COLLINGWOOD G&M HOSPITAL	Document: **Policy and Procedure**	Primary Manual: **Interprofessional**	Folder:
Title: **Pharmacist Adaptation and Therapeutic Drug Monitoring**			
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Purpose

This document intends to provide a guideline for Registered Clinical Pharmacists to adapt medication orders for patients of Collingwood General and Marine Hospital (CGMH).

Policy Statement

This policy will apply to the adaptation of medication orders and the ordering of laboratory tests by registered clinical pharmacists at CGMH. It will allow pharmacists to provide timely, safe and cost-effective patient-centered care by:

1. Facilitates timely access of medications for patients
2. Mitigating actual or potential drug-related problems
3. Improving efficacy of medication therapy through:
    - Optimization of medications to patient-specific factors and patient preferences
    - Ensuring continuity of care
    - Minimizing medication related harm

This policy will also provide guidance on management of narrow therapeutic index medications to ensure drug levels are taken appropriately to aid in management of dosing and avoidance of toxicity. Ancillary lab tests will allow for the safe monitoring of these medications including dose determinations and monitoring of potential toxicity or adverse effects.

This policy is in alignment with the Pharmacy Act that was passed in October 2012, to expand scope of pharmacists and the 2010, CSHP guidance document “Hospital Pharmacists: Information Paper on Direct Patient Care and Beyond”.

The Pharmacist must possess the knowledge, skills, and judgment to safely adapt prescriptions AND it must be in the interest of patient care for the pharmacist to intervene.

This policy applies only to patients over the age of 18. All patients under the age of 18 are excluded from this adaptation policy and pharmacists will need to contact the most responsible physician to discuss any potential medication issue.

Definitions

Adapt: to change a patient's prescription with respect to:

- the dose of the prescribed drug
- the dosage form of the prescribed drug
- the directions for use or frequency of the prescribed drug
- the route of administration for administering the prescribed drug
- the concentration, diluent or rate of administration of a medication administered through a parenteral route
- the duration of therapy

Procedure

1. Pharmacists shall adapt medication orders in situations such as, but not limited to:
    - The prescriber has written an order for pharmacist to adjust medications
    - Adapt dosage and/or frequency based on renal function (refer to *Appendix A: Renal Dose Adjustment medication List*)
    - Discontinue medications based on following criteria:
        - Duplicate therapy
        - Not available in the hospital AND deemed not required as per Non-formulary Drugs and Patient's Own Medications Policy and Procedure)
        - Patient not taking a medication ordered as continuation from home
    - Adapt the dosage form to optimize route of administration of the medication (example changing to an oral liquid for a tube fed patient) including substitution of a therapeutic equivalent formulary product
    - Adapt orders to correct inadvertent prescribing discrepancies such as dosage forms that do not exist
2. Medications requiring therapeutic drug monitoring for efficacy and to prevent toxicity. As part of this policy, Pharmacists can order required lab work to determine vancomycin IV (refer a*ppendix B*) and aminoglycoside levels (refer a*ppendix C)* and adjust medication doses to achieve target levels.
3. When adapting medication orders, pharmacists will ensure that:
    - they have adequate information to make appropriate therapeutic decisions
    - the medical needs of the patient are being met
    - the effectiveness of medication therapy is maintained or improved
    - the patient is not placed at increased risk

- the appropriate documentation and communication is completed
- they continue to manage and monitor the drug regimen in collaboration with the health care team

Weight Calculation:

- ABW – Actual body weight
- IBW – Ideal body weight
    - Female IBW = 45.5 + 2.3 (Height in inch - 60)
    - Male IBW = 50 + 2.3 (Height in inch - 60)
- DBW – Dosing body weight = 0.4 (ABW – IBW) + IBW

Creatinine clearance calculation:

Cockcroft-Gault equation for CrCl = $\frac{1.23 \times \text{Sex} \times (140 - \text{Age}) \times \text{Weight (kg)}}{\text{Serum Creatinine (µmol/L)}}$

For sex Female = 0.85, Male = 1.

If ABW is greater than 25% of IBW then DBW would be used in the Cockcroft Gault equation.

Appendix - A

Renal Dose Adjustment medication List

Antimicrobials	Non - antimicrobials
Amoxicillin	Acetaminophen & Tramadol (Tramacet)
Acyclovir	Allopurinol
Amoxicillin/Clavulanate	Cetirizine
Ampicillin	Colchicine
Cefazolin	Famotidine
Cefotaxime	Gabapentin
Ceftazidime	Gliclazide
Cefuroxime	Glyburide
Cephalexin	Ketorolac
Ciprofloxacin	Metformin
Clarithromycin	Metoclopramide
Fluconazole	Mirabegron
Gentamycin (See Appendix – C)	Pregabalin
Levofloxacin	Ranitidine
Meropenam	Rosuvastatin
Nitrofurantoin	Silodosin
Norfloxacin	Sitagliptin
Oseltamivir	Solifenacin
Penicillin G IV	Tolterodine
Penicillin V PO	
Piperacillin-Tazobactam	
Sulfamethoxazole/Trimethoprim	
Tetracycline	
Tobramycin (See Appendix – C)	
Vancomycin (See Appendix – B)	

Appendix - B

Vancomycin dosing adjustment guideline

Loading Dose:

- Indication:
  - Seriously ill patients when rapid attainment of target vancomycin trough is required (e.g. sever sepsis/bacteremia, MRSA pneumonia, etc).
  - Significant renal dysfunction in order to decrease time required to attain target troughs
- Dose: **20 mg/kg** using ABW, cap dose at 2000 mg
- Round to closest 250 mg increment. Round down for frail elderly, round up for more robust younger patients
- For patients who do not meet criteria for loading dose, initiate therapy with the maintenance dose

Maintenance Dose:

- Dose: **15 mg/kg** using (if under 100 kg use ABW, if over 100 kg use DBW).
- Maximum dose: 2000 mg/dose and 4000 mg/day.
- Round to closest 250 mg increment. Round down for frail elderly, round up for more robust younger patients.

Dosing interval:

CrCl (mL/min)	Dosing Interval		Timing of Trough prior to dose
	Trough 15-20 mg/L	Trough 10-15 mg/L	
> 80	Q12H (if older *or* more frail) Q8H (if younger *and* bigger)	Q12H	Pre – 4th (Q8H, Q12H) Pre – 3rd (Q24H) Pre – 2nd (> Q24H)
50 – 80	Q12H	Q24H	
25 – 49*	Q24H	Q36H to Q48H	
< 25*	Give a single dose, order vancomycin level at 24 hours then determine frequency.		
*Consider loading dose based on clinical scenario			

Target serum concentrations and infection:

Infection	Desired trough Level
- All MRSA infections - Invasive and/or deep space infections, including but not limited to: Osteomyelitis, Pneumonia, CNS infection, Endocarditis, Bacteremia, Prosthetic joint infection	15-20 mg/L
Uncomplicated skin and soft tissue infections Urinary tract infections	10-15 mg/L
vancomycin levels should always be maintained above 10 mg/L to avoid development of resistance	

Monitoring:

- Pharmacists may order levels and SCr to determine the dose and interval of Vancomycin.
- SCr at baseline and 2-3 times per week while on vancomycin. Check daily if at high risk of nephrotoxicity.
- Serum level monitoring is only indicated if duration of therapy is over 72 hours.
- For patients with good renal function, order a vancomycin trough pre-4th dose
- For patients with renal insufficiency, order vancomycin trough pre-2nd or 3rd dose
- Order levels during pharmacy hours preferably. Sometimes, it may be acceptable to order an initial trough level pre-5th dose if patient has *excellent* renal function, to assure time of level is during pharmacy hours.
- If stable renal function, and if initial levels were satisfactory, vancomycin trough levels should be monitored at least every 5-7 days. More frequent monitoring will be required if reduced or fluctuating renal function.
- Clinical judgment should guide the frequency of trough monitoring:
    - More frequent monitoring (i.e. every three days) is advisable in:
        i. Patients receiving aggressive dosing (i.e. to achieve sustained trough levels of 15-20 mg/L)
        ii. Patients at risk of nephrotoxicity (receiving concurrent nephrotoxins, i.e. aminoglycosides, amphotericin B, furosemide, cisplatin)
        iii. Patients with unstable (deteriorating or significantly improving) renal function
    - Less frequent monitoring (i.e. once weekly) may be considered in patients who are clinically stable and have had initial trough levels in the target range.
- Following dose changes, a second steady-state trough concentration should be ordered (prior to the 3rd dose of the new dosing schedule but can be as early as the second dose). Then continue monitoring as clinically appropriate.

Appendix - C

Gentamicin/Tobramycin dosing adjustment guideline

Extended (once daily dosing) aminoglycoside regimen or traditional (multiple daily dosing) regimen will be used for aminoglycoside dosing in adults. The pharmacist will determine the appropriate regimen based on baseline clinical data, creatinine clearance and assessment parameters as outlined in these guidelines.

Assessment of Extended versus Traditional dosing

Assess patient for appropriateness for either the extended aminoglycoside dosing regimen or the traditional multiple daily dose regimen

Patients are initiated on the extended regimen unless one of the following exclusion criteria is met:

- Pregnancy, Neonates or pediatrics
- Dialysis
- CrCl less than 40 mL/min
- Following medical conditions: Endocarditis, Ascites, Burns, Cystic fibrosis, Meningitis
- Synergy for enterococcus infections
- IM administration

Patients who meet one or more of the above criteria must have therapy initiated with the traditional dosing regimen.

Extended Gentamicin/Tobramycin dosing

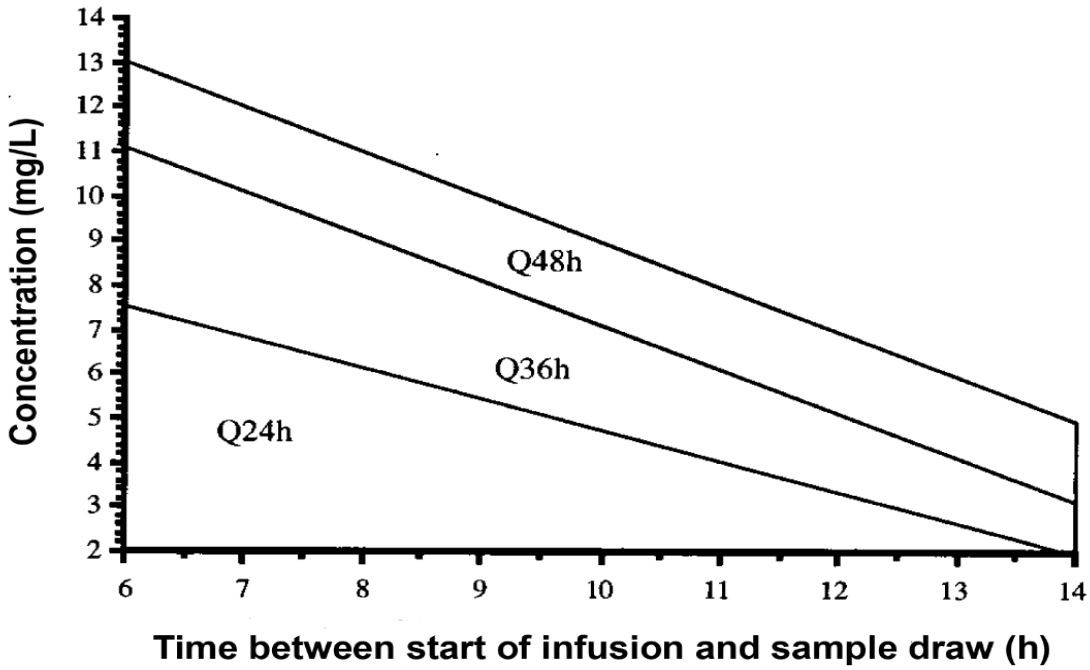
Pharmacists will determine appropriate dose and monitoring for patients who meet criteria for once daily extended interval dosing. Extended doing regimen only apply to dose 7mg/kg or 5 mg/kg.

Monitoring:

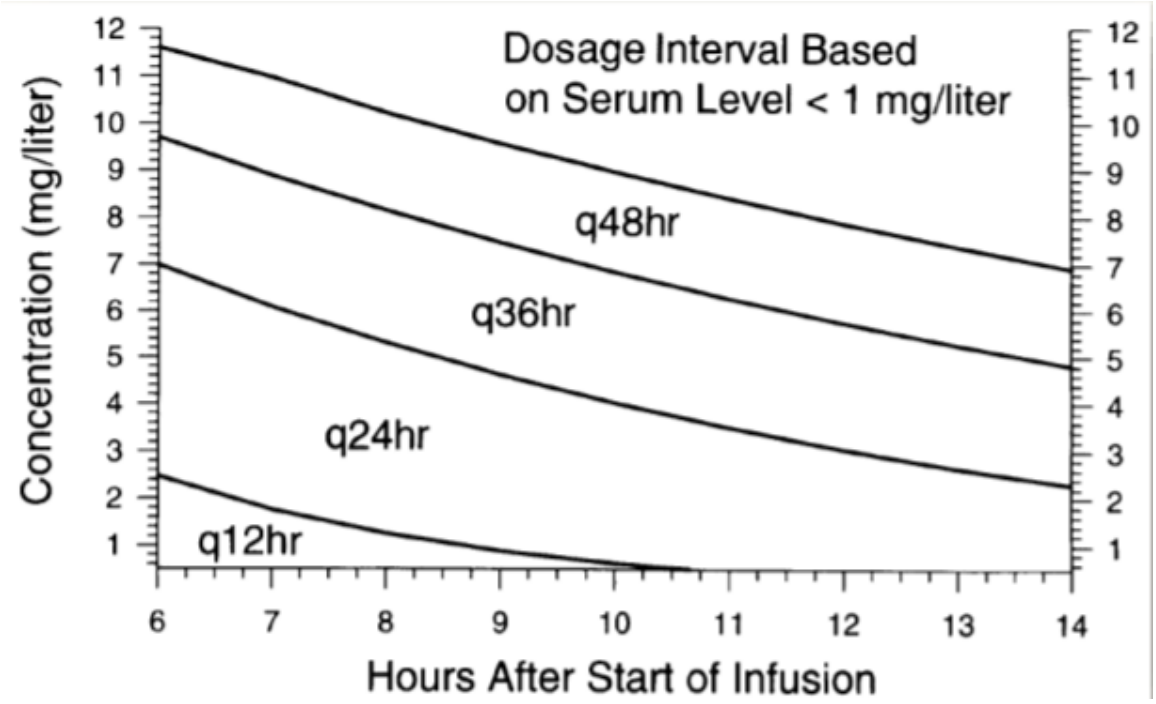
- Pharmacists may order levels and SCr to determine the dose and interval of Gentamicin or Tobramycin.
- For initial monitoring, a single level should be drawn 8-12 hours after the start of the first infusion. Follow-up trough testing should be done 30-60 minutes prior to a dose if the patient demonstrates acute changes in renal function or there is suspicion of extended interval failure.
- Use Hartford Nomogram for 7mg/kg dose and Urban & Craig Nomogram for 5mg/kg dose to calculate next appropriate dose and interval of Gentamicin or Tobramycin.

Interpretation of Aminoglycoside Interval level

1. **Hartford nomogram for Hartford Nomogram for 7mg/kg dose**



2. **Urban & Craig Nomogram for 5mg/kg dose**



Traditional Gentamicin/Tobramycin dosing

Pharmacists will determine appropriate dose and interval based on indication and CrCl (See table 1 and table 2)

Table 1 - Conventional Dosing for Gram Negative Infections

CrCl (mL/min)	Gentamicin/Tobramycin	Timing of Peak	Timing of Trough
> 60	1.7mg/kg Q8h	30 mins after 3rd dose	30 mins before 4th dose
40 to 60	1.7mg/kg Q12h	30 mins after 3rd dose	30 mins before 3rd dose
20 to 39	1.7mg/kg Q24h	30 mins after 2nd dose	30 mins before 2nd dose
< 20	Consult pharmacy		

Table 2 - Gram Positive Synergy Dosing

CrCl (mL/min)	Gentamicin/Tobramycin	Timing of Peak	Timing of Trough
> 60	1mg/kg Q8h	30 mins after 3rd dose	30 mins before 4th dose
40 to 60	1mg/kg Q12h	30 mins after 3rd dose	30 mins before 3rd dose
20 to 39	1mg/kg Q24h	30 mins after 2nd dose	30 mins before 2nd dose
< 20	Consult pharmacy		

Monitoring:

- Pharmacists may order levels and SCr to determine the dose and interval of Gentamicin or Tobramycin.
- To determine next appropriate dose and interval, pharmacist may order peak and trough level as per table 1 or table 2.

Appendix - D

Enoxaparin Dose Adjustment

Dose Rounding Tables for Treatment of ACS, DVT and PE with Enoxaparin

Weight (kg)	Enoxaparin dose for CrCl greater than 30mL/min (1 mg/kg/dose)	Enoxaparin dose for CrCl less than or equal to 30mL/min (1 mg/kg/dose)
Less than 36	Contact physician	Contact physician
25-35.9	30mg SC BID	30mg SC once daily
36-49.9	40mg SC BID	40mg SC once daily
50-69.9	60mg SC BID	60mg SC once daily
70-89.9	80mg SC BID	80mg SC once daily
90-109.9	100mg SC BID	100mg SC once daily
110-129.9	120mg SC BID	120mg SC once daily
130-159.9	150mg SC BID (120 mg + 30mg) SC BID ** use two separate syringes	150mg SC once daily

Weight (kg)	Enoxaparin dose for CrCl greater than 30mL/min (1.5 mg/kg/dose)
Less than 36	Contact physician
36-45.9	60mg SC once daily
46-55.9	80mg SC once daily
56-70.9	100mg SC once daily
71-85.9	120mg SC once daily
86-100.9	150mg SC once daily
Greater or equal to 101	Use BID dosing

References

1. Ontario College of Pharmacists. Initiating, Adapting and Renewing Prescriptions. http://www.ocpinfo.com/regulations-standards/policies-guidelines/adapting-renewing-prescriptions/. Updated December 2020.
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3. Headwaters Health Care Centre, Pharmacist Adaptation Policy for Adult Patients, updated January 2019.
4. Blondel-Hill E. & Fryters S. Bugs & Drugs 2012: An Antimicrobial/Infectious Disease Reference. Edmonton, AB. 2012.
5. Stanford Hospital & Clinics. Vancomycin Dosing Guidelines 2020. http://med.stanford.edu/bugsanddrugs/guidebook/_jcr_content/main/panel_builder_584648957/panel_0/download_2105810811/file.res/SHC%20Vancomycin%20Dosing%20Guide.pdf
6. Sunnybrook Health Sciences Centre “Renal dosing and Insufficiency: Drug dosing Consideration” https://sunnybrook.ca/content/?page=antimicrobial-stewardship-renal-dialysis, accessed December 2020.

Data Charts

Documents and tracks the progress of policy approval, revision, and archiving.

PATH	COMMITTEE	DATE	PURPOSE	STATUS
Originating Committee	Originally develops or revises policy	dd/mm/yy	**DRAFT Agreement**	☐ completed
Reviewing Committee	Provides input. Can agree with content but doesn't have approval authority	dd/mm/yy	**Review & Agreement**	☐ completed
Approving Committee	Final approval given	dd/mm/yy	**FINAL Approval**	☐ completed

Historical Dates:	
Original Policy Date:	Original date of development
List of Dates Reviewed and Revised:	List kept of each date of revision approval
Policies This Document Replaces	Tracks policy development and archival processes
Policy Archive Date:	Date a policy is retired and archived