UCSF Benioff Children's Hospitals

Aminoglycoside Guideline

Pediatrics

CONTENTS

This document was developed by the Pediatric Antimicrobial Stewardship Program

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HOW TO USE THESE GUIDELINES

These guidelines serve as a reference for clinical pharmacists at UCSF caring for pediatric patients receiving aminoglycosides (amikacin, gentamicin, and tobramycin).

The document is designed to be interactive, with hyperlinks for quick navigation between sections. Each section links back to the main page, though the guidelines may also be read straight through as a PDF.

Disclaimer

These guidelines are intended to support, not replace, clinical judgment. Always verify your work carefully. Pharmacokinetic principles should be applied in patients for empiric dosing and when calculating regimens based on aminoglycoside levels.

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WHY BAYESIAN MODELING?

Why we are using Bayesian modeling across all pediatric patient groups: neonates, infants, children, adolescents, and special populations.

- **Ease of use:** faster, simpler data entry.
- **Better documentation:** provides a complete record of each patient's pharmacokinetics.
- **More consistent care:** standardizes approach across pharmacists, reducing variability.
- **Flexibility:** accurately accounts for missed doses, dose changes, and renal fluctuations.
- **Future-proof:** aligns with best practices in therapeutic drug monitoring (TDM).

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NEONATES

1. Determine the initial dose

Determine the initial dose using the Gentamicin/Tobramycin ICN Dosing Card.

2. Determine the goal peak and trough

Gentamicin / Tobramycin		
	Goal Extrapolated Peak	**Goal Extrapolated Trough**
Gram-negative infections	8 to 12 mcg/mL	< 1 mcg/mL

Interpreting the trough: early levels are not steady-state levels.

A trough drawn prior to the 2nd dose is not a steady-state trough. It reflects elimination of the first dose only, before any accumulation has occurred, so a directly measured value that appears acceptable early will typically be higher once steady state is reached.

Example: a neonate on gentamicin q48h has a trough of 0.9 mcg/mL drawn prior to the 2nd dose. Against a goal of < 1 mcg/mL that looks acceptable, but the value represents washout from a single dose. As subsequent doses accumulate, the steady-state trough will be higher than 0.9 mcg/mL, and the regimen may need a longer interval.

Goal trough depends on how the value was obtained:

- Extrapolated to steady state using Bayesian software or something similar: **< 1 mcg/mL**
- Directly measured and not extrapolated using Bayesian software or something similar, or drawn prior to the 2nd dose: **< 0.5 mcg/mL**

3. Obtain serum concentrations

Patients on therapy for 48-hour rule out or with expected duration of therapy < 5 days **do not** routinely need therapeutic drug monitoring (TDM).

Situations where TDM **is** typically indicated:

- Expected duration of treatment is ≥ 5 days
- 24-hour urine output (UOP) is < 2 mL/kg/hour
- A pathogen is identified (this helps ensure extrapolated peak is a minimum of 8 to 10X MIC)

If a pathogen **is** identified, peak and trough monitoring is usually recommended. If blood volume is an issue, may need to limit to troughs only on a case-by-case basis.	If a pathogen is **NOT** identified, consider trough-based monitoring without peaks to ensure drug clearance.

Timing of TDM: obtain a trough level 30 minutes prior to dose. Obtain a peak level 30 minutes after end of infusion.

- q24h – prior to 3rd dose
- q36h and q48h – prior to 2nd dose

Do not hold doses while waiting for a level to result.

Aminoglycoside doses should be administered on schedule. Delaying a dose until a trough has resulted risks subtherapeutic exposure and prolongs the dosing interval unintentionally. There are two exceptions:

- The order is written as **aminoglycoside dose per levels**.
- The clinical pharmacist has specifically requested on a case-by-case basis that the dose be held pending a level.

4. Dose Adjustments

Whether to enter a level into Bayesian software depends on how it was obtained:

- **Peak and trough obtained, or two post-dose levels obtained:** use Bayesian software to estimate extrapolated peak and trough concentrations.
- **Trough-only monitoring with a quantifiable trough (≥ 0.5 mcg/mL):** consider entering into Bayesian software, especially if the trough was not drawn at steady state (see Step 2).
- **Trough-only monitoring with an undetectable trough (< 0.5 mcg/mL):** no need to enter into Bayesian software.

Apply Bayesian modeling to evaluate the current regimen and adjust therapy as clinically indicated. Model a new aminoglycoside regimen and recommend a new dosing regimen as needed.

For step-by-step instructions on how to perform Bayesian modeling, please refer to the Aminoglycoside PrecisePK Job Aid.

5. Continued Monitoring

Once at goal, the clinical pharmacist will obtain serum concentrations as described in step 3 once to twice weekly to verify appropriateness of dosing and make recommendations as needed.

More frequent serum concentrations are indicated in patients with changing clinical status, changing renal status, or concern for toxicity.

6. Documentation

A note is not required for initial dosing. Once a level has resulted, write a pharmacokinetic progress note in the patient's chart regardless of whether a dose adjustment was required or not.

Dotphrase = `.RXAMINOGLYCOSIDEPEDS`

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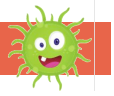
INFANTS / CHILDREN / ADOLESCENTS



1. Determine the initial dose

	Usual Dose	Dose Adjustment
Gentamicin	Treatment: 7 mg/kg/dose IV q24h Synergy: 3 mg/kg/dose IV q24h	Adjust for CrCl < 50 mL/min/1.73 m²* **Consider ASP/ID pharmacist consult for dose adjustment/level assessment*
Tobramycin	Treatment: 7 mg/kg/dose IV q24h	

Urinary tract infection (UTI): a smaller dose may be used.

For UTI, consider 5 mg/kg/dose IV q24h. Aminoglycosides are renally eliminated and achieve very high concentrations in the urine, so adequate exposure at the site of action can be achieved with a lower dose than is required for infections at other sites.

Monitoring for UTI: peak concentrations are not needed. Use trough monitoring only to confirm clearance. The goal extrapolated peak in step 2 does not apply when dosing for UTI.

2. Determine the goal peak and trough

Gentamicin / Tobramycin		
	Goal Extrapolated Peak	**Goal Extrapolated Trough**
Gram-negative infections (non-UTI)	15 to 30 mcg/mL	< 1 mcg/mL
Urinary tract infection (UTI)	NA	< 1 mcg/mL
Gram-positive synergy (gentamicin only)	NA	< 1 mcg/mL

3. Obtain serum concentrations

Patients on therapy for 48-hour rule out or with expected duration of therapy < 5 days **do not** routinely need therapeutic drug monitoring (TDM).

For synergy: obtain trough 2 to 4 days into therapy to ensure clearance.

Situations where TDM is indicated:

- Expected duration of treatment is ≥ 5 days
- CrCl < 50 mL/min/1.73 m²
- Rapidly declining renal function:
  - SCr > 50% increase from baseline, OR
  - 24-hour urine output (UOP) is < 2 mL/kg/hour (if available for younger patients)

If TDM is indicated:

Renal Function	When to obtain level	After which dose?
CrCl > 50 or CRRT	Post dose levels 2 and 6 hours after end of infusion	1st or 2nd dose
CrCl < 50	Post dose levels 2 and 12 hours after end of infusion	1st or 2nd dose
Intermittent hemodialysis (iHD), peritoneal dialysis (PD)	Level obtained prior to the hemodialysis treatment is recommended to guide dosing	1st dose

Do not hold doses while waiting for a level to result.

Aminoglycoside doses should be administered on schedule. Delaying a dose until a trough has resulted risks subtherapeutic exposure and prolongs the dosing interval unintentionally. There are two exceptions:

- The order is written as **aminoglycoside dose per levels**.
- The clinical pharmacist has specifically requested on a case-by-case basis that the dose be held pending a level.

4. Dosing Adjustments

Use Bayesian software to estimate extrapolated peak and trough concentrations. Apply Bayesian modeling to evaluate the current regimen and adjust therapy as clinically indicated.

For step-by-step instructions on how to perform Bayesian modeling, please refer to the Aminoglycoside PrecisePK Job Aid.

5. Continued Monitoring

- Once at goal, check serum concentrations weekly to confirm appropriate dosing.
- Monitor more often if clinical status, renal function, or toxicity risk changes.
- For synergy, obtain an initial trough and utilize weekly troughs thereafter to ensure clearance.

6. Documentation

A note is not required for initial dosing. Once a level has resulted, write a pharmacokinetic progress note in the patient's chart regardless of whether a dose adjustment was required or not.

Dotphrase = **`.RXAMINOGLYCOSIDEPEDS`**

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PEDIATRIC SPECIAL POPULATIONS

Please see our Benioff Children's Hospital Cystic Fibrosis Guidelines for further details.

1. Determine the initial dose

Prior to choosing a dosing regimen the clinical pharmacist should review the patient's previous aminoglycoside regimen(s) to determine if information from previous courses of therapy can aid in selecting dosing for a new course of treatment.

	Dose	Dose Adjustment
Amikacin	**Cystic fibrosis (CF):** 30 mg/kg/dose IV q24h **Nontuberculous mycobacteria (NTM):** 20 mg/kg/dose IV q24h	Adjust for CrCl < 50 mL/min/1.73 m²* **Consider ASP/ID pharmacist consult for dose adjustment/level assessment*
Tobramycin	10 mg/kg/dose IV q24h (max 15 mg/kg/dose)	

2. Determine therapeutic drug monitoring goals

CF and NTM – Extended Interval Dosing			
Tobramycin		**Amikacin**	
Goal Extrapolated Peak	**Goal Extrapolated Trough**	**Goal Extrapolated Peak**	**Goal Extrapolated Trough**
20 to 35 mcg/mL	< 1 mcg/mL	35 to 45 mcg/mL	< 5 mcg/mL

3. Obtain post dose serum concentrations

With extended interval dosing, after the **first dose** if possible. No need to wait for steady state as drug concentrations essentially go to 0 mcg/mL in between doses and drug is not expected to accumulate.

Renal Function	When to obtain level	After which dose?
CrCl > 50 or CRRT	Post dose levels 2 and 6 hours after end of infusion	1st or 2nd dose
CrCl < 50	Post dose levels 2 and 12 hours after end of infusion	1st or 2nd dose
Intermittent hemodialysis (iHD), peritoneal dialysis (PD)	Level obtained prior to the hemodialysis treatment is recommended to guide dosing	1st dose

Do not hold doses while waiting for a level to result.

Aminoglycoside doses should be administered on schedule. Delaying a dose until a trough has resulted risks subtherapeutic exposure and prolongs the dosing interval unintentionally. There are two exceptions:

- The order is written as **aminoglycoside dose per levels**.
- The clinical pharmacist has specifically requested on a case-by-case basis that the dose be held pending a level.

4. Dose Adjustments

Use Bayesian software to estimate extrapolated peak and trough concentrations. Apply Bayesian modeling to evaluate the current regimen and adjust therapy as clinically indicated.

For step-by-step instructions on how to perform Bayesian modeling, please refer to the Aminoglycoside PrecisePK Job Aid.

5. Continued Monitoring

- For stable regimens, obtain a trough once weekly to confirm clearance.
- Consider two post-dose levels for extrapolated peak/trough analysis about once monthly, or less frequently if the patient remains stable.
- Increase monitoring if doses, clinical status, renal function, or toxicity risk change.

6. Documentation

A note is not required for initial dosing. Once a level has resulted, write a pharmacokinetic progress note in the patient's chart regardless of whether a dose adjustment was required or not.

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