

Pharmacist-led prescribing and monitoring of antimicrobials

J. Taylor¹, A. Neels¹

1. Pharmacy Department, Barwon Health

Corresponding author: jmurna@barwonhealth.org.au



Barwon Health

Aim:

To describe the introduction of pharmacist-led prescribing, monitoring, and dose adjustment of vancomycin and gentamicin by credentialed pharmacists in accordance with protocol, Bayesian forecasting and best practice guidelines.

Background:

Vancomycin and gentamicin are antimicrobials with a narrow therapeutic window. Appropriate dosing is based on patient weight, renal function, infection site and severity of infection^[1]. Individualised treatment, adherence to guidelines and appropriate monitoring of drug levels is essential to optimise efficacy, avoid under-dosing and minimise potential adverse effects or toxicity.

The therapeutic target trough range for vancomycin is 15-20mg/L, or up to 25mg/L in certain cases^[2]. Sub-therapeutic levels, below 10mg/L, potentially lead to treatment failure or emergence of antimicrobial resistance^[2]. Supra-therapeutic levels, above 25mg/L, potentially expose the patient to toxicity and adverse effects.

Gentamicin monitoring is recommended when treatment is expected to last for more than 48 hours^[1]. Peak levels, trough levels and area under the curve (AUC) calculations are used to optimise treatment and minimise potential toxicity.

Spot audits of all vancomycin levels taken over a one month period in 2012, 2013 and 2016 showed poor achievement of vancomycin trough levels within the therapeutic target range.

	<10 mg/L	10-15 mg/L	15-20 mg/L	20-25 mg/L	>25 mg/L
2012	16% (n=17)	22% (n=24)	29% (n=31)	21% (n=23)	12% (n=13)
2013	23% (n=19)	26% (n=21)	18% (n=15)	18% (n=15)	15% (n=12)
2016	9% (n=16)	22% (n=40)	33% (n=58)	24% (n=43)	11% (n=21)

Potential reasons for vancomycin trough levels falling outside therapeutic target ranges were identified as:

- variation from hospital protocol
- no loading dose given
- incorrect loading dose based on mg/kg dose
- incorrect maintenance dose based on mg/kg dose
- incorrect dosing interval based on renal function
- incorrect timing of trough level

Following these audits, it was hypothesised that:

- pharmacist-led prescribing of vancomycin and gentamicin per protocol, using Bayesian forecasting, could result in patients reaching therapeutic levels faster, potentially improving patient outcomes, decreasing adverse effects and reducing length of stay; and
- pharmacist-led monitoring and requesting relevant pathology tests could result in cost savings by minimising unnecessary and untimely levels.

Current vancomycin protocol:

STEP 1 – Loading dose 25-30mg/kg^[2]

- Dose according to actual body weight
- Use lower range dosing for low body weight patients
- Discuss morbidly obese patients or doses above 2.5g with Infectious Diseases specialist or pharmacist

STEP 2 – Maintenance dose 15-20mg/kg^[2]

- Dose according to actual body weight
- Calculate creatinine clearance to determine frequency

Vancomycin Maintenance Regime	Creatinine Clearance mL/minute (as estimated by Cockcroft Gault equation)			
	<20 ml/min	20 to <60 ml/min	60 to 90 ml/min	>90 ml/min
	Use lower end of dosing range			
Dosing Frequency	48 hourly	Once daily	Twice daily	
Trough level due: (loading dose considered first dose)	48 hours after the first dose*	Before 3 rd dose	Before 4 th dose	
* Discuss dosing regime with ID/Pharmacy. Re-dosing only appropriate when trough level <20mg/L.				

STEP 3 - Monitoring

Recommended vancomycin target trough concentration is **15-20mg/L^[2]**.

Start monitoring immediately prior to third or fourth dose.

Method:

Approval for pharmacist-led dosing and monitoring was gained from Drugs and Therapeutics, Infection Prevention and Antimicrobial Stewardship Committees. All committees were highly supportive of the process.

A training package for pharmacists was developed in 2016. The Antimicrobial Stewardship (AMS) pharmacist presented education sessions to all pharmacists and prepared online training material to support clinical pharmacists to appropriately use DoseMe[®] pharmacokinetic modelling software.

A protocol was developed by the AMS pharmacist describing requirements for credentialed pharmacists to prescribe selected antimicrobials on the inpatient medication chart, order relevant pathology tests, and complete appropriate documentation in medical records.

From August 2016, all pharmacists completed a competency assessment to demonstrate appropriate use of DoseMe[®] pharmacokinetic modelling software to monitor and recommend dose adjustments for vancomycin and gentamicin. From October 2017, eligible pharmacists completed a second assessment using real-life case studies to demonstrate appropriate prescribing for individual patients.

After completion of both competency packages, credentialed pharmacists were able to prescribe and monitor selected antimicrobials.

Results:

In the first nine months, credentialed pharmacists received 22 referrals for vancomycin and one referral for gentamicin.

On five occasions, nurses prompted doctors to refer to credentialed pharmacists to facilitate pharmacist-led prescribing when the decision to prescribe vancomycin was made.

Interventions by credentialed pharmacists included:

- Prescribing vancomycin loading doses of 25-30mg/kg per protocol (n=11)
- Prescribing vancomycin maintenance doses of 15-20mg/kg per protocol (n=20)
- Prescribing gentamicin 4mg/kg per protocol (n=1)
- Identifying sub-optimal prescribing by doctors and prescribing correctional doses, achieving therapeutic targets within 48 hours of intervention (n=3)
- Ordering vancomycin trough levels at appropriate times (n=18)
- Cost saving by advising nurses against taking vancomycin levels at inappropriate times (n=4)
- Providing advice about appropriate vancomycin dosing and monitoring in haemodialysis (n=3)
- Transitioning from intermittent vancomycin dosing to continuous infusion prior to Hospital in the Home transfer, achieving therapeutic targets within 48 hours (n=3)

Credentialed pharmacists successfully achieved a high rate of vancomycin levels within the therapeutic target range. No patients had sub-therapeutic levels (<10mg/L) after 48 hours of treatment and only one patient had a supra-therapeutic (>25mg/L) level.

	<10 mg/L	10-15 mg/L	15-20 mg/L	20-25 mg/L	>25 mg/L
2018	0% (n=0)	17% (n=3)	55% (n=10)	22% (n=4)	6% (n=1)

Conclusion:

Credentialed pharmacists prescribed vancomycin and gentamicin per protocol, made appropriate recommendations for vancomycin loading and maintenance doses, appropriately used Bayesian forecasting to support clinical decision making and made appropriate dose adjustments when required.

Credentialed pharmacists requested true vancomycin trough levels at appropriate times, reduced the number of untimely levels and achieved a high percentage of trough levels within therapeutic target ranges.

Reference:

[1] Up to Date (2018) Vancomycin: Parenteral dosing, monitoring, and adverse effects in adults. Available online via www.uptodate.com [subscription required]

[2] Therapeutic Guidelines Antibiotic (2018). Available online via www.tg.org.au [subscription required]



OUR VALUES / RESPECT / COMPASSION / COMMITMENT / ACCOUNTABILITY / INNOVATION