


# All Wales Ovarian Cancer Prehabilitation Project (AWOCPP)

Josh Courtney McMullan <sup>1</sup>, Catherine Smith,<sup>1</sup> Rosalind Jones,<sup>2</sup> Caryl Butterworth,<sup>2</sup> Christine Davies,<sup>3</sup> Helen Long,<sup>4</sup> Jacqueline Pottle,<sup>2</sup> Claire Jarrom,<sup>4</sup> Richard Peevor,<sup>2</sup> Rachel Jones,<sup>3</sup> Preeti Gupta,<sup>4</sup> Louise Hanna,<sup>5</sup> Emma Hudson,<sup>5</sup> Sadie Jones<sup>4</sup>

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<sup>1</sup>Gynaecological Oncology, University Hospital of Wales, Cardiff, UK

<sup>2</sup>Ysbyty Gwynedd, Bangor, UK

<sup>3</sup>Singleton Hospital, Swansea, UK

<sup>4</sup>University Hospital of Wales, Cardiff, UK

<sup>5</sup>Velindre Hospital, Cardiff, UK

## Correspondence to

Dr Josh Courtney McMullan;  
[joshcmmullan@doctors.org.uk](mailto:joshcmmullan@doctors.org.uk)

## ABSTRACT

Over 50% of patients with ovarian cancer are diagnosed with advanced disease (stage 3+) in Wales when treatment typically involves chemotherapy, combined with cytoreductive surgery. Postoperative morbidity is common resulting in prolonged hospital stays and delays in returning to chemotherapy. Patients with advanced ovarian cancer commonly have modifiable risk factors that can be targeted for improvement with personalised prehabilitation. Multimodal personalised prehabilitation has been shown to have a positive impact on perioperative outcomes and length of stay (LOS).

Quality improvement methods were used to implement a multimodal prehabilitation programme for all patients with advanced ovarian cancer planned for surgery in Wales. A unique approach to determining an individual patient's modifiable risk factors was devised that enabled a personalised prehabilitation programme to be created including exercise, smoking cessation, medical and nutritional optimisation and emotional support. Data were collected to enable future health economic evaluation of the programme in anticipation of national role out as standard of care. To evaluate if the prehabilitation intervention was impacting the quality of care, the following outcome measures were assessed: LOS, postoperative complications and surgery to chemotherapy interval (SCI). These measures were compared with a historical Welsh data set from 2018 to 2019 when access to prehabilitation was not available.

Following the implementation of prehabilitation for ovarian cancer, the median LOS reduced from 6 to 5 days ( $p=0.29$ ). There was a reduction in postoperative complications: from 16.9% to 12.7% (Grade 2), 4.4% to 1.8% (Grade 3), 0.6% to 0% (Grade 4+5). The median SCI following prehabilitation was 43.5 days (range 27–91) compared with 40 days (range 15–182 ( $p=0.65$ )).

Prehabilitation has had a positive impact on the treatment pathways for advanced ovarian cancer in Wales. Means of improving patient engagement and establishing cost-effective delivery need to be developed to make this intervention standard of care.

## PROBLEM

Collaborative guidance from Macmillan, the Royal College of Anaesthetists and the National Institute of Healthcare Research states that prehabilitation 'should be integral in the management and support of patients

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Prehabilitation has been shown to improve the perioperative outcomes for patients in other surgical groups. Little is known regarding the benefits of prehabilitation in gynaecological oncology.

## WHAT THIS STUDY ADDS

⇒ In patients undergoing surgery for advanced ovarian cancer, a standardised national approach to personalised, multimodal prehabilitation appears to be feasible and acceptable to patients and healthcare providers alike. Further, this project supports the association with clear healthcare benefits including reduced postoperative morbidity, shorter hospital stay and reduced surgery to chemotherapy intervals.

## HOW THIS MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This model of personalised, multimodal prehabilitation in this group of high-need, high-risk patients is now developed to a point of readiness for national implementation as the standard of care. Importantly, this project demonstrates the specific needs of this patient group and therefore, where prehabilitation resources are required and should be focused. This information can be used for health economic evaluation, crucial to ensure that intervention like this is justified and that National Health Service resources are being used efficiently. The strength of this personalised, multimodal approach to prehabilitation is quality and more efficient use of resources. It ensures that each patient gets what they need based on standardised assessment and nothing more and nothing less. It avoids the potential pitfalls of a 'one size fits all approach' which is often compromised in terms of the quality and impact seen. Role out nationally as standard of care is however better undertaken in the context of broader national programmes delivering prehabilitation to multiple patient groups to ensure staffing resources are used efficiently. It is crucial that these national programmes have the ability to tailor prehabilitation to the patient, particularly in high-need, high-risk groups like those with advanced ovarian cancer.

diagnosed with cancer'.<sup>1</sup> Prehabilitation is specifically mentioned in the Welsh Quality Statement for Cancer 5-year plan published

in March 2021.<sup>2</sup> Finally, guidance published by the European Society for Gynaecology Oncology states that prehabilitation should be applied in the surgical management of patients with ovarian cancer.<sup>3</sup> Until now, patients with ovarian cancer in Wales have not had access to prehabilitation and this was the problem that we sought to address with this project. In the absence of prehabilitation, Welsh patients are likely to be suffering avoidable postoperative morbidity, requiring a longer than necessary hospital stay. Postoperative complications may also result in a delay in commencing chemotherapy which has been shown to negatively impact on survival outcomes.<sup>4–7</sup>

A review of 2 years of Welsh data investigating perioperative outcomes for patients undergoing surgery for ovarian cancer revealed a median length of stay (LOS) of 6 days, postoperative complications in 28.8% of patients and median surgery to chemotherapy interval (SCI) of 40 days. An audit of 4 months of patients undergoing treatment for advanced ovarian cancer at the South East Wales Gynaecological Oncology Centre (SEWGOC), demonstrated that 45% of patients have medical comorbidities, polypharmacy or other indicators of frailty, 22.7% of patients had evidence of poor nutrition and 18.2% had anaemia that would benefit from optimisation. Although services exist in Wales at all cancer centres that could optimise these patients, indications for referral are not clearly defined and they are delivered as separate entities as opposed to within a prehabilitation service.

## BACKGROUND

Ovarian cancer remains the sixth most common cancer in women<sup>8</sup> and the leading cause of death from gynaecological cancer in the UK<sup>9</sup> with a lifetime risk of approximately 2%.<sup>10</sup> The objective of cytoreductive surgery in ovarian cancer is to achieve complete resection of all macroscopic disease.<sup>9 10</sup> Cytoreduction surgery can be performed as the primary treatment for ovarian cancer (primary debulking surgery) or as an interval procedure (interval debulking surgery) following neoadjuvant chemotherapy.<sup>10</sup> Cytoreductive surgery is associated with intraoperative (4.7%) and postoperative (25.9%) complications,<sup>4 11</sup> with an impact on recovery, quality of life and commencement of adjuvant chemotherapy.<sup>4</sup> Enhanced recovery after surgery programmes have been shown to reduce surgical complications and LOS,<sup>12–14</sup> however, they fail to address the modifiable preoperative risk factors such as physical fitness, malnutrition, smoking and frailty.<sup>4</sup>

Patients with ovarian cancer are often diagnosed late, in advanced stages with extensive disease. Malnutrition is reported in up to 67% of gynaecological oncology patients<sup>4</sup> and frailty is present in up to 60% of patients, regardless of age which further increases the risk of perioperative morbidity and mortality.<sup>15–17</sup> Most gynaecological cancer patients are obese and fail to meet national recommendations for exercise and nutrition,<sup>18 19</sup> with anxiety and depression reported in up to 30% of patients.<sup>20</sup>

Chemotherapy is an integral part of the management of ovarian cancer and a delay in commencing adjuvant treatment beyond 25–35 days, due to surgical morbidity, can have a detrimental effect on survival.<sup>5–7</sup>

Prehabilitation programmes aim to enhance recovery from surgery by improving the patient's functional and metabolic reserve preoperatively. The majority of prehabilitation programmes are multimodal addressing an individual's functional capacity through physical (exercise), nutritional (protein supplementation) and psychological (emotional well-being) interventions. Additionally, medical optimisation can address frailty and identify modifiable comorbidities (eg, hypertension and anaemia).<sup>10</sup> Smoking cessation techniques and intoxication management can also be addressed, if necessary.<sup>21</sup> The benefits of prehabilitation have been well documented within other surgical specialties such as trauma and orthopaedic, cardiothoracic and colorectal surgery,<sup>22</sup> with evidence of up to a 51% reduction in complications and LOS.<sup>23 24</sup> Diaz-Feiioo *et al* assessed the use of prehabilitation in ovarian cancer and demonstrated a significant reduction in LOS, SCI and no associated major adverse events.<sup>25</sup> There was, however, no significant difference seen in perioperative complication rates.<sup>25</sup> Miralpeix *et al* in 2018 reviewed the role and impact of a multimodal prehabilitation programme for gynaecological oncology patients. This review highlighted that multimodal prehabilitation combining a physical intervention with nutritional and psychological strategies had a better impact on functional outcomes compared with single prehabilitation modalities alone. Miralpeix *et al* published a recommended algorithm for prehabilitation which has been used in the methodology of this prehabilitation programme.<sup>26</sup>

## MEASUREMENT

To determine the resource requirement to deliver the personalised, multimodal prehabilitation programme nationally as standard of care, the following data were collected on the baseline assessment of patients triggering a referral to:

1. Smoking cessation intervention (current smokers)
2. Dietetics (Welsh Adult Nutritional Risk Screening Tool (WAASP) score  $\geq 7$  or albumin  $< 30$  g/dL)
3. Occupational therapy (Hospital Anxiety and Depression Scale (HADS) score  $\geq 7$ )
4. Care of the elderly physician for medical optimisation (presence of  $\geq 1$  predetermined programme-specific criteria)

The measures we chose to assess the impact of our prehabilitation intervention were as follows:

### Primary outcome measures

1. LOS following cytoreductive surgery (days, calculated from the date of surgery to the date of discharge)
2. Postoperative complication rates (Clavien-Dindo scoring)

### 3. SCI (days)

In order to explore any signal of impact the programme was having, these measures were compared with a matched historical cohort of all patients (n=231) undergoing surgery for advanced ovarian cancer across Wales in 2018/2019.

### Secondary outcome measures

1. Change in nutritional status from baseline to presurgery (WAASP score, albumin)
2. Change in exercise tolerance from baseline to presurgery (6-minute walk test)
3. Change in emotional well-being from baseline to presurgery (HADS score)
4. Patient acceptability (programme-specific patient feedback questionnaire)

### DESIGN

The prehabilitation programme was delivered across all three tertiary cancer centres in Wales. The local teams at each cancer centre included:

- ▶ A gynaecology oncology consultant lead
- ▶ Gynaecology trainee doctor
- ▶ Cancer nurse specialist
- ▶ Dietician
- ▶ Occupational therapist
- ▶ Care of the elderly physician

### Patient population

All patients with stage 3 or 4 ovarian cancer identified at regional multidisciplinary team meetings who were scheduled for cytoreductive surgery were offered prehabilitation. The decision to allocate patients to either primary or interval surgery was at the discretion of the individual cancer centres based on their standard practice. Patients who were initially scheduled for neoadjuvant chemotherapy but did not go on to have surgery were still eligible to participate in the programme until completion of treatment, but the surgical outcome measures were not relevant in this group.

### Prehabilitation pathway

Prehabilitation was offered to patients in the period between initiation of treatment and surgery until the time of completion of chemotherapy. Patients were required to attend at least three additional appointments during their treatment. A prehabilitation baseline consultation was offered to provide information on the programme, conduct baseline assessments and devise the personalised prehabilitation plan using the predefined framework. Following the clinical consultation to discuss and initiate clinical treatment, prehabilitation information was given. So as not to overload the patient with too much information, the project nurse contacted the patient within the following week to schedule the baseline consultation which was delivered by the project specialist nurse at each centre. The patient journey from this point depended on the results of the assessments as detailed below. A

prehabilitation progress consultation then took place within 2 weeks before surgery. At this assessment, data on progress was recorded with necessary adjustments made to their prehabilitation programme. Finally, on completion of chemotherapy, a prehabilitation final assessment was conducted where final progress assessments were undertaken and patient feedback was requested. The pathway is illustrated in [figure 1](#).

### Prehabilitation interventions

#### Physical activity intervention

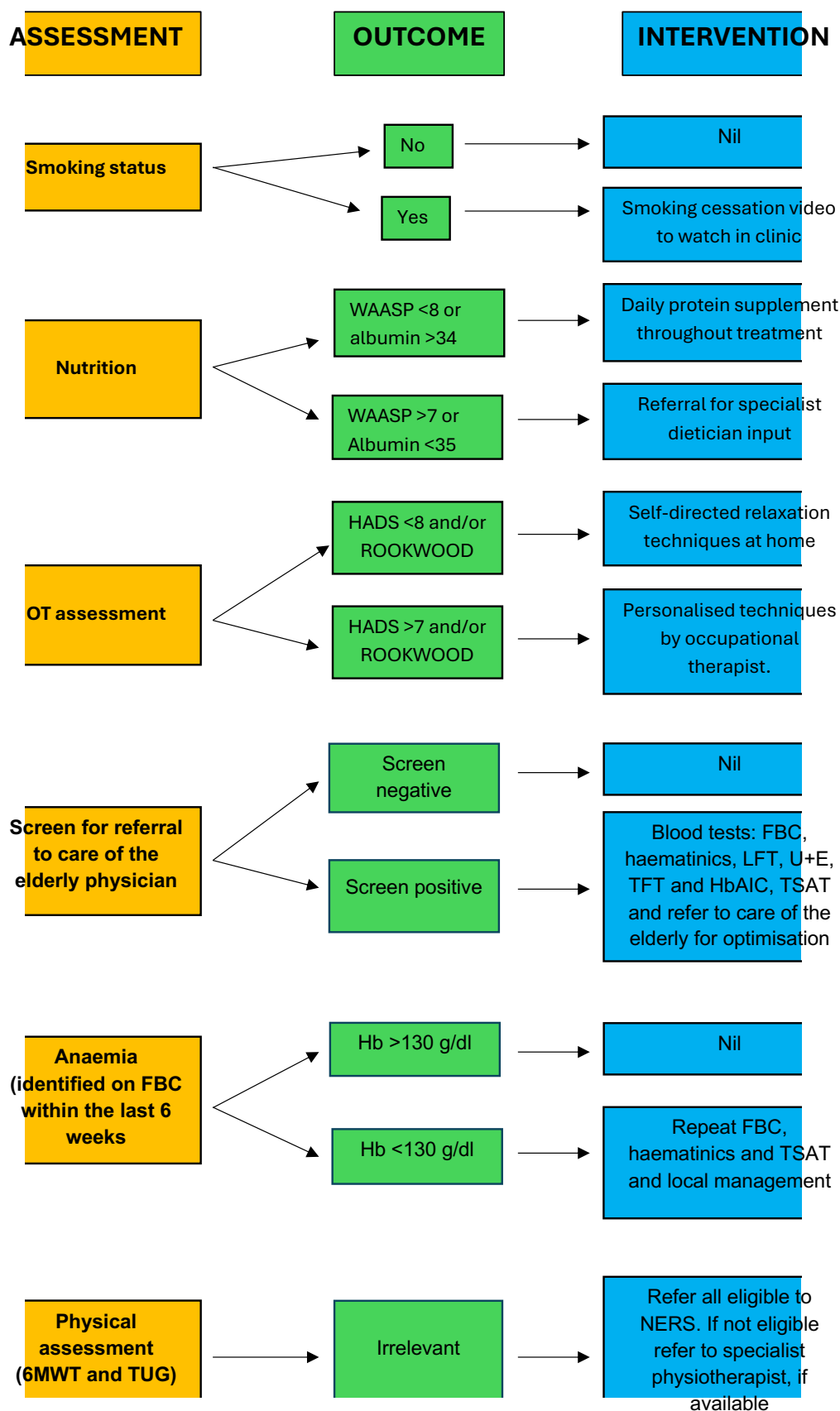
A physical assessment of the patient took place at all three assessment appointments using the 6-minute walk test and a Timed Up and Go test. We had the support of the Welsh National Exercise Referral Scheme (NERS) for the physical activity intervention initially. NERS is a Welsh initiative in which healthcare professionals can refer patients who would benefit from an exercise intervention and is delivered by specialist trainers in the community.<sup>27</sup> Three 2-hour sessions were provided per week that the patients accessed as much as they were able. Each session provided a personalised, guided exercise session as well as relaxation and mindfulness. In addition, all patients were given written information regards daily exercises to undertake during their treatment. Patients were encouraged to keep an exercise diary throughout the course of their treatment to enable an assessment of compliance and analyse the impact of exercise. Over the course of the project, lack of patient engagement with NERS became evident and despite multiple efforts to improve uptake, this could not be achieved. Consequently, for two sites (South-East Wales and North Wales), hospital-based physiotherapy replaced NERS for the physical activity intervention and was delivered in the patient's local cancer centre by physiotherapists or physiotherapy assistants.

#### Nutritional intervention

The nutritional status of all patients was assessed using the WAASP which is a validated, nationally standardised assessment tool which generates a risk score (low, moderate or high).<sup>28</sup> It was accepted as the All-Wales nutritional screening tool in 2020 as it meets the nutritional screening criteria set out by the European Society for Clinical Nutrition and Metabolism.<sup>29</sup> All patients were given generic verbal advice and an ovarian cancer dietetics booklet (see online supplemental material), created specifically for this project as well as daily protein supplements (Ensure Shake or Actisolve Smoothie). The criteria which triggered referral to a dietician can be seen in [figure 1](#). Albumin was not used as a marker of malnutrition in itself but rather as a marker of deconditioning in surgical patients.

#### Smoking cessation intervention

If a patient was identified as a smoker, they were given written information regards the benefits of smoking cessation and referred to a local smoking cessation service. They were also provided with a 4-min video, developed



**Figure 1** Prehabilitation pathways for individual prehabilitation interventions. FBC, full blood count; HADS, Hospital Anxiety and Depression Scale; Hb, haemoglobin; HbA1c, glycated haemoglobin; LFT, liver function tests; NERS, National Exercise Referral Scheme; OT, occupational therapy; 6MWT, 6-minute walk test; TFT, thyroid function tests; TSAT, transferrin saturation; TUG, Timed Up and Go test; U+E, urea and electrolytes; WAASP, Welsh Adult Nutritional Risk Screening Tool.



in Wales and hosted by the British Thoracic Society, that specifically details the benefits of smoking cessation prior to surgery.

### Well-being intervention

The well-being assessment included a Hospital Anxiety and Depression Score<sup>30</sup> and an Edmonton quality of life assessment (EQ5D-5L).<sup>31</sup> The Hospital Anxiety and Depression Score is a validated screening tool which is recommended by National Institute for Health and Care Excellence.<sup>32</sup> The occupational therapist offered specialist group therapy and Thai Chi sessions which were delivered virtually. Nominated occupational therapists from each cancer centre rotated the virtual delivery of the sessions for all patients in Wales. This was a unique, resource-efficient approach for delivering this aspect of the programme. All patients were offered three sessions per week of exercise, relaxation and mindfulness through the NERS sessions and were given written advice on relaxation techniques developed by Macmillan Cancer Support<sup>33</sup> and breathing exercises, developed by Maggie's.<sup>33</sup>

### Medical optimisation intervention

The medical and drug history of each patient in combination with a Rockwood Frailty assessment,<sup>34</sup> mini-cog assessment and anaemia screen was assessed at the baseline consultation. The criteria for referral to a care of the elderly physician were as follows:

- ▶ Rockwood Frailty score>3
- ▶ Medications>4
- ▶ Mini-Cog score<3
- ▶ Recent hospital admissions in the preceding 12 months
- ▶ Age>65 years
- ▶ Evidence of poorly controlled medical condition
- ▶ History of fall

### Patient engagement and involvement

Patient representatives were involved throughout the project from the design phase through to completion. During the development phase, they helped guide the practical delivery of the project, ensuring it was acceptable to patients. They were heavily involved in the development of all written information and attended our regular all-Wales meetings. Their input was particularly helpful in ensuring patients were not overburdened with too many appointments, in troubleshooting reasons for the lack of engagement with NERS and in developing the modified approach to hospital-based physiotherapy. Finally, patient acceptability was assessed using an anonymous feedback questionnaire on completion of the programme.

## STRATEGY

We initially started with 2weekly All-Wales meetings during the programme development phase and then reduced to monthly and eventually 2monthly once the programme was well established. The meetings were well attended, ensuring adequate updates on progress, results

and troubleshooting of challenges to implement changes. Further to the All-Wales meeting, the SEWGOC and the North Wales Cancer Centre, held fortnightly local team meetings where progress and challenges at a local level could be discussed in more detail. Direct patient feedback was also collected in real-time to ensure patient engagement and uptake could be optimised.

### Cycle 1: programme development phase

During this time a baseline assessment was completed to assess the need for prehabilitation within an advanced ovarian cancer cohort in Wales. We agreed on the referral criteria, individual multimodal prehabilitation interventions and developed patient information to be distributed accordingly on referral.

### Cycle 2: implementation of prehabilitation

Following the implementation of prehabilitation, we hypothesised that the timing of the patient's baseline assessment would be more beneficial if it was carried out separately from the initial clinical appointment. To avoid information overload, written information about the programme was given at the patient's initial clinical consultation and followed up with a telephone call with the prehabilitation team 5–10 days later.

### Cycle 3: change to an essential component of care

The programme was initially presented as an optional component of care that patients could participate in if they wished. Three months into the programme, patient feedback highlighted a lack of perceived need from many patients and consequently, some patients decided they did not need the prehabilitation level of intervention. At this point, 75% of patients who were approached for recruitment were attending prehabilitation appointments. We adapted our approach to presenting the programme as an essential part of their care, with the potential to improve their postoperative outcome. During the following cycle, engagement increased to 82%.

### Cycle 4: change to hospital-based physiotherapy

Six months into the programme it became clear that patients were reluctant to engage with the NERS exercise intervention, following direct patient feedback. As a group, we decided to switch from the NERS exercise scheme to hospital-based physiotherapy. Overall, this took around 2months to implement, due to the logistics of setting up the service.

## RESULTS

The baseline assessment data enabled us to gain better insight into what the demand for this level of specialised, personalised prehabilitation would be in this patient population. 10.9% (6/55) identified as a current smoker and therefore benefiting from smoking cessation interventions. 56.4% (31/55) triggered a referral to a care of the elderly physician, 54.5% (30/55) triggered a referral to a dietician and 74.5% (41/55) were referred to

**Table 1** Median prehabilitation intervention assessments comparing baseline, preoperative and end-of-treatment results

	Baseline n=55	Preoperative n=45	P value (baseline—preoperative)	End of treatment n=45	P value (baseline—end)
6-minute walk test (m)	330 (20–500)	400 (300–490)	0.16	405.00 (293–450)	0.06
TUG (s)	9.61 (5–32)	9.00 (7.9–20.0)	0.66	8.00 (6–11.78)	0.11
WAASP	6 (0–18)	4 (2–7)	0.0013	2 (0–5)	0.0016
Grip strength	21 (9.71–30.9)	21.25 (14.2–29.2)	0.64	21 (15.5–29.2)	0.76
Rockwood	3 (1–5)	2 (1–4)	0.01	2 (1–3)	0.04
Haemoglobin	126	121.75	0.46	124.89	–
Albumin	36	40	0.0004	37.5	–
BMI	27.16	27.50	0.31	24.40	0.12
Weight (kg)	70.5	69.7	0.37	64.6	0.11

BMI, body mass index; TUG, Timed Up and Go; WAASP, Welsh Adult Nutritional Risk Screening Tool.

occupational therapy for well-being support. These data will contribute to the planned health economic evaluation of this intervention.

**Table 1** shows how the assessment scores of patients changed over the course of their time in the programme. The median WAASP score reduced from 6 at baseline to 2 at the end of treatment indicating improved nutritional status ( $p=0.0016$ ) and the median Rockwood score reduced from 3 at baseline to 2 at the end of treatment ( $p=0.04$ ).

In relation to primary treatment, 49% (27/55) had primary debulking surgery, 33% (18/55) had neoadjuvant chemotherapy followed by interval debulking surgery, 18% (10/55) had chemotherapy only and 4% (2/55) had best supportive care. The median time from the baseline appointment to the date of surgery for primary debulking and interval debulking surgery was 83.5 days and 88 days, respectively. This data was collected for South-East and South-West Wales only and therefore did not include North Wales patients.

### Impact on clinical outcomes

The primary outcome measures assessed were compared with a historical data set of all cases of advanced ovarian cancer in Wales (2018–2019) when access to prehabilitation was not available (**figure 2**). The median LOS (**figure 2**) reduced from 6 (range 2–84 (IQR 2)) to 5 (range 2–12 (IQR 3)) days across all centres ( $p=0.29$ ). The median SCI (**figure 2**) following prehabilitation was 43.5 days (range 27–91 (IQR 17.25)) compared with 40 days (range 15–182 (IQR 16.75)) across all centres ( $p=0.65$ ). For postoperative complications, there was an increase in grade 1 complications from 6.25% to 18.2% in the prehabilitation cohort in conjunction with a reduction from 16.9% to 12.7%, 4.4% to 1.8% and 0.6% to 0% in Grade 2–5 complications which require intervention, respectively (**figure 2**).

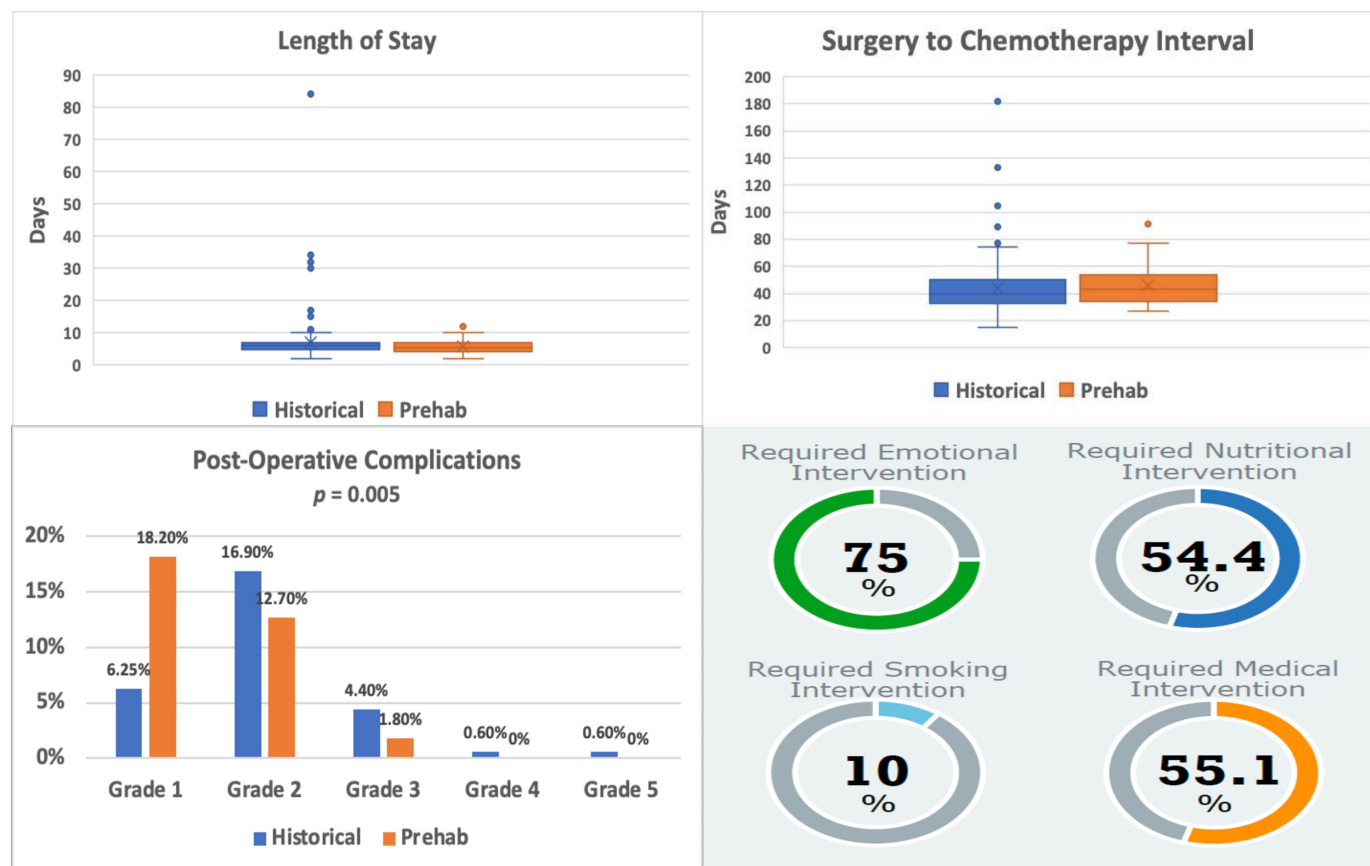
### Patient feedback

Out of 55 patients, 13 returned patient feedback forms (23.6%). 100% of patients felt the information was easy to understand and 92% of patients found the number of appointments easy to manage. Those that responded to the questionnaire did not trigger a referral to care of the elderly physician, therefore we do not have feedback relating to this aspect of the programme. For the individual interventions, 77% of occupational therapy patients and 85% of dietician patients felt it was ‘very good’ or ‘good’. 84% of patients felt the nutrition intervention enabled them to make dietary changes and 61% reported an ability to manage their symptoms and improve their quality of life. 67% of patients found the physical intervention helpful in becoming more active. However, many patients commented on the distance they had to travel and overall, 47% had a positive view.

### LESSONS AND LIMITATIONS

The key lesson we have learnt with this project is that the delivery of high-quality, personalised prehabilitation for patients with advanced ovarian cancer across Wales is feasible, acceptable and appears to have a positive impact with reduced postoperative morbidity, shorter hospital stays and a reduced range of SCI. Further, we have learnt what the resource requirement is for the delivery of prehabilitation, within Wales, that can be used to perform health economic evaluation.

Many important lessons have been learnt over the course of the project. First, the importance of incorporating prehabilitation as an essential component of care. When this programme was initiated across Wales, it was offered as optional resulting in poor patient engagement. When this was addressed with a much stronger focus placed on the importance of prehabilitation by health-care professionals, patient engagement significantly improved. Furthermore, ensuring that all healthcare professionals involved in the patients’ journey are aware



**Figure 2** Outcome measures following implementation of prehabilitation.

of the prehabilitation programme and its benefits is paramount to its success. In terms of sustainability, the model of prehabilitation developed as part of this project is no longer in place with inequalities in care still evident. At present, only patients in SEWGOC have access to prehabilitation. However, an all-Wales collaborative is currently in place to establish comprehensive prehabilitation for all specialties. Therefore, there is currently no provision of consistent or standardised prehabilitation for patients with advanced ovarian cancer in Wales.

A second important lesson was related to the exercise intervention. With the initial use of NERS, patients were not attending the classes and therefore not benefiting from this important component of prehabilitation. We adopted this approach initially to be more cost-effective but to also offer better access to exercise with classes available on multiple days and locations throughout the week. It was difficult to establish exactly why this did not work. Multiple attempts over the course of the project addressing patient education, information sources, types of classes (including virtual sessions) were offered but with no improvement. We eventually moved to hospital-based, targeted physiotherapy in two of the three centres which immediately improved uptake. It is our opinion that patients perceive an exercise intervention that is offered as a hospital appointment, in the context of physiotherapy, as a higher priority than external exercise sessions. The exercise component of prehabilitation

carries significant value but is probably the most challenging to deliver effectively. While delivery by physiotherapists in secondary care is possible, it may not represent the most cost-effective or accessible approach and should be a focus for future development of prehabilitation programmes if they are to become sustainable.

The final key aspect of learning that came from this project was the increased understanding of each other's roles. Prior to this project, the surgical team had limited insight into the extent of support that occupational therapy and dietetics could offer these patients. In the same breath, the allied health professionals now have a greater understanding of the unique needs of patients with advanced ovarian cancer. This new familiarity with one another will continue to be of huge benefit to patients going forward and lead to many more quality improvement initiatives in the future.

Our primary outcome measures have confirmed that prehabilitation is beneficial to patients with advanced ovarian cancer and leads to improvements in LOS and postoperative complications, with a reduced range of SCI. Unlike prospective research studies, quality improvement projects are unable to ensure that confounding factors, contributing to outcome measures, are controlled as much as possible. The literature already reports the clear benefits of prehabilitation and this was not something that our quality improvement project aimed to demonstrate. It is a universally acknowledged challenge that

those patients undergoing primary surgery are under a much tighter time frame compared with interval surgery. Although there are no reports highlighting an association between the length of time spent in prehabilitation and outcomes, the recommended duration of prehabilitation, as per international guidance, is 2–4 weeks.<sup>26</sup> Patients within this programme had a median time from decision to treat and surgery of 83.5 and 88 days for primary and interval surgery, respectively. It is important to note that these data represent a select cohort of patients going through ovarian cancer care in Wales at this time. The primary surgery group figure here is significantly influenced by an outlying patient whereby complications resulted in a decision to treat and surgery interval being 144 days. If this outlying patient is removed the median time from the decision to treat and primary debulking surgery reduces to 21 days.

It is important to remember that this project was designed as a quality improvement project rather than a piece of research aimed at accurately answering these questions. Any observations of change and impact can therefore only be commented as observations as potential signals of effect. For LOS, a 1 day reduction will have a cost-saving effect for all National Health Service services. More importantly, the range of LOS (2–84 days vs 2–12 days) and SCI (15–182 days vs 27–91 days) was much tighter following the implementation of prehabilitation, showing a much more cohesive approach. In addition, the IQRs were similar across both cohorts, with significant outliers seen in the historical cohort. These outlying patients are the very patients who will benefit most from prehabilitation.

More grade 1 postoperative complications were observed in the prehabilitation cohort compared with the historical data set. This is likely explained by the limitations of the methodology used. The historical data set was generated from patient files (electronic) where information regards postoperative complications is not specifically recorded, especially for grade 1 complications that frequently would not present to secondary/tertiary care. This was information specifically collected for this prehabilitation programme, so it is not surprising that higher detection of the grade 1 complications was observed. We have, however, demonstrated a reduction in major postoperative complications that require intervention (Grade 2–5) with statistical significance ( $p=0.005$ ). Despite the cautious interpretation of outcome measures in small sample size, future prehabilitation programmes should continue to collect these data as they become increasingly valid with increasing sample sizes and would likely demonstrate statistical significance.

The changes seen in the nutritional status and frailty of patients are of interest within this cohort. Admittedly, it is reassuring to see statistically significant reductions in the WAASP ( $p=0.0016$ ) and Rockwood frailty scores ( $p=0.04$ ). It is, however, of paramount importance that these outcomes are interpreted

cautiously as they will have inevitably improved with treatment and therefore cannot be attributed to the implementation of prehabilitation alone.

## CONCLUSION

We provided an evidence-based framework of personalised prehabilitation that was acceptable to patients and healthcare providers. We have generated data that will enable service planning regarding the proportion of patients who triggered onward referral for specialist prehabilitation intervention. Not all patients require a direct dietician, occupational therapist or physician input and being able to identify those patients who will benefit is advantageous. Excellent communication was required throughout to ensure all team members were aware of the aims of the project to maintain motivation and morale.

X Josh Courtney McMullan @court\_mcmullan and Catherine Smith @ResearchCath

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**Contributors** JCM: research fellow, data collection and analysis, manuscript preparation and revision. CM: research nurse, lead prehabilitation nurse, data collection and analysis, manuscript preparation and revision. Rosalind Jones: North Wales lead gynaecological oncology surgeon, data collection, manuscript review. RP: South-West Wales gynaecological oncology surgeon, data collection. CB/CD/HL/CJ/Rachel Jones/PG/EH/JP: data collection, manuscript review. LH: medical oncologist, data collection, manuscript review. SJ: South-East Wales lead gynaecological oncology surgeon, data collection and analysis, manuscript preparation and revision, supervision, project lead and guarantor.

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**Ethics approval** This project went through Cardiff and Vale NHS Research and Development Review and was deemed and registered as a quality improvement project.

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## ORCID iD

Josh Courtney McMullan <http://orcid.org/0009-0007-1061-489X>



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