after propensity score match

Appendix A: Theory of Change Diagram for Prehab2Rehab



Appendix B: Demographic Information for full sample

Demographic information for full sample (n=1907)

	Frequency % (n)
Sex	
Male	62.2 (1186)
Female	37.8 (721)
Type of Surgery	
Colorectal	50.4 (962)
Upper GI	19.6 (374)
HPB	29.9 (571)
Area	
Cardiff	58.1 (1108)
Tertiary	41.9 (799)
Complications	
Yes	12.6 (240)
No	87.4 (1667)
Death	
Yes	1.7 (32)
No	98.3 (1875)
30 Day Readmission	
Yes	8.9 (169)
No	91.1 (1738)
Age[1]	65.94 (11.26) Median = 67.00
Post Surgery Length of Stay[1]	9.95 (12.21) Median = 7.00
WIMD Quintile	N=1902
1 – Most deprived	18.7 (355)
2	15.0 (286)
3	15.5 (295)
4	16.2 (308)
5 – Least deprived	34.6 (658)
Prehab Appt (Any)	
Yes	37.9 (722)
No	62.1 (1185)
Prehab Exercise Appt (Any)	
Yes	8.9 (169)
No	91.1 (1738)
Prehab 3+ Exercise Appt	
Yes	6.8 (130)
No	93.2 (1777)
[1]Mean (SD)	

Appendix C: Descriptive of full sample by attendance (n=1907)

	3+ exercise sessions N=130	Prehab but not 3+ exercise N=592	No prehab N=1185
Age	67.62 (8.9)	66.01 (11.2)	65.72 (11.5)
Sex			
Male	65.4 (85)	63.7 (377)	61.1 (724)
Female	34.6 (45)	36.3 (215)	38.9 (461)
Type of Cancer			
Colorectal	70.8 (92)	43.4 (257)	51.7 (613)
Upper GI	8.5 (11)	22.6 (134)	19.3 (229)
HPB	20.0 (26)	33.1 (196)	28.2 (334)
Time Diagnosis to Admission (days)	191.18 (242.82)	160.09 (206.55)	96.59 (128.64)
Post Op LOS	6.39 (3.5)	10.22 (12.8)	10.21 (12.5)
ASA			
1	3.1 (4)	2.0 (12)	4.3 (51)
2	62.3 (81)	52.5 (311)	54.3 (644)
3	33.1 (43)	42.1 (249)	36.0 (427)
4	0.8 (1)	1.2 (7)	1.4 (17)
WIMD			
1	16.9 (22)	18.1 (107)	19.1 (226)
2	12.3 (16)	16.6 (98)	14.5 (172)
3	10.0 (13)	17.2 (102)	15.2 (180)
4	19.2 (25)	17.2 (102)	15.3 (181)
5	41.5 (54)	30.4 (180)	35.8 (424)
Chemotherapy			
Yes	18.5 (24)	28.2 (167)	26.3 (312)
No	42.3 (55)	25.8 (153)	23.2 (275)
Radiotherapy			
Yes	8.5 (11)	7.3 (43)	8.2 (97)
No	57.7 (75)	37.0 (219)	35.0 (415)
Mobilised Post-op Day 1			
Yes	16.2 (21)	17.4 (103)	14.0 (166)
No	23.1 (30)	25.2 (149)	14.3 (169)

Appendix D: Data Availability

Missing data occurred in both the audit data as well as the Prehab2Rehab programme data. Missing data ranged from 67% missing (e.g. mobilised post-op day 1) to 0% missing (e.g. age, sex, type of surgery). Our analysis approaches required full and complete data, so any patients with missing data were removed from the study.

Table 3. Percent of data available for each variable (n=1907)

Variable	% Available
Sex	100%
Area	100%
Age	100%
ASA Grade	97%
WIMD	99%
Type of Surgery	100%
Cancer Stage	52%
Time in Surgery	35%
Chemotherapy	52%
Radiotherapy	45%
Time from Diagnosis to Admission	36%
Post-op Length of Stay	100%
Complications	100%
30 Day Re-admission	100%
Death	100%
Re-operation	35%

ASA – American Society of Anaesthesiologists Grade (for presurgical health)
WIMD – Welsh Index of Multiple Deprivation

Appendix E: Sensitivity Analysis

Three sensitivity analyses were run to assess the impact of removing variables with high amounts of missing data to increase the sample size for the propensity score match analysis. These were run with the outcomes of post-op length of stay as well as complications. For all tests, post-op length of stay was still significantly difference (see tables below). However, for all tests, complications were no longer statistically different (p>0.05).

Test 1:

Variables included: (those over 99% available)

- Age
- Sex
- WIMD

Table. Results from propensity score matching negative binomial regression to compare days post-op length of stay

	Mean (SD) Days	Coefficient (95% CI)	P Value
<3 exercise sessions (n=260)	11.39	-	-
3 or more exercise sessions (n=130)	6.34	-0.54 (-0.71 - -0.37)	0.000

CI: confidence interval

Test 2:

Variables Included (those over 90%)

- Age
- Sex
- WIMD
- AGA grade
- Type of Surgery

Table. Results from propensity score matching negative binomial regression to compare days post-op length of stay

	Mean (SD) Days	Coefficient (95% CI)	P Value
<3 exercise sessions (n=258)	10.01	-	-
3 or more exercise sessions (n=129)	6.41	-0.39 (-0.55 - -0.24)	0.000

CI: confidence interval

Test 3 :

Variables Included: (those over 50%)

- Age
- Sex
- SIMD
- ASA grade
- Type of Surgery
- Cancer Stage
- Chemotherapy

Table. Results from propensity score matching negative binomial regression to compare days post-op length of stay

	Mean (SD) Days	Coefficient (95% CI)	P Value
<3 exercise sessions (n=150)	11.81	-	-
3 or more exercise sessions (n=75)	6.42	-0.56 (-0.79 - -0.33)	0.000

CI: confidence interval

Appendix F: Propensity Score Matching 1:2 Nearest Neighbour Graph and Table

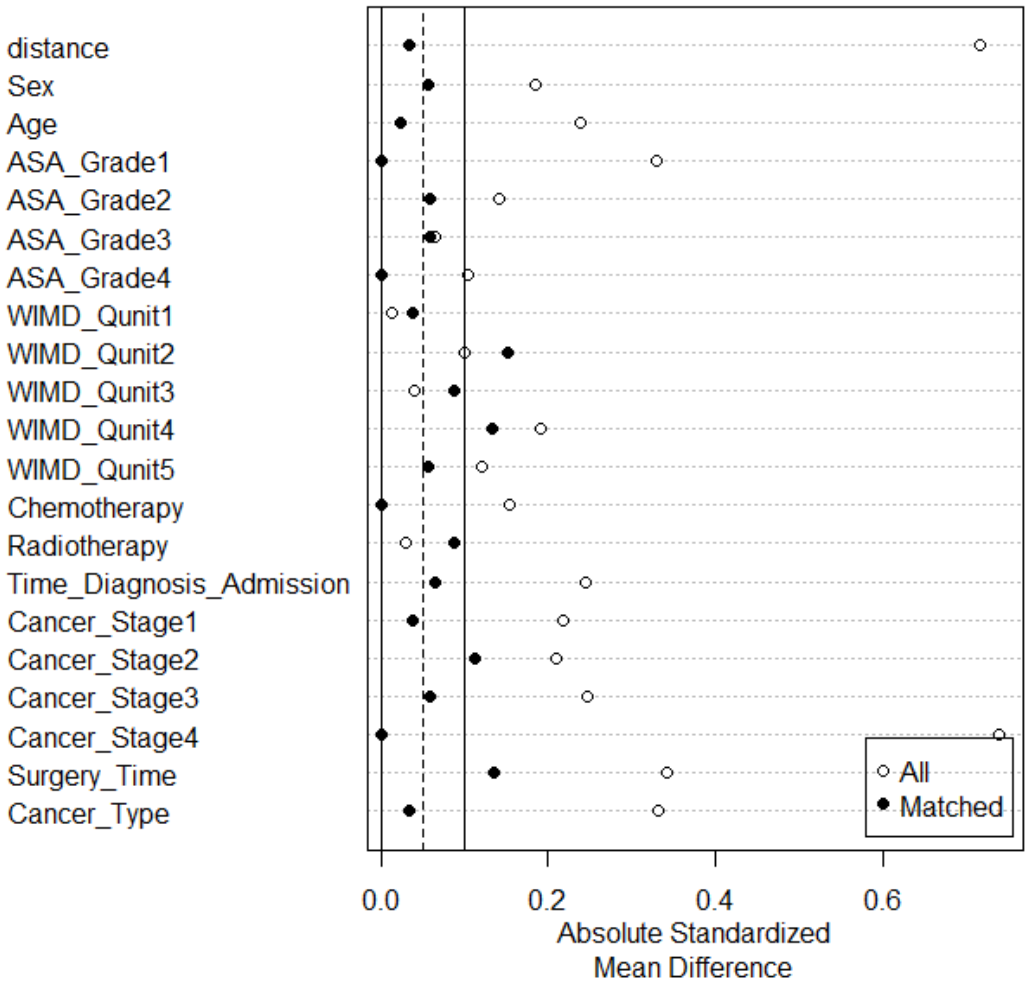


Figure 4. Covariates of the matched sample (n=106) compared with full sample (n=351)

Table 4. Means of the included covariates by the exposed and unexposed in the matched sample and the standardised mean difference between exposed and unexposed

	Means Exposed (n=36)	Means Unexposed (n=72)	Standardised Mean Difference
Distance	0.13	0.13	0.03
Sex	1.36	1.37	-0.03
Age	68.03	68.22	-0.13
ASA Grade 1	0.00	0.00	0.00
ASA Grade 2	0.63	0.67	-0.06
ASA Grade 3	0.36	0.33	0.06
ASA Grade 4	0.00	0.00	0.00
WIMD Quintile 1	0.17	0.18	-0.04
WIMD Quintile 2	0.08	0.12	-0.15
WIMD Quintile 3	0.11	0.14	-0.09
WIMD Quintile 4	0.22	0.17	0.13
WIMD Quintile 5	0.41	0.39	0.06
Chemotherapy	0.36	0.43	-0.14
Radiotherapy	0.11	0.07	0.13
Time Diagnosis to Admission	153.36	143.86	0.43
Cancer Stage 1	0.17	0.18	-0.04
Cancer Stage 2	0.17	0.13	0.11
Cancer Stage 3	0.64	0.67	-0.06
Cancer Stage 4	0.03	0.02	0.00
Time in Surgery	220.61	223.65	-0.05
Cancer Type	1.44	1.40	0.04

Appendix G.

Table 6. Descriptives of sample unmatched and after propensity score match

	Unmatched			Matched		
	Prehab Group (n=36)	Non-Prehab Group (n=315)	P-Value	Prehab Group (N=36)	Non-Prehab Group (n=72)	P-Value
Age[1]	68.03 (43-85)	65.75 (17-91)	.203	68.0 (43-85)	69.22 (34-91)	.612
Sex						
Male	63.9 (23)	54.9 (173)	.305	63.9 (23)	62.5 (45)	.888
Female	36.1 (13)	45.1 (142)		36.1 (13)	37.5 (27)	
ASA Grade						
1	0	8.9 (28)		0	<5%	
2	63.9 (23)	57.1 (180)	.402	63.9 (23)	51.4 (37)	.412
3	36.1 (13)	33.0 (104)		36.1 (13)	44.4 (32)	
4	0	1.0 (3)		0	<5%	
Cancer Type						
Colorectal	77.8 (28)	91.7 (289)	**.007**	77.8 (28)	80.6 (58)	.735
HPB	22.2 (8)	8.2 (26)		22.2 (8)	19.5 (14)	
Cancer Stage						
1	16.7 (6)	8.6 (27)		16.7 (6)	18.1 (13)	
2	16.7 (6)	24.4 (77)	.034	16.7 (6)	26.4 (19)	.724
3	63.9 (23)	52.1 (164)		63.9 (23)	44.4 (32)	
4	2.8 (1)	14.9 (47)		2.8 (1)	11.1 (8)	
Time from Diagnosis to Admission (Days)[1]	153.36 (0-937)	100.23 (0-1028)	0.161	153.36 (0-937)	143.86 (0-869)	.826
Time in Surgery (mins)[1]	220.61 (115-329)	200.48 (5-650)	.173	220.61 (115-329)	223.65 (41-650)	.851
WIMD						
1	16.7 (6)	17.1 (54)		16.7 (6)	16.7 (12)	
2	8.3 (3)	11.1 (35)		8.3 (3)	9.7 (7)	.537
3	11.1 (4)	9.8 (31)	.803	11.1 (4)	9.7 (7)	
4	22.2 (8)	14.3 (45)		22.2 (8)	11.1 (8)	
5	41.7 (15)	47.6 (150)		41.7 (15)	52.8 (38)	
Chemotherapy						
Yes	43.1 (31)	43.5 (137)	.396	43.1 (31)	36.1 (13)	.489
No	56.9 (41)	56.5 (178)		56.9 (41)	63.9 (23)	
Radiotherapy						
Yes	<10%	10.2 (32)	.858	<10%	<10%	.460
No	>90%	89.8 (283)		>90%	>90%	

[1]Mean(range)
Bold indicates statistical significance

GIG CYMRU NHS WALES

Iechyd Cyhoeddus Cymru
Public Health Wales

Gweithio gyda'n gilydd i greu Cymru iachach

Working together for a healthier Wales