Bevacizumab 15mg/kg, CARBOplatin (AUC 6) and PACLitaxel 175mg/m^2 Therapy

INDICATIONS FOR USE:

INDICATION	ICD10	Regimen Code	HSE approved reimbursement status*
For the front-line treatment of adult patients with advanced (International Federation of Gynecology and Obstetrics (FIGO) stages III B, III C and IV) epithelial ovarian, fallopian tube, or primary peritoneal cancer.	 C56 C57 C48	00766a	N/A

*This is for post 2012 indications only

TREATMENT:

The starting dose of the drugs detailed below may be adjusted downward by the prescribing clinician, using their independent medical judgement, to consider each patients individual clinical circumstances.

Bevacizumab is administered once every 3 weeks as an intravenous infusion in addition to CARBOplatin and PACLitaxel for up to 6 cycles of treatment followed by continued use of bevacizumab as single agent until disease progression or for a maximum of 15 months (22 cycles) or until unacceptable toxicity, whichever occurs earlier.

Facilities to treat anaphylaxis MUST be present when the systemic anti-cancer therapy (SACT) is administered.

Cycle 1-6

Admin. Order	Day	Drug	Dose	Route	Diluent & Rate	Cycle Frequency
1	1	PACLitaxel	175mg/m^2	IV infusion	500mL 0.9% NaCl over 3 hours[a,b]	Every 21 days
2	1	CARBOplatin	AUC 6	IV infusion	500mL glucose 5% over 30 minutes	Every 21 days
3	1	Bevacizumab[c]	15mg/kg	IV infusion	100mL 0.9% NaCl over 90 minutes[d, e]	Every 21 days
[a]PACLitaxel must be supplied in non-PVC containers and administered using non-PVC giving sets and through an in-line 0.22µm filter with a microporous membrane.						
[b]PACLitaxel should be diluted to a concentration of 0.3-1.2mg/mL.						
[c]Initiate bevacizumab treatment from cycle 2 for patients who have undergone surgery						
[d]Flush line with NaCl 0.9% pre and post bevacizumab dose as it should not be mixed with glucose solutions.						
[e]The initial dose of bevacizumab should be delivered over 90 minutes as an intravenous infusion. If the first infusion is well tolerated, the second infusion may be administered over 60 minutes. If the 60-minute infusion is well tolerated, all subsequent infusions may be administered over 30 minutes as per the NCCP Bevacizumab Rapid Infusion Rate Guidance here.						

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Cycle 7 onwards (for up to 22 cycles)

Day	Drug	Dose	Route	Diluent & Rate	Cycle Frequency
1	Bevacizumab	15mg/kg	IV infusion	100mL NaCl 0.9% over 90minutes[a,b]	Every 21 days
[a]Flush line with NaCl 0.9% pre and post bevacizumab dose as it should not be mixed with glucose solutions.					
[b]The initial dose of bevacizumab should be delivered over 90 minutes as an intravenous infusion. If the first infusion is well tolerated, the second infusion may be administered over 60 minutes. If the 60-minute infusion is well tolerated, all subsequent infusions may be administered over 30 minutes as per the NCCP Bevacizumab Rapid Infusion Rate Guidance here. It should not be administered as an intravenous push or bolus.					

CARBOplatin dose:

The dose in mg of CARBOplatin to be administered is calculated as follows:

Dose (mg) = target AUC (mg/mLx min) x (GFR mL/min +25)

- **Measured GFR** (e.g. nuclear renogram) is preferred whenever feasible.
- **Estimation of GFR** (eGFR) may be performed using the Wright formula to estimate GFR or the Cockcroft and Gault formula to estimate creatinine clearance.
- The GFR used to calculate the AUC dosing should not exceed 125mLmin.
- For obese patients and those with a low serum creatinine, for example due to low body weight or post-operative asthenia, estimation using formulae may not give accurate results; measured GFR is recommended.
    - Where obesity (body mass index [BMI] ≥ 30 kg/m^2) or overweight (BMI 25-29.9) is likely to lead to an overestimate of GFR and isotope GFR is not available the use of the adjusted ideal body weight in the Cockcroft and Gault formula may be considered.
    - Where serum creatinine is less than 63 micromol/L, the use of a creatinine value of 62 micromol/L or a steady pre-operative creatinine value may be considered
- These comments do not substitute for the clinical judgement of a physician experienced in prescription of CARBOplatin.

WRIGHT FORMULA

There are two versions of the formula depending on how serum creatinine values are obtained, by the kinetic Jaffe method or the enzymatic method. The formula can be further adapted if covariant creatine kinase (CK) values are available (not shown).

1. *SCr measured using enzymatic assay.*

$$\text{GFR (mL/min)} = \frac{(6230 - 32.8 \times \text{Age}) \times \text{BSA} \times (1 - 0.23 \times \text{Sex})}{\text{SCr (micromol/min)}}$$

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2. *SCr measured using Jaffe assay*

$$\text{GFR (mL/min)} = \frac{(6580 - 38.8 \times \text{Age}) \times \text{BSA} \times (1 - 0.168 \times \text{Sex})}{\text{SCr (micromol/min)}}$$

Key: Sex = 1 if female, 0 if male; Age in years; BSA= DuBois BSA

COCKCROFT-GAULT FORMULA

$$\text{GFR (mL/min)} = \frac{S \times (140 - \text{age in years}) \times \text{wt (kg)}}{\text{serum creatinine (micromol/L)}}$$

S= 1.04 for females

ELIGIBILITY:

- Indications as above
- ECOG status 0-2
- Adequate haematological, renal and hepatic function

USE WITH CAUTION:

- Bleeding/clotting disorders
- Previous anthracycline exposure
- History of significant venous thromboembolism
- Surgical procedure or complications that could lead to increased risk of fistulation or perforation
- Underlying condition that could lead to increased risk of fistulation or perforation

EXCLUSIONS:

- Hypersensitivity to bevacizumab, CARBOplatin*, PACLitaxel, or any of the excipients
- Pregnancy or lactation
- Hypersensitivity to Chinese Hamster Ovary (CHO) cell products or other recombinant human or humanised antibodies
- Severe hepatic impairment (PACLitaxel)
- Cerebrovascular disease (e.g. TIA, CVA or cerebral haemorrhage within 6 months prior to treatment)
- Cardiovascular disease e.g. MI within 6 months prior to treatment, poorly controlled arrhythmia, congestive cardiac failure >/= Class 2
- Baseline neutrophil count < 1.5 x 10^9 cells/L

*If it is felt that the patient may have a major clinical benefit from CARBOplatin, it may in exceptional circumstances be feasible to rechallenge a patient with a prior mild hypersensitivity reaction e.g. using a desensitisation protocol, but only with immunology advice, premedication as advised, and a desensitisation protocol under carefully controlled conditions with resuscitation facilities available and medical and/or ITU/ HDU supervision (9).

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PRESCRIPTIVE AUTHORITY:

- The treatment plan must be initiated by a Consultant Medical Oncologist.

TESTS:

Baseline tests:

- FBC, renal and liver profile
- Isotope GFR measurement (preferred) or GFR / Cr Clearance estimation
- Audiometry if clinically indicated
- Dipstick urinalysis for protein
- Blood pressure measurement
- Cardiac assessment including history, physical exam and baseline ECG.
    - ECHO should be considered in patients who have a history of cardiovascular disease, prior treatment with an anthracycline or other cardiotoxic drug or prior chest wall radiation.
- INR if clinically indicated*

Regular tests (prior to each cycle):

- FBC with differential, renal and liver profile
- Dipstick urinalysis for protein
- Blood pressure (including post treatment).
- INR if clinically indicated*
  *(For patients on warfarin, weekly INR until stable warfarin dose established, then INR prior to each cycle.)

Disease monitoring:

Disease monitoring should be in line with the patient's treatment plan and any other test/s as directed by the supervising Consultant.

DOSE MODIFICATIONS:

- Any dose modification should be discussed with a Consultant.
- Bevacizumab dose reduction for adverse events is not recommended (SmPC). If indicated, bevacizumab therapy should either be permanently discontinued or temporarily suspended until toxicity resolves (See Table 3 and 4).
- Dose modifications for PACLitaxel and CARBOplatin can be managed by the dose reduction table for haematological and adverse events.

Table 1: Suggested Dose Reductions for PACLitaxel and CARBOplatin for Toxicity[a]

Drug	Dose level	Dose level -1	Dose level -2	Dose level -3
PACLitaxel	175mg/m^2	135mg/m^2	[b]110 mg/m^2	Discontinue
CARBOplatin	AUC 6	AUC 5	AUC 4	Discontinue
[a]For dose modifications for hepatic impairment see Table 3				
[b]If clinically appropriate rather than discontinuation				

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Haematological:

Table 2: Dose Modifications for Haematological Toxicity*

ANC (x 10^9/L) On Treatment Day	
0.5 to < 1.0	Delay treatment until recovery
< 0.5	Delay treatment until recovery. Consider using prophylactic GSCF (preferred) or reducing PACLitaxel and CARBOplatin by one dose level for subsequent cycles
Febrile neutropenia	Delay treatment until recovery. Use prophylactic GCSF on subsequent cycles and consider reducing PACLitaxel and CARBOplatin by one dose level for subsequent cycles
Platelets (x 10^9/L) on treatment day	
50 to < 100	Delay treatment until recovery. Consider reducing PACLitaxel and CARBOplatin by one dose level for subsequent cycles; reduction is mandatory if recovery is > 7 days
Platelets (x 10^9/L) at any stage in cycle	
50 to <100	Delay treatment until recovery.
<50	Delay treatment until recovery and consider reducing PACLitaxel and CARBOplatin by one dose level for subsequent cycles
*For some patients, especially ECOG 2, treatment thresholds may be higher If a patient experiences significant myelosuppression, consideration should be given as to whether GFR is being over-estimated	

Renal and Hepatic Impairment:

Table 3: Dose Modifications in Renal and Hepatic Impairment

Drug	Renal Impairment	Hepatic Impairment			
Bevacizumab	Renal impairment: no need for dose adjustment is expected. Haemodialysis: no need for dose adjustment is expected.	No need for dose adjustment is expected.			
CARBOplatin	See note below[a]	No dose modification required.			
PACLitaxel	Renal impairment: no need for dose adjustment is expected. Haemodialysis: no need for dose. adjustment is expected	**ALT**		**Total bilirubin**	**Dose of PACLitaxel**
		< 10xULN	and	≤ 1.25xULN	175mg/m^2
		< 10xULN	and	1.26-2xULN	135mg/m^2
		< 10xULN	and	2.01-5xULN	90mg/m^2
		≥ 10xULN	and/or	> 5xULN	Contraindicated

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[a]Renal dysfunction and CARBOplatin:

- Patients with creatinine clearance values of <60mL/min are at greater risk of developing myelosuppression.
- If GFR between 20 to ≤ 30mL/min, CARBOplatin should be administered with extreme caution
- If GFR ≤ 20mL/min, CARBOplatin should not be administered at all.
- If Cockcroft & Gault or Wright formula are used, the dose should be calculated, as required per cycle based on a serum creatinine obtained within 48 hrs of drug administration.
- If isotope GFR is used, the dose can remain the same provided the serum creatinine is ≤110% of its value at the time of the isotope measurement. If the serum creatinine increases, consideration should be given to remeasuring the GFR or to estimating it using Cockcroft & Gault or Wright formulae.

Management of Specific Adverse Events:

Table 4: Dose Modifications for Adverse Events

Adverse reactions		Recommended dose modification
Motor or sensory neuropathy	Grade 2 Grade ≥ 3	Reduce PACLitaxel by 1 dose level. If persists, reduce PACLitaxel by an additional dose level (see table) Omit PACLitaxel
Hypertension	Uncontrolled * or symptomatic hypertension on Day 1	Withhold bevacizumab treatment and start antihypertensive therapy or adjust pre-existing medication
	Grade 2-3 hypertension	Initiate antihypertensive therapy and consider interruption of bevacizumab until controlled
	Grade 4 hypertension or persisting grade 3 hypertension	Discontinue bevacizumab
Grade 4 Proteinuria		Discontinue bevacizumab
Tracheoesophageal (TE) fistula or any Grade 4 fistula		Discontinue bevacizumab
Grade 4 Thromboembolic events		Discontinue bevacizumab
Haemorrhagic event ≥ Grade 3		Discontinue bevacizumab
Gastrointestinal Perforation		Discontinue bevacizumab
*Uncontrolled hypertension for initiating bevacizumab is defined as sustained BP>150/100mmHg while receiving anti-hypertensive medication		

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Proteinuria:

Table 5: Dose modifications of bevacizumab for proteinuria

Degree of proteinuria	Action
Neg or 1+ dipstick or less than 1 g/L laboratory urinalysis for protein	Administer bevacizumab dose as scheduled
2+ or 3+ dipstick or greater than or equal to 1 g/L laboratory urinalysis for protein	Administer bevacizumab dose as scheduled. Collect 24-hour urine for determination of total protein within 3 days before the next scheduled bevacizumab administration. Adjust bevacizumab treatment based on the table below
If urine dipstick shows 4+ at baseline or during treatment	Withhold bevacizumab and proceed with 24 hour urine collection
24-hour urine total protein (g/24hr)	**Action**
less than or equal to 2	Proceed
greater than 2 to 4	Hold dose and recheck 24 hour urine every 2 weeks, resume therapy when less than or equal to 2g/24hour
greater than 4	Discontinue Therapy

SUPPORTIVE CARE:

EMETOGENIC POTENTIAL:

Bevacizumab Minimal **(Refer to local policy).**
CARBOplatin High (**Refer to local policy).**
PACLitaxel Low **(Refer to local policy).**

PREMEDICATIONS:

- All patients must be premedicated with corticosteroids, antihistamines, and H_2 antagonists prior to first dose of PACLitaxel treatment.
- The H_2 antagonist, famotidine, can potentially be omitted from the pre-medication requirements for PACLitaxel but the risk of hypersensitivity with this approach is unknown.
    - Caution is advised particularly for patients receiving PACLitaxel every 3 weeks. It is recommended that if famotidine is omitted that patients are monitored closely for any signs of hypersensitivity. Any hypersensitivity should be managed as per local policy.
    - Where a patient experiences hypersensitivity, consider the use of alternative H_2 antagonists **(Refer to local policy).**
- Table 6 outlines suggested premedications prior to treatment with PACLitaxel.

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Table 6: Suggested premedications prior to treatment with PACLitaxel

Drug	Dose	Administration prior to PACLitaxel
dexAMETHasone	20mg oral or IV[a,b]	For oral administration: approximately 6 and 12 hours or for IV administration: 30 minutes
Chlorphenamine	10mg IV	30 minutes
Famotidine[c]	20mg IV	30 minutes
[a]Dose of dexAMETHasone may be reduced or omitted in the absence of hypersensitivity reaction according to consultant guidance.		
[b]If aprepitant is added to the anti-emetic regimen, consideration should be given to reducing the dose of dexAMETHasone to 12mg on the day of treatment.		
[c]Dose of famotidine may be omitted in the absence of hypersensitivity reaction according to consultant guidance.		

OTHER SUPPORTIVE CARE:

- Myalgias and arthralgias may occur with PACLitaxel. Analgesic cover should be considered.
- Anti-diarrhoeal treatment may be required with Bevacizumab **(Refer to local policy).**

ADVERSE EFFECTS / REGIMEN SPECIFIC COMPLICATIONS

The adverse effects listed are not exhaustive. Please refer to the relevant Summary of Product Characteristics for full details.

Bevacizumab

- **Gastrointestinal perforations:** Patients may be at an increased risk for the development of gastrointestinal perforation and gall bladder perforation when treated with bevacizumab. Intra-abdominal inflammatory process may be a risk factor for gastrointestinal perforations in patients with metastatic carcinoma of the colon or rectum, therefore, caution should be exercised when treating these patients. Therapy should be permanently discontinued in patients who develop gastrointestinal perforation.
- **Wound healing complications:** Bevacizumab may adversely affect the wound healing process. Therapy should not be initiated for at least 28 days following major surgery or until the surgical wound is fully healed. In patients who experienced wound healing complications during therapy, treatment should be withheld until the wound is fully healed. Therapy should be withheld for major elective surgery for 28 days and for 7 days for minor surgery or as directed by the prescribing Consultant. Necrotising fasciitis, including fatal cases, has rarely been reported in patients treated with bevacizumab. This condition is usually secondary to wound healing complications, gastrointestinal perforation or fistula formation. Bevacizumab therapy should be discontinued in patients who develop necrotising fasciitis, and appropriate treatment should be promptly initiated.
- **Hypertension:** An increased incidence of hypertension has been observed in patients treated with bevacizumab. Clinical safety data suggest that the incidence of hypertension is likely to be dose-dependent.
    - Pre-existing hypertension should be adequately controlled before starting bevacizumab treatment. Bevacizumab may be continued in conjunction with standard anti-hypertensive therapy at physician's discretion.

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- Patients should have their blood pressure measured before each dose or more frequently if hypertension develops/worsens.
- Any patient who develops hypertension (>150/100 mmHg) should be treated with anti-hypertensive medications, or have their pre-existing medications adjusted. Patients developing severe hypertension (>200/110 mm Hg) or any symptomatic hypertension that is not controlled with medication should have bevacizumab permanently discontinued.

- **Posterior Reversible Encephalopathy Syndrome (PRES):** There have been rare reports of bevacizumab-treated patients developing signs and symptoms that are consistent with PRES, a rare neurologic disorder, which can present with the following signs and symptoms among others: seizures, headache, altered mental status, visual disturbance, or cortical blindness, with or without associated hypertension. A diagnosis of PRES requires confirmation by brain imaging, preferably magnetic resonance imaging (MRI). In patients developing PRES, treatment of specific symptoms including control of hypertension is recommended along with discontinuation of bevacizumab. The safety of reinitiating therapy in patients previously experiencing PRES is not known.
- **Proteinuria:** Patients with a history of hypertension may be at increased risk for the development of proteinuria.
- **Thromboembolism:** Patients receiving bevacizumab plus chemotherapy, with a history of arterial thromboembolism or age > 65 years have an increased risk of developing arterial thromboembolic reactions during therapy. Caution should be taken when treating these patients. Therapy should be permanently discontinued in patients who develop arterial thromboembolic reactions. Patients may be at risk of developing venous thromboembolic reactions, including pulmonary embolism under bevacizumab treatment. Bevacizumab should be discontinued in patients with life-threatening (Grade 4) thromboembolic reactions, including pulmonary embolism. Patients with thromboembolic reactions ≤ Grade 3 need to be closely monitored.
- **Haemorrhage:** Patients treated with bevacizumab have an increased risk of haemorrhage, especially tumour associated haemorrhage and minor mucocutaneous haemorrhage. Bevacizumab should be used with caution in patients at risk of bleeding.

CARBOplatin and PACLitaxel

- **Neutropenia:** This is the dose limiting toxicity. Fever or other evidence of infection must be assessed promptly and treated appropriately.
- **Hypersensitivity:** Reactions to CARBOplatin may develop in patients who have been previously exposed to platinum therapy. However allergic reactions have been observed upon initial exposure to CARBOplatin. Severe hypersensitivity reactions characterised by dyspnoea and hypotension requiring treatment, angioedema and generalised urticaria have occurred in <1% of patients receiving PACLitaxel after adequate premedication. In the case of severe hypersensitivity reactions, PACLitaxel infusion should be discontinued immediately, symptomatic therapy should be initiated and the patient should not be re-challenged with the drug.

CARBOplatin

- **Neurotoxicity and ototoxicity:** Neurological evaluation and an assessment of hearing should be performed on a regular basis, especially in patients receiving high dose CARBOplatin. Neurotoxicity, such as parasthesia, decreased deep tendon reflexes, and ototoxicity are more likely seen in patients

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previously treated with CISplatin, other platinum treatments and other ototoxic agents. Frequency of neurologic toxicity is also increased in patients older than 65 years.

PACLitaxel

- **Peripheral neuropathy:** Occurs frequently but the development of severe symptoms is rare. Dose reduction or discontinuation may be necessary.
- **Arthralgia/myalgia:** May be severe in some patients; however, there is no consistent correlation between cumulative dose and infusion duration of PACLitaxel and frequency or severity of the arthralgia/myalgia. Symptoms are usually transient, occurring within 2 or 3 days after PACLitaxel administration, and resolving within days.
- **Hepatic Dysfunction:** Patients with hepatic impairment may be at increased risk of toxicity, particularly grade 3-4 myelosuppression.
- **Extravasation:** PACLitaxel causes pain and tissue necrosis if extravasated **(Refer to local policy).**
- **Cardiac conduction abnormalities:** If patients develop significant conduction abnormalities during PACLitaxel administration, appropriate therapy should be administered and continuous cardiac monitoring should be performed during subsequent therapy with PACLitaxel. Hypotension, hypertension, and bradycardia have been observed during PACLitaxel administration; patients are usually asymptomatic and generally do not require treatment. Frequent vital sign monitoring, particularly during the first hour of PACLitaxel infusion, is recommended.

DRUG INTERACTIONS:

- Current drug interaction databases should be consulted for more information.

Bevacizumab:

- The safety and efficacy of concomitant administration of radiotherapy and bevacizumab has not been established.
- No interaction studies have been performed between EGFR antibodies and bevacizumab. EGFR monoclonal antibodies should not be administered for the treatment of mCRC in combination with bevacizumab-containing chemotherapy. Results from the randomised phase III studies, PACCE and CAIRO-2, in patients with mCRC suggest that the use of anti-EGFR monoclonal antibodies panitumumab and cetuximab, respectively, in combination with bevacizumab plus chemotherapy, is associated with decreased PFS and/or OS, and with increased toxicity compared with bevacizumab plus chemotherapy alone.
- Concurrent use of bevacizumab and sunitinib can increase the risk of microangiopathic haemolytic anaemia (MAHA).

CARBOplatin:

- Avoid concurrent use with nephrotoxic drugs (e.g. aminoglycosides, furosemide, NSAIDS) due to additive nephrotoxicity. If necessary, monitor renal function closely.
- Avoid concurrent use with ototoxic drugs (e.g. aminoglycosides, furosemide, NSAIDS). When necessary perform regular audiometric testing.

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PACLitaxel:

- Risk of drug interactions causing increased concentrations of PACLitaxel with CYP3A inhibitors.
- Risk of drug interactions causing decreased concentrations of PACLitaxel with CYP3A inducers.

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Version	Date	Amendment	Approved By
1	12/12/2022		Prof Maccon Keane
2	17/01/2024	Reviewed. Dose modifications for renal and hepatic impairment updated in line with recommendations by Giraud at al, 2023	Prof Maccon Keane

Comments and feedback welcome at oncologydrugs@cancercontrol.ie.

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