Prehab4Cancer Evaluation

Greater Manchester Cancer

Prehab4Cancer Evaluation

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1. Executive Summary

Greater Manchester (GM) Health and Social Care system is the first in the UK to deliver a system-wide, multi-modal prehabilitation (prehab) and recovery programme for cancer patients. Prehab4Cancer (P4C) builds upon the already implemented Enhanced Recovery After Surgery (ERAS+)[1-3] model and is designed to improve post-operative outcomes for cancer patients across GM. It is offered to patients undergoing colorectal, lung and oesophago-gastric cancer surgery.

In May 2021, P4C were awarded recurrent funding for service delivery agreed by the accountable officers from the ten GM Clinical Commissioning Groups (CCGs), to commence from October 2021. NHS South, Central and West Commissioning Support Unit (SCW) were commissioned to undertake an independent evaluation to provide information to confirm and underpin this funding decision. The evaluation aim was to establish the impact P4C had on patient outcomes, as well as pathway and service efficiencies.

The SCW evaluation team combined existing Secondary Usage Services (SUS) data from prehab and legacy/ comparison cohorts to establish the impact of the P4C programme. This resulted in the creation of a bespoke dashboard that can be used by P4C and other similar prehab programmes for future service improvement.

The evaluation shows that P4C is benefitting patients, providers, and systems:

- Patients are optimised prior to surgery and have long-lasting health benefits following post-operative rehabilitation. This reduces demands on healthcare services throughout the cancer pathway.
- Quality of life and physical activity improvements indicate long-term behaviour change and health improvement, with patients taking control of their care.
- Improvements are seen in both ward and critical care bed day usage resulting in improved elective care capacity and effective use of resources. Additional positive impacts on 30 and 90-day readmission and emergency department admissions have been observed.

- Efficiency improvements to pathways are visible which support delivery of elective care and cancer recovery plans, and achievement of cancer performance standards.
- Evidence that supports improved survival in patients who complete prehab.

The colorectal patients who completed prehab were the largest cohort. Headline results include:

- 1.5-day reduction in hospital length of stay per prehab patient
- 0.4-day reduction in critical care length of stay per prehab patient
- 550 ward bed days ‘released’
- 146 critical care bed days ‘released’
- Bed days ‘released’ from 1000 colorectal prehab patients enable 179 additional patients to access timely surgical pathways.

Bed days 'released’ per prehab patient cover the costs involved in setting up and delivering P4C for a year and this is sustainable on a recurrent basis.

Other significant findings include a two-day reduction in length of stay for colorectal cancer patients over 70 years of age. This cohort also have fewer emergency readmissions and emergency department attendances.

Taking a value-based healthcare approach, the P4C programme provides better patient outcomes and efficient use of resources. In the current post-COVID-19 recovery period efficiencies generated assist systems to recover and address elective care backlogs. Reducing demand for critical care beds is essential if elective care recovery plans are to be achieved alongside managing ongoing COVID-19 demands.

The evaluation evidence can be utilised by commissioners making decisions about the recurrent funding for P4C. This report has relevance to GM and other emerging ICSs who are developing or considering the introduction of prehab to rehab programmes.

P4C now offer a blended model of face-to-face and virtual interventions following the COVID-19 pandemic offering more choice to patients and increasing programme adherence. Understanding local health inequalities and collecting more detailed participant demographic information would ensure equity of access to the P4C programme across GM. It would also support expansion of the programme to wider patient cohorts, realising more patient and pathway benefits.

The P4C programme has shown benefits for certain cancer surgery cohorts. It is likely that more patients could benefit from similar prehab to rehab programmes. This includes other cancer and non-cancer pathways.

Recommendations for further improvements include targeting a wider roll-out across non-cancer surgery and other cancer treatments. The SCW developed dashboard can be used to enhance the evidence base and enable capacity benefits to be maximised and patient outcomes improved for larger populations. Learning from COVID-19 should be utilised to develop virtual, face to face and blended offer, whilst ensuring equity of access.

2. Introduction

National Context

The NHS Long Term Plan (LTP)[4] set out an ambitious vision of improved care for cancer patients including personalised care, screening, early diagnosis, tackling health inequalities and maximising value. The NHS Cancer Taskforce[5] also focused on continuous improvement in patient experience and quality of life aiming for a reduction in variation.

Personalised care[6] aims to empower people living with cancer to take control of their care. The public health messages on healthy eating, physical activity, smoking, and alcohol cessation are a key part of prehabilitation (prehab) programmes, contributing to improving health and long-term behaviour change.

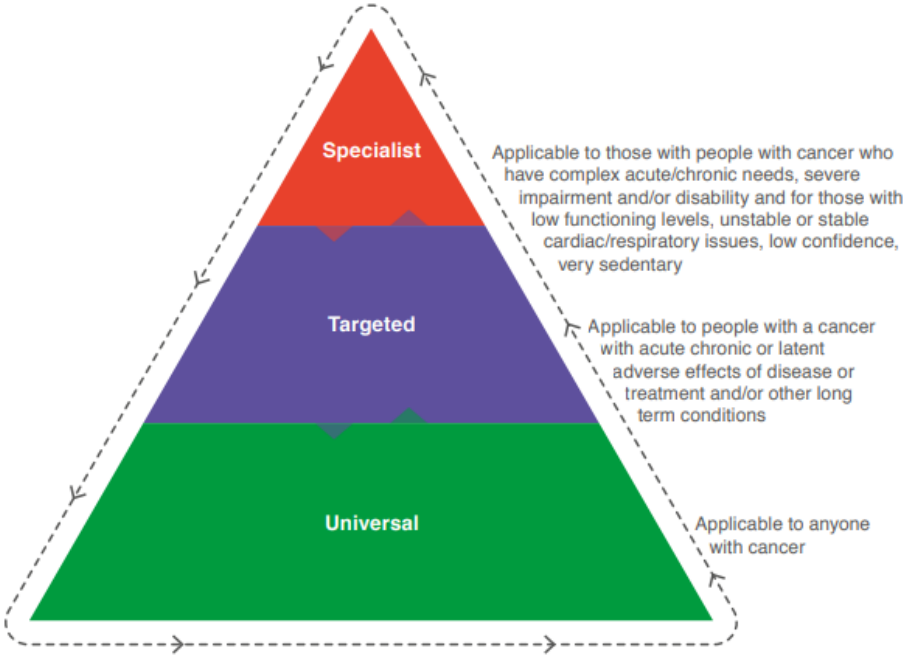
Prehab can improve cancer outcomes offering the following patient benefits:

- improved physiological function and resilience to the counteract the effects of cancer treatments
- shortens recovery time and reduces peri-operative complications
- fosters a sense of control in improving quality of life
- impacts long-term health through positive behaviour change

Prehab enables people to regain more control over their own health and has the potential to provide economic benefits to the NHS. In 2019 Macmillan and the Royal College of Anaesthetists produced the Prehabilitation Principles and Guidance report[7] which the P4C director and programme lead contributed to developing. The report endorsed a multi-modal prehab approach aiming to improve quality of life, reduce length of stay and enhance recovery, and categorised interventions into universal, targeted and specialist as seen below.

However, prehab is not yet incorporated into routine cancer care. It is hoped that evidence of its effectiveness and efficacy will be provided from robust multi-centre trials currently being undertaken both in the UK[8-9] and internationally.[10] Prehab services are becoming increasingly available to patients nationally, although this is not happening consistently. There is considerable learning that can be derived from P4C and other programmes.[11-14]

Figure 1. Prehabilitation Interventions



Local Context

Greater Manchester (GM) Cancer was the first regional system in the UK to introduce a large scale prehabilitation and rehabilitation programme as a standard of care for cancer patients. The P4C programme is a work stream of GM Cancer, which is the Cancer Alliance for GM and the cancer programme of GM Health and Social Care Partnership. It started as a two-year transformation project, launched in April 2019, aiming to provide patients with the best opportunity for excellent quality outcomes and long-term survival.

Internal evaluation of P4C has already been undertaken in the form of an interim report and ten locality reports. These reports, based on 1200 referrals, have been shared with commissioners and are available from the P4C team.

GM Prehab4Cancer Service Model

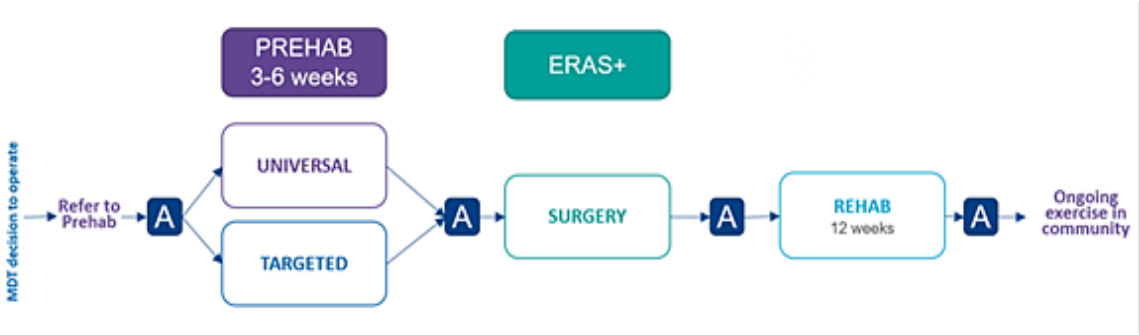
P4C is offered to newly diagnosed cancer patients who will be undergoing either colorectal, lung or oesophago-gastric surgery. Since August 2020 eligibility criteria also included any patient with lung cancer being offered curative intent oncological treatments. The programme includes prescribed

physical exercise, nutritional screening and advice, and emotional wellbeing support both before, during and after cancer treatment.

Prior to the COVID-19 pandemic, the service offered a community leisure centre-based model with Level 4 cancer rehab qualified exercise specialists managing one to two boroughs each within GM. This was in partnership with GM Active, a collective of 12 leisure and community organisations in GM. Full details about the P4C programme can be found on their website[15] and their recently published article which describes programme implementation details.[16]

The pre-COVID-19 cohort includes P4C programme delivery from 24 April 2019 involving patients who had surgery prior to 22 March 2020. Figure 2 shows the P4C timeline of interventions and assessments.

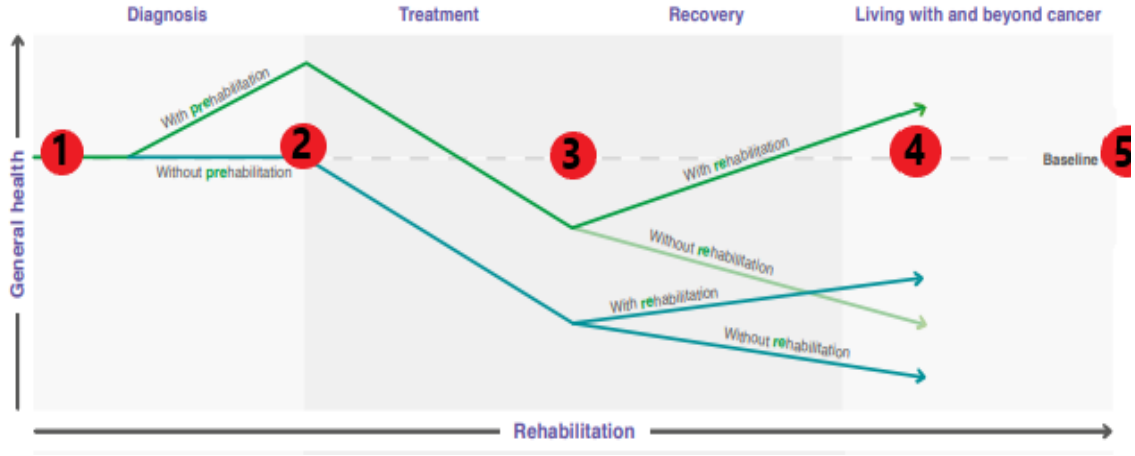
Figure 2: P4C Interventions and Assessment Points linked to the ERAS+ Pathway



All patients referred to P4C have an initial assessment as soon as possible after diagnosis. This should occur within 48 hours of patients being contacted following referral. Patients are then re-assessed using the same outcome metrics (detailed in Appendix 1) at three further time points during the programme with a final telephone assessment at one year. This is to determine long term health behaviour change benefits.

Adding the five P4C assessments below shows the expected upward or downward trend in the participant's level of general health following cancer surgery. The diagram is widely used to illustrate the benefits of prehab and rehabilitation.[17]

Figure 3: Diagram adapted from *'Silver JK. Cancer prehabilitation and its role in improving health outcomes and reducing health care costs'*



Since March 2020, the service remained open to new referrals and continued to support patients through a remote service delivery model. This included phone or video assessments, tailored home exercise packs and support with 1-2-1 sessions. 13 live classes per week were offered alongside a YouTube channel with recorded exercise videos. Patients were provided with heart rate monitors to enable safe remote monitoring, effective exercise intensity education and to increase adherence.

The remote home-based service delivery enabled greater patient choice and was preferable to some patients. P4C propose to offer an ongoing blended programme, considering the needs and preferences of patients. The aim is, where possible, for patients to be seen face to face especially for the initial assessment. The P4C team use the motto 'Best assessment, Best exercise prescription, Best outcomes for patients.' Face to face functional assessment enable the exercise specialists to prescribe and deliver an optimised exercise prescription for patients. This is especially important when there is only a short prehab duration available. Remote assessment is felt by the team to lead to a cautious exercise prescription being provided and reduced engagement in digital resources from the patients.

3. Evaluation Aims and Methodology

GM Cancer commissioned NHS South, Central and West Commissioning Support Unit (SCW) to undertake an independent evaluation of the P4C programme to support the wider GM Cancer programme evaluation. In May 2021 P4C obtained recurrent funding for service delivery from the GM CCGs Accountable Officers. The independent quantitative evaluation will be used to provide information to confirm and underpin the recurrent funding decision. The evaluation focus was multi-faceted, focussing on patient, provider, and system impacts. It included consideration of the localised context including the impact of a devolved health and social care system and emerging ICS.

The purpose of this report is to show any evidence of the impact of the P4C programme on patient, provider, and system benefits. In the wider context this evaluation aims to provide an independent evaluation of a prehab to rehabilitation (rehab) model.[18] This will help inform other systems to develop viable business cases to enable the wider integration of prehab and rehab into established clinical pathways.

This report provides recommendations for transitioning to a future sustainable service delivery model and an independent review of associated costings.

The key evaluation questions are outlined below:

What effect does the P4C programme have on health resource usage?

This was measured using the following:

- Length of Stay (LoS) after cancer surgery. This included standard ward bed days and critical care bed days
- Number of emergency readmissions in the 30 and 90-days following surgery
- Number of Emergency Department (ED) attendances in the 30 and 90-days following surgery

What effect does P4C have on patient outcomes?

The following measures were amongst those collected by the P4C team to assess patient outcomes delivered by the programme (see appendix 2 for the full list of P4C collected outcome measures).

Physiological Measures (Data partially complete due to impact of COVID-19)

- Six Minute Walk Test (6MWT)
- Rockwood Clinical Frailty Score

Patient Reported Outcome Measures

- WHODAS 2.0 (World Health Organisation's Disability Assessment Schedule) – measures functional change/Quality of Life (QoL)
- EQ-5D-5L (Euro-Quality of Life) – measures functional change/QoL
- IPAQ-SF (International Physical Activity Questionnaire- Short Form) – measures behavioural change

The P4C programme utilised validated self-assessment tools asking participants to complete the above questionnaires at the four assessment points. EQ-5D-5L, WHODAS and IPAQ were also assessed at one-year with telephone follow up.

It was predicted that these benefits would equate to lower healthcare and social costs with patients returning to their baseline levels quicker with fewer complications and on-going morbidities.

Mortality

One-year survival data was used to assess the impact of P4C on mortality.

Methodology

The P4C team had established a comprehensive dataset including physiological assessments and Patient Reported Outcome Measures (PROMS) that were reliable and validated. The GM Cancer Business Intelligence (BI) team provided the Secondary Usage Services (SUS) data for the agreed patient cohorts. The evaluation used a mixed methods approach linking the SUS data

with the clinical outcome and P4C patient dataset. The method used to link these data sets was enabled through existing data sharing agreements in place within the emerging GM ICS and the existing GM CCGs. SCW received data relating to patients admitted for colorectal, lung and oesophago-gastric (OG) surgical procedures between 13 December 2018 and 11 May 2021.

Each patient was assigned to a range of 'cohorts' as follows:

- **Prehab and Non-Prehab cohorts** Non-prehab patients included those in the post-2019 cohort. This was to capture those not referred to prehab, not eligible or not wanting to engage with the programme
- **Pre- and Post-COVID-19 cohorts** Whether the surgical procedure took place before or after 22 March 2020
- **Prehab Completed / Not Completed**
- **Procedure Risk** High, Moderate, Low
- **Clinical Commissioning Group (CCG)**
- **Secondary Care Provider where surgery was performed**
- **Listed procedures versus All procedures** (Detailed in Appendix 3)
- **Gender**
- **Ethnicity**
- **Age Range**

SCW developed a bespoke dashboard which enabled analysis of subgroups using combinations of any of the above. Detailed analysis of all the subgroups is not possible within the report, therefore only significant findings have been reported on. To enable meaningful comparison of the prehab and non-prehab cohorts SCW calculated mean LoS with 95% upper and lower confidence limits. This identified where there is a significant difference between prehab and non-prehab LoS.

Cohort Selection

To evaluate the impact of the prehab element of the programme on secondary healthcare usage and patient outcome (physiological and PROMS) the "completed prehab" cohort was selected. This was defined as those patients

who had completed assessments one and two and undertook prehab prior to surgery. The evaluation considered that combining the pre-COVID-19 and post-COVID-19 data for patient outcomes reflected the new blended model for P4C programme delivery. This resulted in larger patient cohort numbers, giving greater validity to the results. In reality there are more patients who completed assessment one and part or all of the prehab element of the programme, however for the purposes of standardising the evaluation these patients have not been included.

To enable an understanding of the effects of prehab to rehab, PROMS were reviewed for assessments one to four. An evaluation of the longer-term impact of the programme on patient outcomes was completed by reviewing patient outcome data from assessments one to five, including the one-year follow-up data.

Finance Methodology

Evaluation of this programme centres on the value based healthcare approach, including patient outcomes and the impact on resources. Average cost was derived from the National Cost Collection Index 2019/20.[19] This does not account for the uplift to 2020/21 prices. A proxy measure of bed-day cost was calculated as an average of the excess bed day tariff for colorectal procedures (£342). The critical care CCU02 tariff for surgical patients (£1,214) was used for assessing impact on critical care. To consider impact of emergency readmission, a one-day excess bed day tariff was used (£342).

It must be noted that this does not realise actual cash releasing ‘cost savings’ but reflects impact on provider costs in terms of bed days, and capacity. If it shows a positive outcome, resources can be redirected and a net efficiency saving for the system can be demonstrated. Any resultant pathway and patient flow efficiencies can assist with elective care and cancer COVID-19 recovery plans[20] and cancer waiting times.[21]

4. Results

This section provides results for secondary healthcare usage and patient outcomes. The testimony below provides an insight how P4C has impacted patients.

Figure 4: Patient Feedback

"I have found the Prehab program fantastic. Since starting with my exercises, I have found that my energy levels and fitness levels have improved immensely. My flexibility has also improved, and I am able to do so much more.

Before starting the exercises, I was beginning to avoid going out as my confidence had dropped and walking up hills was very challenging and I avoided them when I did go out, but now having done the exercises and taking part in the classes has given me the confidence to go out walking more and instead of avoiding the hills I look for them.

Since moving from Scotland to be near to my sons I have not been able to give them a hug as I have had to shield but doing the online classes has made shielding easier and has made me feel like I have an extended family. The classes are so welcoming, and the instructors are very good at what they do. Me and my husband look forward to the classes and we now plan our lives around them."

SCW received data for 1534 patients referred to the P4C programme. The numbers in each cancer surgery group and the age ranges are shown below.

Figure 5: Patient Numbers per Cancer Surgery Cohort

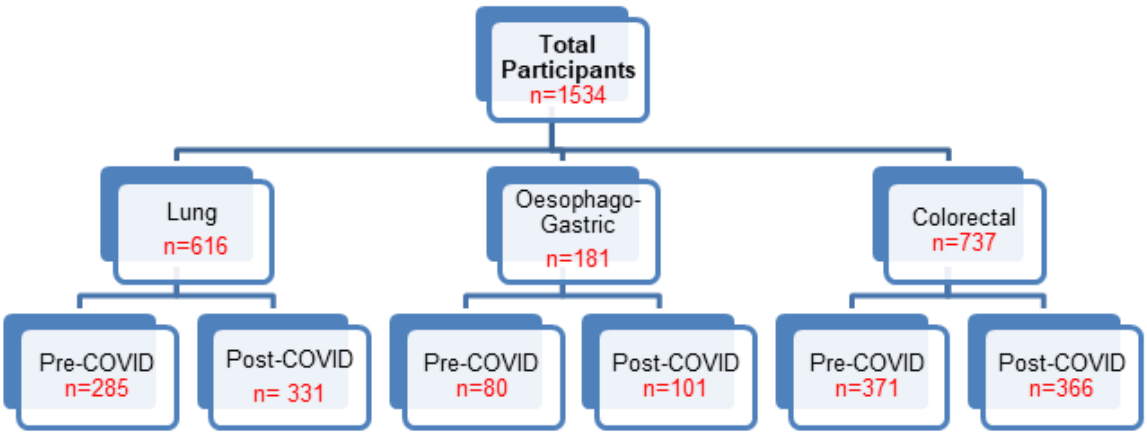


Table 1: Patient Age Range Breakdown

Age	Total		Pre-COVID-19		Post COVID-19	
Under 40	21	1%	11	1%	10	1%
40-49	59	4%	31	4%	28	4%
50-59	225	15%	101	14%	124	16%
60-69	497	32%	233	32%	264	33%
70-79	579	38%	280	38%	299	37%
80-89	151	10%	79	11%	72	9%
90+	2	<1%	1	<1%	1	<1%
Total	1534		736		798	

Male patients accounted for 57% of participants, there were two transgender patients and two with unknown gender.

Ethnicity: The data provided on ethnicity shows that 35% were categorised as British, however 63% of participants withheld this information. It is therefore difficult to evaluate whether there was equity of access for all ethnic groups due to the high percentage of non-disclosure.

Inequalities Impact: The P4C programme was available to all GM residents regardless of age, ethnicity, gender, and other protected characteristics. Recording of ethnicity and other protected characteristics was not robust enough to enable analysis and discussion in this paper. The P4C team had previously completed an Equality Impact Assessment.

Programme Adherence

From the P4C data of 1534 patients 73% completed both the prehab and rehab elements of the programme. There is a difference in adherence between the pre- and post-COVID-19 groups with 60% completing pre-COVID-19, compared with 84% post-COVID-19. The overall P4C adherence compares favourably

with reported national pulmonary rehabilitation adherence rates[22] of approximately 70%. Formally reported reasons for leaving the P4C programme can be seen below. Anecdotally it has been reported that many patients felt they did not need to continue with the rehab element due to the improvements they made from prehab.

Table 2: Reasons for Leaving P4C Programme

Reason for leaving P4C	Total		Pre COVID-19		Post COVID-19	
Other	215	14%	155	21%	60	8%
Not wanting to continue	113	7%	71	10%	42	5%
Medical	47	3%	40	5%	7	1%
Deceased	37	2%	20	3%	17	2%
COVID-19	7	<1%	5	1%	2	<1%
Moved Away	1	<1%	0	0	1	<1%
Mis-referred	1	<1%	1	<1%	0	0

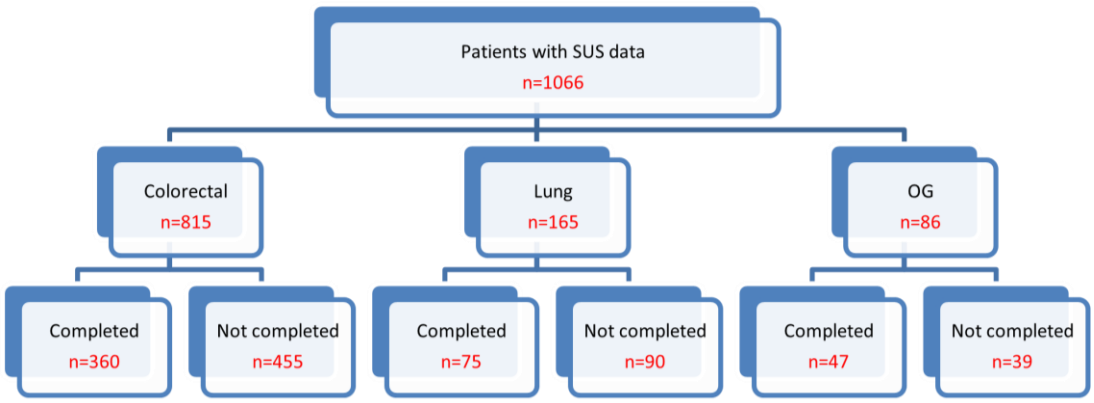
Participant feedback would be useful to understand detailed reasons for non-completion. This would help identify who benefits from face-to-face programme delivery and who is more suited to virtual delivery. The current delivery model is a blended approach of face-to-face and virtual and this information would assist future programme planning and staffing. It is also important to consider barriers to delivery such as digital exclusion or shielding of immunocompromised participants, which may affect participant adherence.

It is understood that the P4C service does record participant feedback. This information was unable to be shared with SCW due to Information Governance restrictions. Furthermore, the GM Cancer P4C project had previously commissioned an acceptability study completed by the University of Manchester. This included semi-structure telephone interviews with engagers and non-engagers in the service. Findings when available will offer greater insights into non-completion.

a) Secondary Healthcare Usage

SUS data was matched for 1329 of the P4C patients. Data was used for 1066 patients with procedures on the agreed surgical list. This was to ensure the prehab and non-prehab cohorts had comparable procedures with similar resultant LoS. There were 482 of the 1066 patients who completed assessments one and two, which were defined as the “completed prehab” cohort. However, some of the “not completed” cohort were identified as patients who completed the prehab sessions but were unable to complete the second assessment due to earlier than anticipated surgery.

Figure 6: Number of Patients who “Completed Prehab” in each Cohort



The table below details the number of patients who completed two, four and five assessments.

Table 3: Number of Patients who completed PROMS in each Cohort

Assessments completed	Metric	Cancer type			
		Overall	OG	Lung	Colorectal
		Total Number of people			
At least 1	N/A	1534	181	616	737
1 and 2	WHODAS	672	87	273	312
1 and 2	EQ5D	672	87	273	312

1 and 2	IPAQ	672	87	273	312
1 and 2	Frailty	672	87	273	312
1 and 2	6MWT*	170	28	50	92
1 - 4	WHODAS	286	31	115	140
1 - 4	EQ5D	286	31	115	140
1 - 4	IPAQ	286	31	115	140
1 - 4	Frailty	284	31	113	140
1 - 4	6MWT*	29	4	8	17
All 5	WHODAS	106	12	50	44
All 5	EQ5D	106	12	50	44
All 5	IPAQ	106	12	50	44

* Patients complete either a 6MWT or ISWT at assessment two and four. This accounts for the lower numbers of completed 6MWT seen above.

The tables and graphs below were created as outputs from the evaluation dashboard. Green shading indicates any reduction in secondary healthcare usage and red any increase. The GM P4C team have access to the dashboard to enable future local audit and service improvements.

Table 4: All Patients who have "Completed Prehab" (Completed Assessment One and Two prior to Surgery)

Cohort	Number of patients in cohort		Mean total length of stay (days)			Mean Critical care length of stay		Bed-days released	CC Bed-days released	Bed-days released per Prehab patient	CC Bed-days released per Prehab Patient
	In Prehab	Not in Prehab	In Prehab	Not in Prehab	Significance (95% confidence)	In Prehab	Not in Prehab				
Colorectal	360	856	8.4	10.0	Prehab significant	1.4	1.8	550.1	146.6	1.5	0.4
Lung	75	209	5.8	6.2	Prehab significant	1.1	1.3	29.0	19.4	0.4	0.3
OG	47	110	14.7	14.9		5.0	3.5	7.6	-71.6	0.2	-1.5
TOTAL	**482**	**1175**						**586.7**	**94.4**	**0.5**	**0.08**

LoS is lower in all cancer groups, and significantly lower in colorectal and lung cohorts. Colorectal patients make up 75% of the "completed prehab" cohort therefore this data was utilised for the evaluation of healthcare resource usage.

Colorectal: Mean LoS was 8.4-days in the prehab cohort compared to 10.0-days in the non-prehab cohort (significant). There are 1.5 bed days and 0.4 critical care bed days released per prehab patient. This results in a total of 550 hospital bed days and 146 critical care bed days 'released'.

Lung: The lung cohort was smaller with only 75 patients in the prehab cohort. Mean LoS was 5.8-days (prehab) compared to 6.2-days (non-prehab) which was a significant finding. This results in 29 hospital bed days and 19 critical care bed days 'released'.

OG: The OG cohort was the smallest with only 47 patients in the prehab cohort. There is a small decrease in mean hospital bed days and an increase in critical care LoS in the prehab cohort. This results in 7.6 bed days 'released' but 72 more critical care bed days required.

Table 5: Emergency Readmissions for Patients who "Completed Prehab"

Cohort	Emergency Readmissions within 30 days		Emergency Readmissions within 30 days per Patient		30-Day Readmissions 'released'	Emergency Readmissions within 90 days		Emergency Readmissions within 90 days per Patient		90-Day Readmissions 'released'
	In Prehab	Not in Prehab	In Prehab	Not in Prehab		In Prehab	Not in Prehab	In Prehab	Not in Prehab	
Colorectal	47	112	0.13	0.13	0.10	71	239	0.2	0.3	29.5
Lung	11	35	0.15	0.17	1.56	16	55	0.2	0.3	3.7
OG	5	20	0.11	0.18	3.55	19	49	0.4	0.4	1.9
TOTAL	**63**	**167**	**0.13**	**0.14**	**5.21**	**106**	**343**	**0.22**	**0.29**	**35.19**

The 30-day emergency re-admissions for both colorectal, lung and OG prehab cohorts are less than half those in the non-prehab cohort, with lower rates seen per patient in the lung and OG prehab cohorts. There are larger reductions in 90-day emergency readmissions for the prehab cohort ‘saving’ 35 readmissions overall.

Table 6: ED Attendances for Patients who “Completed Prehab”

Cohort	Emergency Department Attendances within 30-days of Surgery		Emergency Department Attendances within 30-days per Patient		Emergency Department Attendances within 30-Days 'released'	Emergency Department Attendances within 90-days of Surgery		Emergency Department Attendances within 90-days of Surgery per Patient		Emergency Department Attendances within 90-Days 'released'
	In Prehab	Not in Prehab	In Prehab	Not in Prehab		In Prehab	Not in Prehab	In Prehab	Not in Prehab	
Colorectal	69	148	0.19	0.17	-0.88	102	303	0.3	0.4	3.3
Lung	17	59	0.23	0.28	0.61	32	103	0.4	0.5	0.7
OG	6	25	0.13	0.23	0.50	17	55	0.4	0.5	0.7
TOTAL	**92**	**232**	**0.19**	**0.20**	**0.23**	**151**	**461**	**0.31**	**0.39**	**4.74**

Both 30 and 90-day ED attendances show reductions of more than half for all cancer groups in the completed prehab cohort. The 30-day ED attendances per colorectal prehab patient are very slightly higher compared to the non-prehab cohort. However, the completed prehab cohort overall is seen to ‘release’ five ED attendances at 90-days.

Effect of Prehab on the Older Patient

On review of the cohorts a stand-out group were patients over 70 years old in the pre-COVID programme. Those patients that had “completed prehab” showed a significantly lower length of stay, indicating that prehab might be having an enhanced effect on patients over 70.

Table 7: Pre-COVID-19 Colorectal Prehab Patients aged over 70

Number of Patients in Cohort		Mean Total Length of Stay (days)			Mean Critical care Length of Stay (days)		Bed-days released	CC Bed-days released	Bed-days released per Prehab Patient	CC Bed-days released per Prehab Patient
In Prehab	Not in Prehab	In Prehab	Not in Prehab	Significance (95% confidence)	In Prehab	Not in Prehab				
196	267	10.5	12.5	Prehab significant	2.5	2.8	380.8	56.8	1.9	0.3

Mean total length of stay is two days shorter in the prehab cohort which equates to an overall ‘release’ of 381 bed days. The prehab cohort also shows fewer critical care bed days used with 57 bed days ‘released’.

ED attendances within 30 and 90-days are lower in the prehab cohort equating to 1.7 and 5.0 fewer ED attendances respectively. The overall number of 30 and 90-day emergency readmissions was lower in the prehab cohort, with a 90-day readmission ‘release’ of nine in total.

Financial Summary

The annual cost of the P4C programme across all ten GM localities is £584,532. This is to deliver the programme to approximately 1000 patients and includes non-recurring set up costs. In addition to the staff delivering the programme, one WTE Band 7 (Agenda for Change) healthcare professional will provide clinical input to the team, liaison with NHS clinical referring teams, ongoing programme leadership and some elements of delivery (i.e., exercise physiology, complex cases etc.).

The cost per participant is estimated to be approximately £400. Data from the "completed prehab" cohort was used to identify cost efficiency in terms of bed days saved for 1000 colorectal patients.

Table 8: Financial Impact of P4C (Colorectal Cohort)

	Number per Prehab Patient	Value	TOTAL (Based on 1000 participants)
Bed Days released	1.5	£342 per day*	£513,000
Critical Care Bed Days released	0.4	£1214 per day*	£485,000
ED Attendances prevented	0.39	£375 per attendance*	£146,250
Emergency Readmissions prevented	0.29	£342 per admission*	£99,180
Estimated Financial Benefit			**£1,244,030**
P4C Programme Delivery Cost	-	£400 per participant	£400,000
Balance			**£844,030**

*Taken from National Cost Collection Index 2019/20.[19]

The total estimated financial benefit based on bed day savings for 1000 colorectal patients covers the overall cost of P4C delivery. Using the P4C

estimate of £400 per participant, estimated provider efficiencies per patient are £1,244 and this enables the programme to be delivered to a further 2,110 patients, equating to 3110 patients in total.

Lower demands for GP consultations, psychological support services, and reduced requirement for other community services are other pathway efficiencies achieved throughout the programme but unable to be quantified.

Secondary Healthcare Usage Summary

These findings show improved patient outcomes with fewer post-operative complications and quicker recovery. Secondary Care providers benefit from increased surgical and critical care capacity and improved patient flow.

The release of critical care beds helps provide sufficient capacity to undertake complex cancer surgery whilst also supporting critically ill COVID-19 patients. COVID-19 continues to place large demands upon the critical care provision in GM.

The dashboard created by SCW enables further local analysis to be carried out by the P4C team to identify providers, CCGs, and other cohorts with significantly lower LoS to use as exemplars locally and disseminate good practice and lessons learnt. The dashboard will be a working document to enable audit into all areas of the programme to develop the service, adopting a continuous quality improvement methodology, ensuring equity of access and best use of resources.

b) Patient Outcomes

The following section provides analysis of patient outcome data. The case study below provides a patient testimony about the P4C programme.

Figure 7: Patient Case Study

Patient A was referred in June 2019, he was 75, diagnosed with a tumour and was scheduled for a colon resection in August 2019. Patient A was generally well and active but had hypertension and Barrett's oesophagus. He had fusion of his right ankle for rheumatism leaving him with reduced mobility. His weight, at 106.2kg gives a BMI of 31.9 (obese). With his current activity levels, motivated attitude, and good general wellbeing Patient A was categorised as suitable for the universal pathway.

Patient A hadn't used a gym before but was well motivated to take on the challenge and keen to improve his strength, balance, and cardio fitness. He was happy that as his surgery was 8 weeks away, he had the time to 'get stuck in'. Exercising independently on the universal pathway, Patient A completed 10 sessions before his surgery. At his pre op assessment his 6MWT result improved by 43.5m showing improvements with aerobic capacity, mobility and balance. Unfortunately, Patient A had to have a second surgery 2 days as the first wasn't entirely successful. Following the second surgery, Patient A recovered well.

"I found prehab really beneficial. Personally, without the fitness programme I don't think I would have made it. Two major operations in 3 days tested my fitness" **(Patient A feedback)**

World Health Organisation Disability Assessment Schedule (WHODAS 2.0)

WHODAS is a self-administered questionnaire which assesses difficulties related to health conditions that impact on a participant's ability to undertake daily activities. A lower overall score on the WHODAS indicates greater function

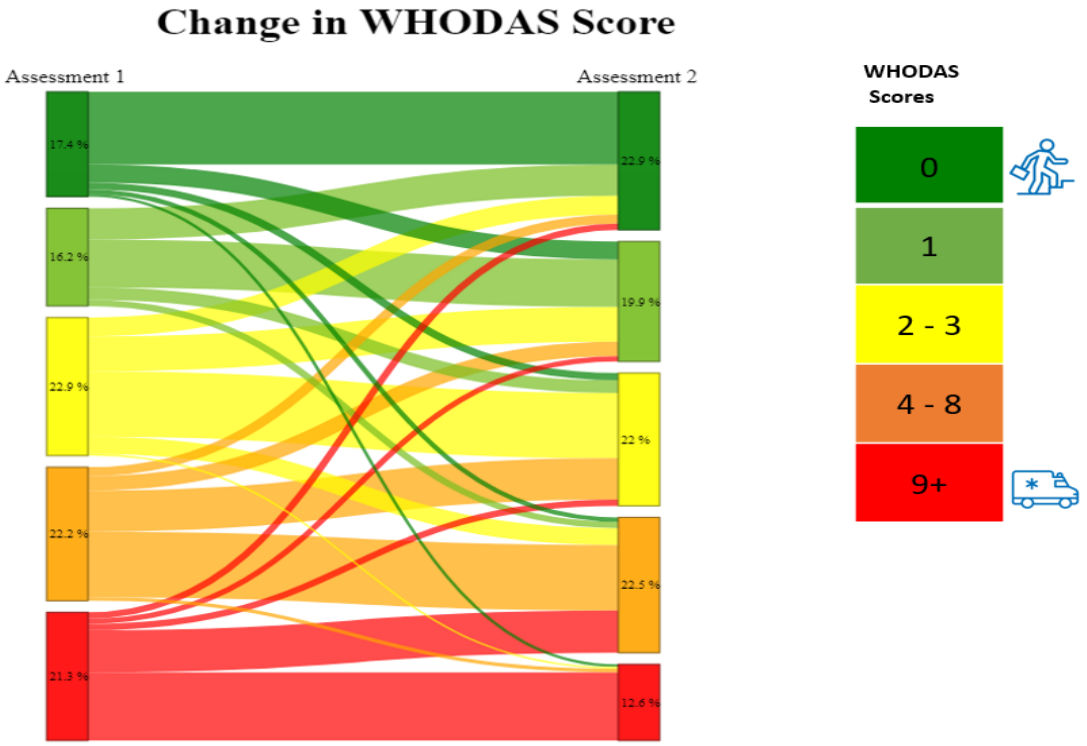
and lower disability. Sankey diagrams, which are a type of flow diagram, were produced to visually show the score changes throughout the programme. The coloured bars at each assessment point show the percentage of participants with each WHODAS score, with a larger bar indicating a higher total of scores at that assessment. The best/lowest WHODAS scores are indicated by the green bar, so it is possible to see the percentage of patients whose scores improved.

Completed Prehab

Table 9: WHODAS Scores for 672 Patients who "Completed Prehab"

Assessment	Mean score	Variation in score (Standard Deviation)
1: Initial P4C Referral	5.17	6.33
2: Pre-op	3.79	5.13

Figure 8: WHODAS Scores for Patients who "Completed Prehab"



The flow of results shows improved WHODAS scores after prehab compared to baseline. The change in scores between assessment one and two is significant at 95% confidence. There are 34% of patients who score 0-1 (green flow) on assessment one, increasing to 43% after completing prehab. The group with the lowest functional ability (red flow) make up 21% of the total at assessment one and reduce to 13% at assessment two.

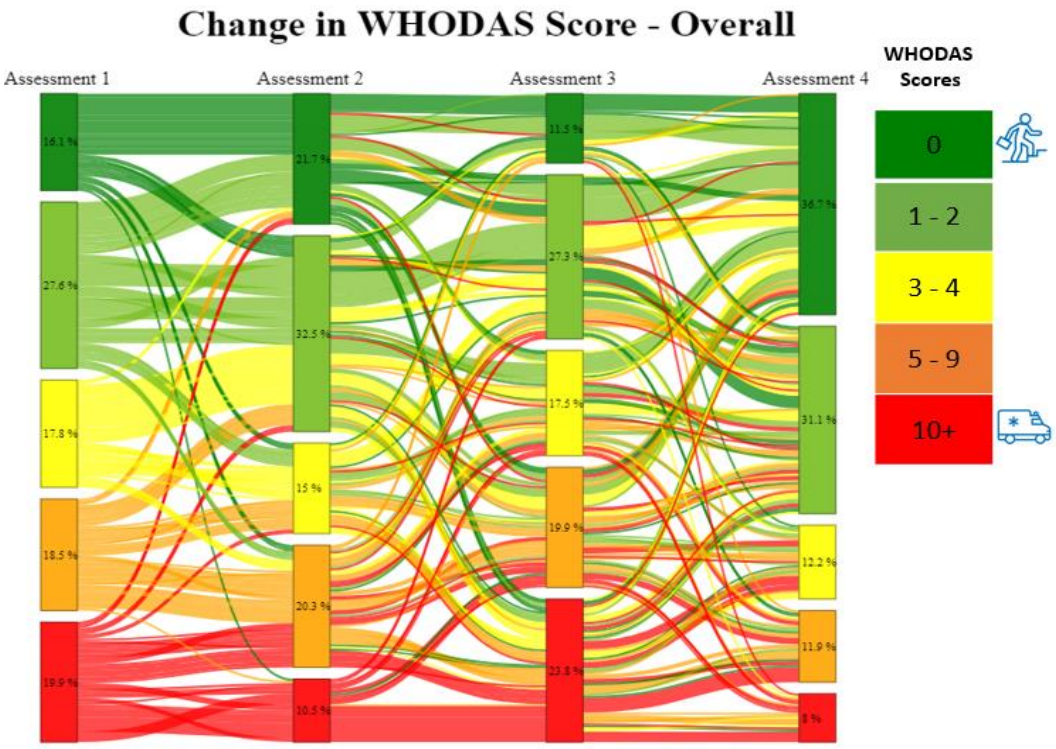
Completed Prehab and Rehab

Table 10: WHODAS Scores for 286 Patients completing Prehab and Rehab

Assessment	Mean score	Variation in score (Standard Deviation)
1: Initial P4C Referral	5.44	6.59
2: Pre-op	3.92	5.09
3: Post-op	5.98	6.33
4: Completion of Rehab	2.87	4.65

There is a significant change in scores between assessment one and four. Functional ability reduces, as expected post-operatively, then shows a further significant improvement after rehab.

Figure 9: WHODAS Scores for Patients completing Prehab and Rehab



There are 44% of patients who score 0-2 (green flow) on assessment one, increasing to 68% at programme completion. The group with the lowest functional ability (red flow) make up 20% of the total at assessment one and reduce to 8% at assessment four. This provides compelling evidence of the need for both prehab and rehab to enable patients to return to baseline or improve their functional ability.

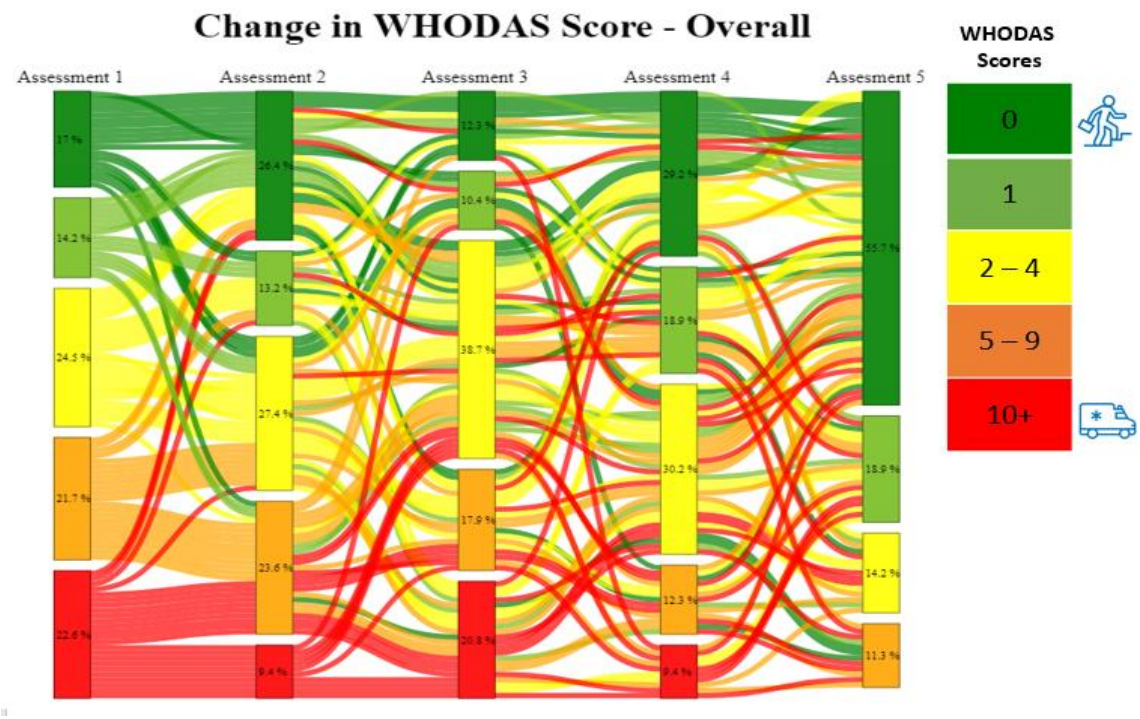
Longer-Term WHODAS Outcomes

106 patients completed all five assessment points with a significant change in mean score. Green scores increased from 31% to 75% and a dramatic change is seen in the group with the lowest functional ability with 22% of patients with a score above ten at assessment one to assessment five where there are none.

Table 11: WHODAS One-Year Follow-Up

Assessment	Mean score	Variation in score (Standard Deviation)
1: Initial P4C Referral	5.91	7.13
2: Pre-op	3.79	4.88
3: Post-op	5.24	5.50
4: Completion of rehab	3.21	5.26
5: 1-year follow-up	1.32	2.17

Figure 10: WHODAS One-Year Follow-Up



Rockwood Clinical Frailty Scale

The Rockwood Clinical Frailty scale is widely used to assess frailty. Frailty is described as a state of increased vulnerability resulting from a decline in physiological reserve and function across multiple organ systems, and inability to withstand stressors such as surgery.[23] If a prehab intervention can be shown

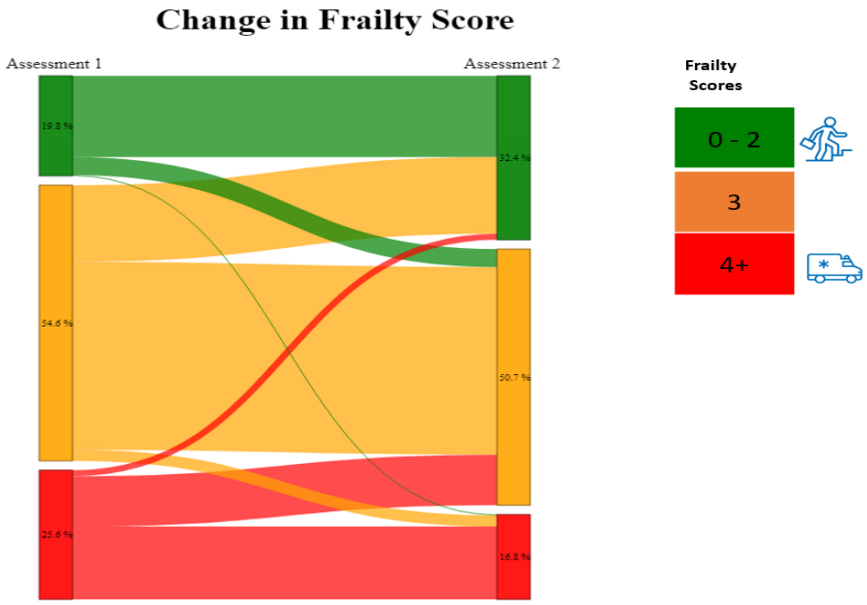
to reduce frailty, then this can provide morbidity, mortality and quality of life benefits and contribute to reduced LoS and other secondary healthcare usage. A lower frailty score indicates a better level of functioning.

Completed Prehab

Table 12: Frailty Scores for Patients who "Completed Prehab"

Assessment	Mean score	Variation in score (Standard Deviation)
1: Initial P4C Referral	3.07	0.82
2: Pre-op	2.81	0.85

Figure 11: Frailty Scores for 672 Patients who "Completed Prehab"



The results show that patients have reduced frailty scores following completion of prehab.

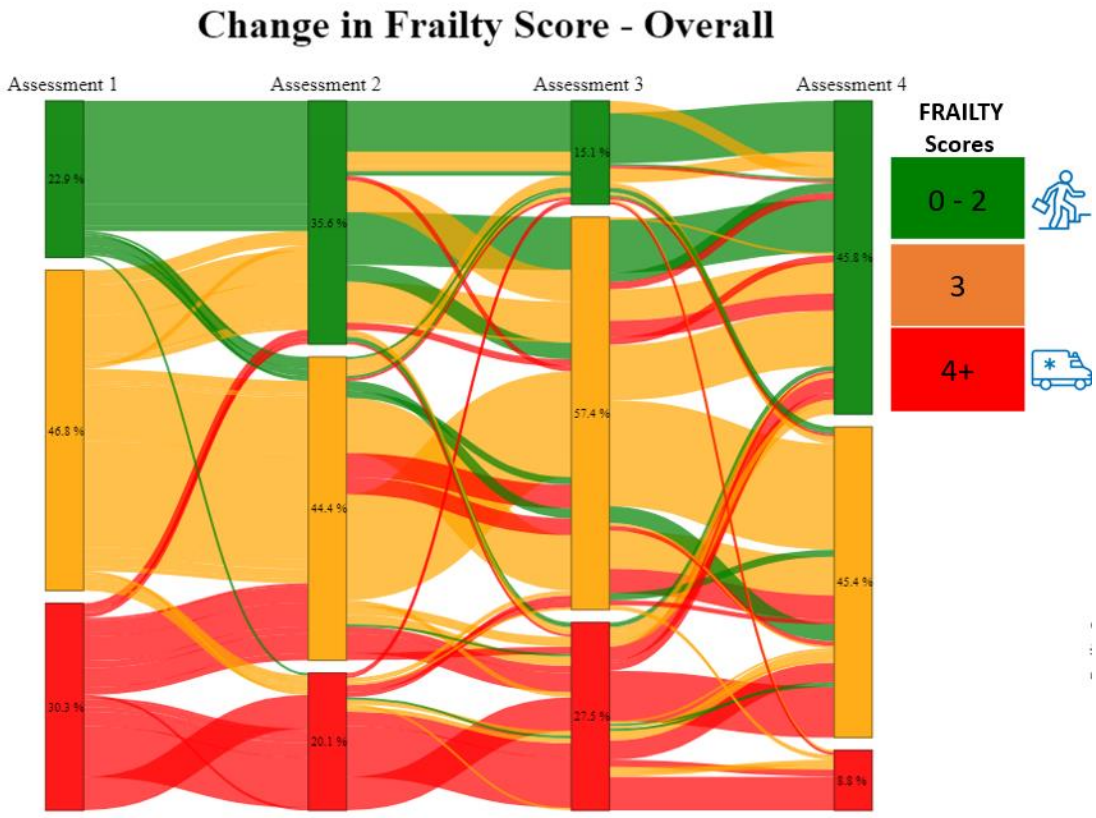
Completed Prehab and Rehab

There were 284 patients who undertook all four assessments points and results show a significant improvement in frailty scores.

Table 13: Frailty Scores for Patients who completed Prehab and Rehab

Assessment	Mean score	Variation in score (Standard Deviation)
1: Initial P4C Referral	3.10	0.93
2: Pre-op	2.76	0.94
3: Post-op	3.17	0.80
4: Completion of rehab	2.56	0.88

Figure 12: Frailty Scores for Patients who completed Prehab and Rehab



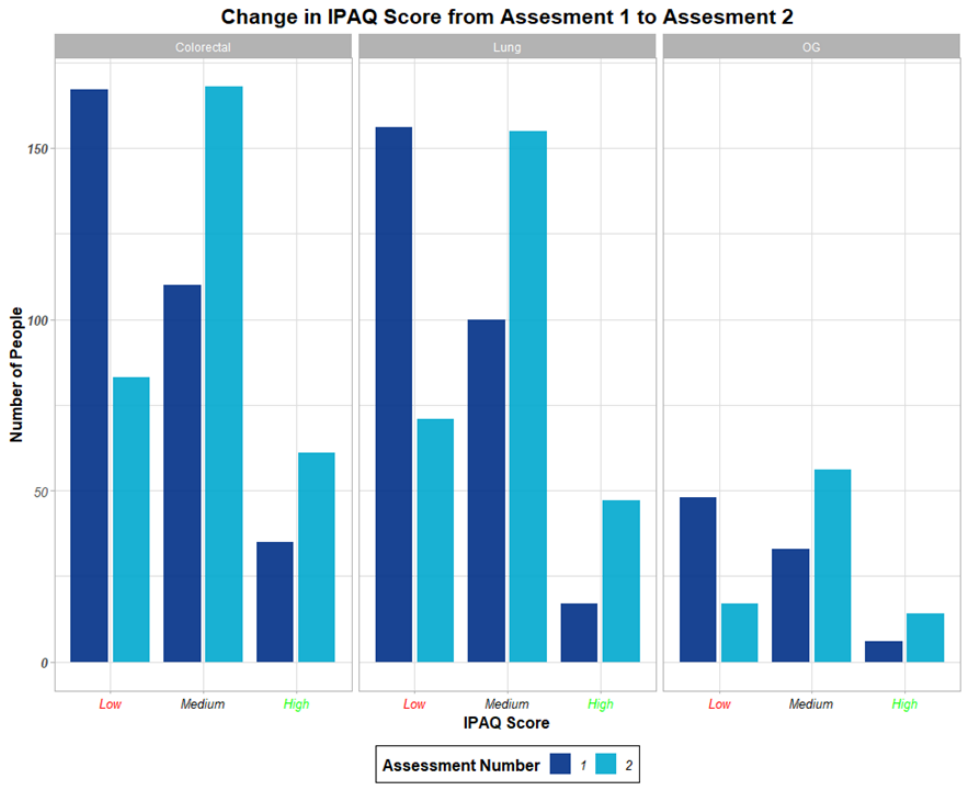
International Physical Activity Questionnaire- Short Form (IPAQ-SF)

IPAQ is an instrument designed primarily for population surveillance of adults to obtain comparable estimates of physical activity. The short version, used in the P4C programme is suitable for national and regional surveillance. Items are structured to provide separate scores on walking, moderate and vigorous intensity activity as well as a combined total score to describe overall level of activity. Scores are categorised as follows: Low =1, Moderate =2 and High =3.

Completed Prehab

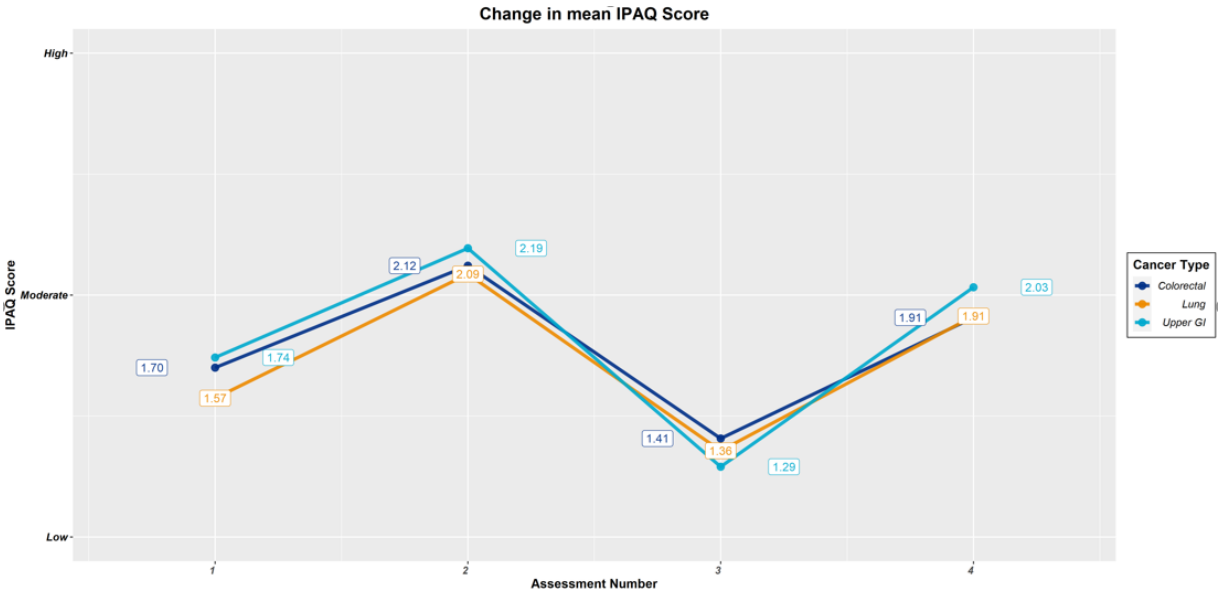
IPAQ scores improved in all cancer groups, and there was a significant change in the lung and colorectal cohorts. The OG cohort followed the same pattern but the results were not significant. This suggests that during the prehab phase patients are taking control and adopting a more active lifestyle.

Figure 13: IPAQ Scores for Patients who "Completed Prehab"



Completed Prehab and Rehab

Figure 14: IPAQ Scores for Patients who completed Prehab and Rehab



IPAQ scores mirror the same pattern of improvement seen in the other patient outcome measures with significant change in colorectal, lung and OG scores. Only 106 patients completed the IPAQ at all five assessment points, therefore the longer-term physical activity impact cannot be reliably analysed.

Euro Quality of Life - EQ-5D-5L

EQ-5D is the most widely used generic PROM measuring health outcomes across a range of disease areas. It is a descriptive system of health-related quality of life states consisting of five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Improvements in EQ5D scores reflect quality of life in terms of both physical and psychological recovery and indicate a positive impact on participants ability to return to usual activities including work. Poor quality of life has been shown to be associated with both early retirement and other non-employment after cancer.[25] EQ-5D health is deemed to be 'better' if it is improved in at least one dimension and is no worse in any other dimension, and vice versa for a 'worse' health state.

Completed Prehab

Results for patients who completed prehab showed a significantly 'better' health state in four of the five domains suggesting that P4C was effective in improving quality of life for patients who completed prehab.

Table 14: EQ5D scores for 672 Patients who have "Completed Prehab"

	Assessment Point Mean Score		Significant Change
Metric	1	2	
Mobility	1.5	1.35	**Yes**
Self-Care	1.14	1.1	**Yes**
Anxiety and Depression	1.41	1.31	**Yes**
Having pain or discomfort	1.74	1.55	**Yes**
Doing usual activities	1.74	1.71	**No**

Six Minute Walk Test (6MWT)

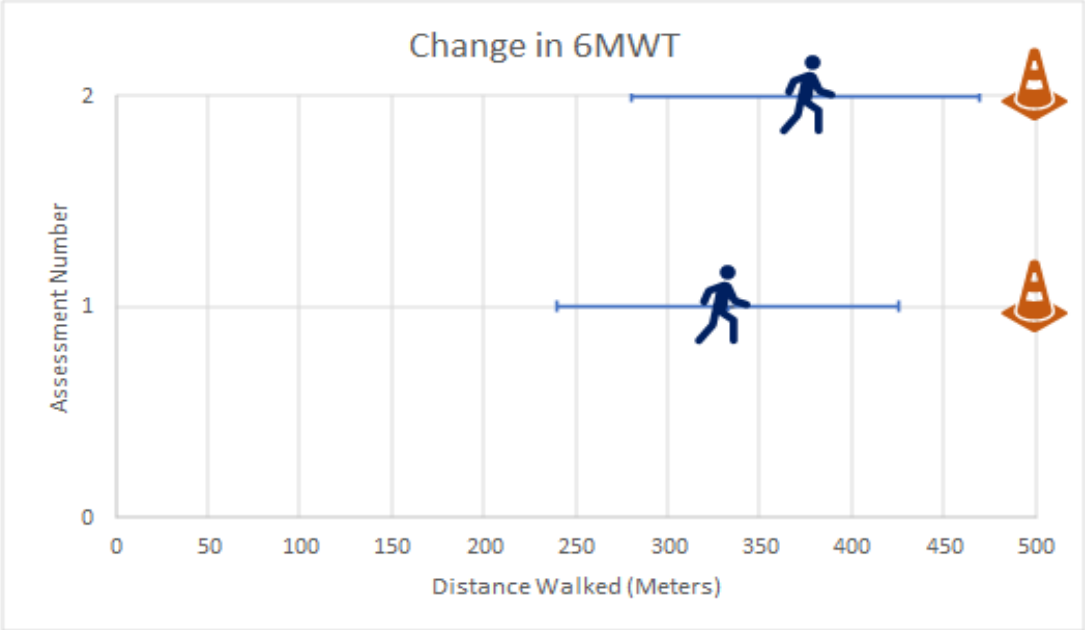
To assess physiological benefits of the prehab and rehab phases of the programme patients complete either a Six minute walk test (6MWT) or an incremental shuttle walk test (ISWT). These sub-maximal standardised exercise assessments are used to assess aerobic capacity and endurance. The analysis focuses on the 6MWT data for the "prehab complete" cohort as this data was available to the evaluation team.

Table 15: 6MWT Results

Assessment	Mean score (Meters)	Variation in score (Standard deviation)
1: Initial P4C Referral	332.63	92.56
2: Pre-op	375.23	94.51
Difference between Assessment 1 and 2	**+42.60m (Significant)**	

In the diagram below the blue line shows the range of distances for each assessment and the placement of the person shows the mean distance.

Figure 15: 6MWT Results for Patients who have "Completed Prehab"



The 6MWT shows a clinically significant improvement in patient's aerobic capacity and endurance. This level of improvement impacts positively on patient's ability to mobilise post-operatively, which is known to facilitate readiness for discharge. Due to COVID-19 only 190 patients completed a 6MWT at assessment point one and two. It is recommended that data is analysed further as the P4C dataset develops. This will enable detailed understanding of the physiological effects on patients, the reasons for any variation and allow for tailoring of the programme for maximum benefit.

Summary of Patient Outcomes

Patients who have participated in P4C show statistically significant improvements in function, frailty level, physical activity, health-related quality of life and mobility. The marked improvement in WHODAS scores for prehab, prehab to rehab, and at one-year follow-up are likely to result in increased independence and reduced need for costly, over-stretched health and social care input. The continued improvement for participants at one-year suggests sustained health behaviour change and endorses the long-term effectiveness of the programme at a system level.

Frailty data showed patients were stronger after prehab, then showed increased frailty following the surgical procedure, but improving after rehab to a level higher than baseline. This will positively impact future care requirements for patients and enable reduced reliance on carers, paid and unpaid. Further analysis of larger cohorts would be recommended as the P4C dataset develops. Future work could focus on how to optimally assess and target interventions towards frailer patients and those where the biggest gains are to be made to maximise benefits for patients and the system.

EQ5D, in all domains improved on completion of prehab. Patients with a better health state are likely to be more resilient and able to cope physically and psychologically. Improvement in health related QoL will reduce the burden upon primary, secondary and community services.

A significant change in 6MWT distance was found which correlates with the shorter LoS seen in the secondary healthcare usage data for the completed prehab cohort. This helps improve patient flow and increase elective capacity.

The changes demonstrated by the P4C programme represent important health and social benefits for patients and their families, which are sustained over longer-term periods.

c) Mortality

Using the P4C SUS dataset, a comparison was undertaken of one-year survival for patients who “completed prehab” prior to surgery and the non-prehab cohort (including those that have not taken part in prehab or only completed part of the prehab programme). For the colorectal cohort who “completed prehab” the analysis shows a significant improvement in one-year survival (97.5% compared to 92.7%) when compared with patients who have not completed the prehab programme. The upper GI cohort also showed a significant survival advantage for those who “completed prehab” (95.7% compared to 86.8%).

There are limitations to this type of comparison as it is not possible to fully understand the weighting attributed to cancer stage and patient co-morbidities within the patient cohorts. However, allowing for this it appears likely that there is a positive association for one-year survival for colorectal and upper GI surgical patients completing the P4C prehab programme.

Table 16: One-Year Survival Post-Surgery: Comparison between “Completed Prehab” and “Non-Prehab” Cohorts

	Number of Patients		Survival at One-Year Post-Surgery			
Cohorts	Prehab	Non-Prehab	Prehab	Non-Prehab	Difference (%)	Significance (P-value)
Colorectal	593	1226	578 (97.47%)	1137 (92.74%)	4.73%	0.03246
Lung	358	454	333 (93.02%)	434 (95.59%)	-2.57%	0.110911
OG	93	91	89 (95.70%)	79 (86.81%)	8.89%	0.03246

*Statistical significance shown where P-value is <0.05

6. Conclusion

The P4C programme demonstrated a range of benefits to patients, providers, and the GM system. Patients experience fewer post-operative complications and appear to have a faster recovery back to health. Increased hospital and critical care capacity improve patient flow, contributing significantly to elective care (cancer and non-cancer) recovery and attainment of cancer performance standards. The release of critical care beds is required both immediately and longer-term with GM continuing to support a considerable number of critically ill COVID-19 patients. Prehab appears to have an additional positive effect on patient survival at one-year post-surgery.

Maximising capacity to carry out more planned procedures is key in accessing allocation of elective recovery funding based on achieving target activity. Providers will be better placed to restore productivity, reduce backlogs, and enable treatment of long waiters. As cancer referrals recover to pre-COVID-19 levels there will be greater demand for cancer treatments. This will have a further negative effect on waiting lists. Prehab can help optimise capacity and empower patients to enact healthy behaviours which help them to be optimally prepared for future treatments.

The bed days ‘released’ from 1000 colorectal patients would cover the cost of the P4C service. There are further benefits identified in the evaluation which are unquantified.

The dashboard created by SCW enables further local analysis to be carried out by the P4C team across a range of cohorts. This is a tool to enable future audit of all areas of the programme to develop the service, adopting a continuous quality improvement methodology, ensure equity of access and effective use of resources.

P4C addresses the NHS LTP targets for cancer of reducing disability; improving quality of life; adoption of the personalised care agenda and empowers patients to play an active role in managing their disease. The significant effects on

patient reported outcomes help to promote self-management, tackle inequalities, and deliver effective health and wellbeing information and support.

Crucially, for patients, disability, frailty, and physical activity levels improve after the P4C programme, resulting in faster recovery and return to positive health states. Patients report a greater sense of control, and lower levels of anxiety and low mood. The rehabilitation element of the programme delivers further improvement in patient outcomes and there is emerging evidence of longer-term positive health behaviour change. The one-year improvements seen represent important gains for patients; endorse the longer-term effectiveness of the programme at a system level and represent value for money for commissioners as it indicates a reduction in health and social care usage. The positive association of prehab on mortality provides additional evidence to support the need for the continued development of prehab services.

This report is relevant to both GM and other emerging ICSs who are developing or considering the introduction of prehab to rehab programmes. P4C can be considered a good example of cross-system working which delivers quality integrated care for patients.

The P4C programme has shown benefits for certain cancer surgery cohorts. Future consideration of wider roll out of programmes to other non-surgical cancer treatments and non-cancer surgery using an evidence-based approach is essential to realise the benefits to wider patient populations

7. Recommendations

Below are recommendations for the P4C team to consider as part of future service improvements.

Embed P4C across other cancer treatments and non-cancer surgery to obtain the maximum benefits
This will ensure capacity benefits are maximised and patient outcomes improve for larger populations. Evaluate the most effective programme delivery methods for over 70s and tailor interventions for maximum benefit and optimal patient experience.

Use the SCW developed dashboard to enhance the P4C evidence base
SCW recommend 3-monthly updates of the dashboard with P4C programme data. This will assist in identifying which patients will benefit the most and contribute to local analysis and development of quarterly reports, enabling comparison across the GM ICS. Combining PROMs and SUS data provides a comprehensive suite of outcome measures that is not known to be replicated currently across the UK.

Utilise learning from COVID-19 to develop a virtual, face to face and blended prehab to rehab offer to achieve maximise effectiveness
This would enhance programme adherence and offer a cost-effective service. Elective care recovery funds could be utilised to support delivery of virtual offer to more patients.

Ensure equity of access to the P4C programme
Review the referral and eligibility criteria for the P4C programme. Improve data recording of patient demographics and indices of multiple deprivation to provide information required to ensure equity of access to the service. Use the existing Equality Impact Assessment (EIA) to build an engagement plan to understand more about those not currently represented in the service.

Appendices

Appendix 1: P4C Programme Information

The starting point for the surgical P4C pathway is the multi-disciplinary team decision to operate. All patients undergoing colorectal, lung and oesophago-gastric (OG) cancer surgery were offered P4C without restriction. Full details on the P4C programme can be found on their website and the service specification is available on request.

Appendix 2: P4C Data

The list below details the data collected by the P4C team. Those in red were not available to the SCW team for evaluation.

Type of Measure	Data collected
Physiological Measures	Six Minute Walk Test (6MWT) Incremental Shuttle Walk Test (ISWT) BMI / Weight Rockwood Clinical Frailty Score
Patient Reported Outcome Measures (PROMS)	WHODAS 2.0 EQ-5D-5L IPAQ Self-Efficacy Scale for Exercise Rockwood Clinical Frailty Scale EORTC QLQ-C30 (version 3)
Patient Reported One-year Telephone Assessment	• EQ-5D-5L • WHODAS 2.0 • IPAQ

Appendix 3 - Agreed list of surgical procedures (as agreed by the clinical leads for each cancer site)

Procedure Code	Cancer Site	SUS Procedure Description	Patient Type		Risk Level
			Non-Prehab	Prehab	
Lung					
E541	Lung	Total pneumonectomy	12	8	
E542	Lung	Bilobectomy of lung	13	19	
E543	Lung	Lobectomy of lung	275	335	
E544	Lung	Excision of segment of lung	32	24	
E545	Lung	Partial lobectomy of lung NEC	3	2	
Oesophago-gastric (Upper GI)					
G011	Upper GI	Oesophago-gastrectomy & anastomosis of oesophagus to stomach	15	21	
G031	Upper GI	Partial oesophagectomy & end to end anastomosis of oesophagus		1	
G271	Upper GI	Total gastrectomy & excision of surrounding tissue		1	
G272	Upper GI	Total gastrectomy & anastomosis of oesophagus to duodenum		1	
G275	Upper GI	Total gastrectomy and anastomosis of oesophagus to jejunum NEC	4	7	
G281	Upper GI	Partial gastrectomy and anastomosis of stomach to duodenum		1	
G282	Upper GI	Partial gastrectomy and anastomosis of stomach to transposed jejunum		1	
G283	Upper GI	Partial gastrectomy & anastomosis of stomach to jejunum NEC	4	9	
Colorectal					
G742	Colorectal	Ileectomy and anastomosis of ileum to colon	2	1	
G743	Colorectal	Creation of temporary ileostomy	7	1	
H041	Colorectal	Creation of defunctioning ileostomy	29	2	
H051	Colorectal	Panproctocolectomy and ileostomy	6	11	
H053	Colorectal	Total colectomy and anastomosis of ileum to rectum	3	2	
H061	Colorectal	Total colectomy and ileostomy NEC	4	1	

H062	Colorectal	Extended right hemicolectomy ad end to end anastomosis	4	2	
H063	Colorectal	Extended right hemicolectomy and anastomosis of ileum to colon	29	28	
H064	Colorectal	Extended right hemicolectomy and anastomosis NEC	5	6	
H065	Colorectal	Extended right hemicolectomy and ileostomy HFQ	13	1	
H068	Colorectal	Extended right hemicolectomy and end to side anastomosis		1	
H071	Colorectal	Other specified extended excision of right hemicolon		1	
H072	Colorectal	Right hemicolectomy & end to end anastomosis of ileum to colon	34	13	
H073	Colorectal	Right hemicolectomy and side to side anastomosis of ileum to transverse colon	17	119	
H074	Colorectal	Right hemicolectomy and anastomosis NEC	28	15	
H078	Colorectal	Right hemicolectomy and ileostomy HFQ	27	5	
H081	Colorectal	Unspecified other excision of right hemicolon		3	
H083	Colorectal	Transverse colectomy and end to end anastomosis	1	3	
H092	Colorectal	Left hemicolectomy and end to end anastomosis of colon to rectum	6	8	
H093	Colorectal	Left hemicolectomy and end to end anastomosis of colon to colon	5	9	
H094	Colorectal	Left hemicolectomy and anastomosis NEC	8	4	
H095	Colorectal	Left hemicolectomy and ileostomy HFQ	1	1	
H096	Colorectal	Left hemicolectomy and exteriorisation of bowel NEC	15	3	
H101	Colorectal	Left hemicolectomy and end to side anastomosis		1	
H102	Colorectal	Sigmoid colectomy and end to end anastomosis of ileum to rectum	1	7	
H103	Colorectal	Sigmoid colectomy and anastomosis of colon to rectum	23	21	
H105	Colorectal	Sigmoid colectomy and anastomosis NEC	12	12	
H106	Colorectal	Sigmoid colectomy and exteriorisation of bowel NEC	18	6	
H114	Colorectal	Sigmoid colectomy and end to side anastomosis	2	3	
H293	Colorectal	Colectomy and ileostomy NEC	3	1	

H295	Colorectal	Subtotal excision of colon & creation of colonic pouch & anastomosis of colon to rectum		1	
H298	Colorectal	Subtotal excision of colon & anastomosis of colon to ileum	5	1	
H331	Colorectal	Unspecified subtotal excision of colon	2	1	
H333	Colorectal	Abdominoperineal excision of rectum & end colostomy	29	21	
H334	Colorectal	Anterior resection of rectum & anastomosis of colon to rectum using staples	109	100	
H335	Colorectal	Anterior resection of rectum and anastomosis NEC	23	29	
H336	Colorectal	Recto-sigmoidectomy and closure of rectal stump and exteriorisation of bowel	41	9	
H337	Colorectal	Anterior resection of rectum and exteriorisation of bowel	63	51	

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