**MONOGRAPH**

**Vancomycin Monograph - Paediatric**

| Scope (Staff): | Clinical Staff – Medical, Nursing, Pharmacy |
| Scope (Area):  | PCH |

This document should be read in conjunction with this **DISCLAIMER**

**DESCRIPTION**

- Vancomycin is a glycopeptide antibiotic.
- It inhibits bacterial cell wall synthesis by preventing the formation of peptidoglycan polymers. Vancomycin also alters the bacterial cell membrane permeability and RNA synthesis.¹, ²
- Vancomycin is active against Gram-positive bacteria, including methicillin-resistant Staphylococcus aureus (MRSA), methicillin-resistant coagulase-negative staphylococcal species (e.g. Staphylococcal epidermidis and Enterococcus faecium) and penicillin-resistant Streptococcal or Enterococcal species.³, ⁴

**INDICATIONS AND RESTRICTIONS**

**IV: Monitored (orange) antibiotic**

- If the use is consistent with a standard approved indication, this must be communicated to ChAMP by documenting that indication on all prescriptions (inpatient and outpatient).
- The ChAMP team will review if ongoing therapy is required and/or if the order does not meet ChAMP Standard Indications.
- If use is not for a standard approved indication, phone approval must be obtained from ChAMP before prescribing.

**CONTRAINDICATIONS**

- Vancomycin is contraindicated in patients with a history of serious allergy to vancomycin.²
- Note: Red Man’s syndrome is not considered an allergy, however the infusion time should be extended – see administration section for further information.¹
- Vancomycin should not be recommenced in children who have developed airway or haemodynamic compromise on therapy.
- Vancomycin must not be given via intramuscular or subcutaneous injection due to the risk of ulceration and necrosis.⁵

**PRECAUTIONS**

- Vancomycin should be used cautiously in patients with a history of a serious reaction to teicoplanin, cross reactivity has...
occurred between teicoplanin and vancomycin.\(^{(2)}\)

- Caution should be taken in renal impairment or with the concurrent use of nephrotoxic and ototoxic agents (see 'dosing adjustment'). Ototoxicity may also be more common in patients with renal impairment.\(^{(2)}\)
- General anaesthetics can increase the risk of vancomycin infusion related adverse events. Ensure the vancomycin infusion is completed before induction.\(^{(2, 6)}\)
- Hearing impairment may increase the risk of ototoxicity from vancomycin use.\(^{(2)}\)
- Beware of extravasation as this may cause tissue necrosis.\(^{(5)}\)

<table>
<thead>
<tr>
<th>FORMULATIONS</th>
<th>Available at PCH:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• 500mg Vancomycin powder for injection vial (DBL brand®)</td>
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<tr>
<td></td>
<td>• 1g Vancomycin powder for injection vial (DBL brand®) – For CIVAS use only</td>
</tr>
<tr>
<td>Other formulations available:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 500mg and 1 gram Vancomycin powder for injection vial – multiple generic brands.</td>
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<table>
<thead>
<tr>
<th>DOSAGE</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>The doses listed below fall within the standard range. Higher doses may be prescribed for certain situations in consultation with Infectious Diseases or Clinical Microbiology.</td>
</tr>
<tr>
<td></td>
<td>Loading doses are not routinely recommended in paediatrics but can be used for serious infections in discussion with Infectious Diseases or Clinical Microbiology.</td>
</tr>
<tr>
<td></td>
<td>A loading dose should not exceed 30mg/kg (to a maximum of 1.5grams) once only.(^{(7)})</td>
</tr>
</tbody>
</table>

Doses should be based on the patients actual body weight in obese or overweight patients.\(^{(2)}\)

**Neonates (<1 month of age):**

Please refer to [Neonatal Medication Protocols](#).

**IV:**

**Initial dose:** 15mg/kg/dose (to a maximum of 750mg) 6 hourly.

*Subsequent doses may be increased incrementally based on serum trough levels (prior to the 4th dose) and renal function to a dose of 80mg/kg/day or 3 grams per day, whichever is less.\(^{(7, 8)}\)*

See dosage adjustment section below for further information on increasing doses.

- Initial dose (oncology/haematology patients): 20mg/kg/dose (to a maximum of 1gram) 8 hourly.\(^{(7)}\)
- Subsequent doses may be increased incrementally based on serum trough levels (prior to the 4th dose) and renal function to
Vancomycin monograph - paediatric

A dose of 80mg/kg/day or 3 grams daily, whichever is less.\(^{(9)}\)

- See dosage adjustment section below for further information on increasing doses.
- Patients with malignancy may have increased clearance and may require larger doses to achieve target trough levels.\(^{(10)}\)

**Continuous infusions:**

- If the maximum recommended dose does not result in therapeutic drug levels or if Hospital in the Home (HiTH) is required a continuous infusion may be used in consultation with Infectious Diseases or Clinical Microbiology.

**Initial dose (continuous infusion):** 60mg/kg/day (to a maximum of 3 grams over 24 hours.)

*Subsequent doses may be increased incrementally based on serum levels and renal function to a dose of 80mg/kg/day or 3 grams per day, whichever is less.*

- In the event that dose escalation to 80mg/kg/day or 3 grams per day does not achieve the target serum level (see monitoring section below), Infectious Diseases or Clinical Microbiology must be consulted prior to any further increases.

**Surgical prophylaxis:**

- 15mg/kg/dose (to a maximum of 750mg) via slow infusion (see administration section for further information).
- Vancomycin infusion should be started approximately 2 hours PRIOR to ‘knife to skin’ to allow therapeutic levels to be achieved.\(^{(11)}\)
- General anaesthetics can increase the risk of vancomycin infusion related adverse events. Ensure the vancomycin infusion is completed before induction.\(^{(2, 6)}\)

**Oral:**

Please refer to separate [oral vancomycin monograph](#).

**Inhalation:**

Please refer to separate [inhaled vancomycin monograph](#)

### DOSAGE ADJUSTMENT

**Dose adjustment in overweight or obese patients:**

- Dose obese patients based on [actual] body weight – shorter dosing intervals may be required to maintain serum trough levels.\(^{(2)}\)

**Dosage adjustment required in renal impairment:**

- Dosage adjustment is required in cases of impaired renal function.
- To calculate the estimated glomerular filtration rate (eGFR) use the following formula.\(^{(4)}\)
eGFR (mL/min/1.73m$^2$) = $36.5 \times$ height (cm)

Serum creatinine (micromol/L)

For further information refer to the **WA.MSG “Dose calculations for drugs cleared by glomerular filtration” quick reference guideline**

- This formula is based on a steady state creatinine clearance and is not applicable to patients with a rising serum creatinine.
- Treatment should be initiated at a 15mg/kg dose, but administered at intervals as detailed below.
- Future doses should be adjusted based on therapeutic drug monitoring as per the monitoring section below:
  - eGFR 70-89mL/minute/1.73m$^2$: 100% dose 8 hourly
  - eGFR 30-69mL/minute/1.73m$^2$: 100% dose 12 hourly
  - eGFR 15-29mL/minute/1.73m$^2$: 100% dose 24 hourly
  - eGFR < 15mL/minute/1.73m$^2$: 100% as a single dose with subsequent doses based on therapeutic monitoring.\(^{(9)}\)

- Contact Pharmacy for further information.

**Dosage adjustment required in patients undergoing ECMO (extracorporeal membrane oxygenation):**

Patients on ECMO have an increased circulating volume and transiently altered renal function. Initial dosage should be 20mg/kg/dose every 24 hours.\(^{(9, 10)}\)

**Patients with altered pharmacokinetics:**

Patients with severe burns have a larger volume of distribution and increased drug clearance and may require higher doses. All dose adjustments should still be based on therapeutic drug monitoring.\(^{(2)}\)

### RECONSTITUTION

<table>
<thead>
<tr>
<th>Vial strength</th>
<th>Volume of water required</th>
<th>Resulting concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>500mg</td>
<td>10mL</td>
<td>50mg/mL</td>
</tr>
<tr>
<td>1gram</td>
<td>20mL</td>
<td>50mg/mL</td>
</tr>
</tbody>
</table>

- Further dilute with compatible fluid to a final concentration of 5mg/mL (or 10mg/mL if fluid restricted).
- Refer to administration section below for further information.\(^{(5)}\)
- Use solution prepared by PCS when possible.

### ADMINISTRATION

**Intermittent IV infusion:**

- Dilute to a concentration of 5mg/mL or less and infuse over 60
### Continuous infusion:

Dilute to a final concentration of 5mg/mL or less and infuse over 24 hours.\(^{(5)}\)

### Loading dose:

All loading doses should be infused over a minimum of 2 hours to reduce the risk of infusion related reactions.

### Monitoring

A capillary blood sample is preferred for drug levels wherever possible (i.e. finger prick or heel prick for infants <6 months).

If unable to obtain via this method a venous sample can be taken. Note: levels must not be taken from a CVAD lumen used to administer the vancomycin.

#### Collection tube:

- **Paediatric** - Lithium Heparin (Green top) 1 mL (PST gel) or Serum (Red top) 1 mL (No Gel),
- **Neonatal** - Lithium Heparin (Green top) 600 uL (PST gel)
- **Minimum volume required**: 400 microlitres\(^{(12)}\)

#### Therapeutic drug monitoring (TDM):

All clinical staff involved in the care of the patient are responsible for ensuring regular therapeutic drug monitoring is conducted, reviewed and acted upon prior to the next dose being administered as outlined below.

- Trough level should be taken immediately prior to the 4\(^{th}\) or 5\(^{th}\) dose (18 to 24hr after the first dose) and repeated every 3 to 5 days thereafter with target levels\(^{(4)}\)

#### Standard range: 10-20mg/L\(^{(3)}\)

- The standard range should be used in cases of empiric therapy including empiric therapy for febrile neutropenia and skin and soft tissue infections.

#### Severe infections: 15-20mg/L\(^{(3)}\)

- Severe infections require higher levels and include proven deep tissue or blood stream infections and CNS infections, including meningitis.
- More frequent monitoring should be performed in patients with renal dysfunction and in patients on concomitant nephrotoxic drugs.
- In most circumstances, patients with an eGFR 15 to 69 ml/min/1.73m² should have a level taken before the second dose, the dose given, and subsequent doses adjusted in consultation with a clinical pharmacist and/or nephrologist.
- Patients on dialysis for acute kidney injury or continuous renal replacement therapy (CRRT) should have a level drawn after 12 hours.

**Initial dose adjustment based on TDM (for intermittent dosing):**(4)

**General patients:**

<table>
<thead>
<tr>
<th>Trough plasma concentration</th>
<th>Based on initial dose of 15mg/kg 6 hourly</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10mg/L</td>
<td>Increase dose to 20mg/kg/dose 6 hourly (maximum 3 grams per day)</td>
</tr>
<tr>
<td>≥ 10 to &lt;15mg/L (uncomplicated infection and/or clinically improving)</td>
<td>Maintain current dose</td>
</tr>
</tbody>
</table>
| ≥ 10 to <15mg/L (complicated or severe infection) | Increase dose to 20mg/kg/dose 6 hourly (maximum 3 grams per day)  
For patients who are already receiving the maximum dose of 80mg/kg/day or 3grams per day, contact Infectious Diseases or Clinical Microbiology for advice. |
| ≥ 15mg/L to <20mg/L         | Maintain current dosage |
| ≥ 20mg/L to <25mg/L         | Dose may not need adjustment, consider renal function and other contributing factors, contact ChAMP or pharmacy if unsure. |
| ≥ 25mg/L                    | Withhold dose until level is <20mg/L and investigate cause of the high level - Contact ChAMP or pharmacy for advice on the dose of vancomycin to restart. |
### Oncology/haematology patients:

<table>
<thead>
<tr>
<th>Trough plasma concentration</th>
<th>Based on initial dose of 20mg/kg 8 hourly</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10mg/L</td>
<td>Increase dose to 25mg/kg/dose 8 hourly (maximum 3 grams per day)</td>
</tr>
<tr>
<td>≥ 10 to &lt;15mg/L (uncomplicated infection and/or clinically improving)</td>
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| ≥ 10 to <15mg/L (complicated or severe infection) | Increase dose to 20mg/kg/dose 6 hourly (maximum 3 grams per day)  
For patients who are already receiving the maximum dose of 80mg/kg/day or 3grams per day, contact Infectious Diseases or Clinical Microbiology for advice. |
| ≥ 15mg/L to <20mg/L | Maintain current dosage |
| ≥ 20mg/L to <25mg/L | Dose may not need adjustment, consider renal function and other contributing factors, contact ChAMP or pharmacy if unsure. |
| ≥ 25mg/L | Withhold dose until level is <20mg/L and investigate cause of the high level - Contact ChAMP or pharmacy for advice on the dose of vancomycin to restart. |

- In the event that dose escalation to 80mg/kg/day or 3 grams per day does not achieve the target trough level (see monitoring section below) consider changing to a continuous vancomycin infusion, in consultation with Infectious Diseases and/or Clinical Microbiology.

**ANY further dose increases require approval from Infectious Diseases and/or Clinical Microbiology.**

### Area Under the Curve (AUC):

- Patients with a confirmed invasive MRSA infection, Area Under the Curve (AUC) monitoring can be used to guide clinical care.
- AUC measurements require a mathematical calculation that requires the recording of a number of specific times.
- Refer to the Vancomycin reporting form (MR 860.93) This form will be kept with the patient’s medical records for interpretation by the ward pharmacist, the results will be reported on the Vancomycin dosage calculation form (MR860.94).
- This monitoring is only available Monday to Friday. Contact the ChAMP Pharmacist for further information.
**Monitoring for continuous infusions:**
- Serum level should be measured 36 to 48 hours after commencement of the infusion with target levels between 20-25mg/L.\(^{(3)}\)
- Repeat levels should be conducted every three to five days throughout treatment.

**Additional monitoring:**
- Renal function and electrolytes should be performed twice weekly or when there are signs of renal dysfunction such as oliguria.\(^{(2, 3)}\)
- Patient’s fluid status should also be monitored.\(^{(3, 6)}\)

**Audiology should be considered in patients:**
- requiring long term courses (>2 weeks),
- who receive inadvertent high or toxic levels (>25mg/L),
- Receive concurrent ototoxic medications or
- With underlying hearing loss.\(^{(10)}\)

<table>
<thead>
<tr>
<th>ADVERSE EFFECTS</th>
<th>Red man syndrome:</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Red man syndrome is an infusion related reaction that occurs when vancomycin is administered too quickly.</td>
</tr>
<tr>
<td></td>
<td>Symptoms include: fever, chills, erythema, rash and may be followed by hypotension, angioedema and itch.</td>
</tr>
<tr>
<td></td>
<td>It is not an allergy and if further doses are required, the infusion rate should be slowed. Pre-treatment with an antihistamine may also assist.(^{(2)})</td>
</tr>
<tr>
<td></td>
<td><strong>Common:</strong> nausea, vomiting, abdominal pain, diarrhoea, local pain, thrombophlebitis, infusion related reactions, nephrotoxicity, hypotension, palpitations, tachycardia, fever, dizziness, pruritus, rash, flushing, reversible neutropenia, inflammation or irritation of injection site, hypokalaemia.</td>
</tr>
<tr>
<td></td>
<td><strong>Rare:</strong> Interstitial nephritis, serious skin reactions, Clostridium difficile-associated disease, anaphylaxis, hypersensitivity reactions (including; chills, urticaria, Stevens-Johnson syndrome, toxic epidermal necrosis, eosinophilia, angioedema, vasculitis, fever and rigors), ototoxicity, drug reaction with eosinophilia and systemic symptoms (DRESS), chemical peritonitis (with intra-peritoneal use).(^{(1, 2, 13)})</td>
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<table>
<thead>
<tr>
<th>COMPATIBLE FLUIDS</th>
<th>Glucose 5% and 10%</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Sodium chloride 0.9%</td>
</tr>
<tr>
<td></td>
<td>Hartmann’s(^{(5)})</td>
</tr>
</tbody>
</table>

| STORAGE               | Vials for reconstitution: below 25˚C and protect from light.\(^{(5)}\) |
Vancomycin has drug interactions; please consult PCH approved references (such as Clinical Pharmacology), your ward pharmacist or Pharmacy for more information

- Vancomycin can cause nephrotoxicity and ototoxicity. Caution should be taken with the concurrent use of nephrotoxic and ototoxic agents.\(^{(2, 6)}\)
- General anaesthetics can increase the risk of vancomycin infusion related adverse events. Ensure the vancomycin infusion is completed before induction.\(^{(2, 6)}\)
- Vancomycin may prolong the effects of suxamethonium, the dose of suxamethonium may require reduction.\(^{(2, 6)}\)
- The use of warfarin and vancomycin may increase the INR and increase the risk of bleeding.\(^{(2, 6)}\)

Oral dosing must never be used to treat a systemic infection due to poor oral absorption.\(^{(1)}\)

To access the Manufacturer SDS for this product, use the following link to ChemAlert.

**Please note: The information contained in this guideline is to assist with the preparation and administration of intravenous vancomycin. Any variations to the doses recommended should be clarified with the prescriber prior to administration**

### Related internal policies, procedures and guidelines

- Antimicrobial Stewardship Policy
- ChAMP monographs and guidelines

### References

6. Clinical Pharmacology [Internet]. Elsvier BV. 2018 [cited 22/02/2018]. Available from:


13. Micromedex 2.0 [Internet]. Truven Health Analytics. 2018 [cited 27/02/2018].

Useful resources

ChAMP intranet page

Neonatal Medication Protocols (WNHS)

WA.MSG “Dose calculations for drugs cleared by glomerular filtration’ quick reference guideline

This document can be made available in alternative formats on request for a person with a disability.