

SHC Antimicrobial Dosing Guidelines in Adults on Renal Replacement Therapies

These are general dosing guidelines for reference only. Doses may vary based on indications, severity, and/or patient factors. Please contact Pharm with questions/concerns

Consider adequate loading doses to ensure prompt attainment of steady state drug levels.

* Denotes antimicrobials which require ID review or are ID restricted

Considerations for Dose Selection	Acute Kidney Injury (AKI)	General Guidelines
<ul style="list-style-type: none"> - Indication - Severity of illness and clinical progress - Renal function +/- presence of renal replacement therapy - Weight/Height <p>For critically ill patients, medication dosing can be particularly complex given acute physiologic changes that accompany multi-system organ failure, which can be further complicated by any renal replacement therapies.</p>	<p>Function Criteria for AKI</p> <ol style="list-style-type: none"> i. ↑ SCr by 50% within 7 days OR ii. ↑ SCr by 0.3 mg/dL within 2 days OR iii. Oliguria (UOP <0.5mL/kg/hr) <p>Changes in pharmacokinetics/pharmacodynamics</p> <ol style="list-style-type: none"> i. ↑ Vd of hydrophilic drugs, alters protein binding, alters tissue penetration, ↓ systemic clearance ii. ↑ non-renal clearance that is often not measurable 	<ol style="list-style-type: none"> 1. No adjustment for initial dose often needed (e.g. loading dose) 2. Limit nephrotoxins, if possible 3. Renal replacement therapy may be initiated for: <ol style="list-style-type: none"> a. severe Acidosis (A) b. Electrolyte abnormalities (E) c. Intoxicates (I) d. refractory volume Overload (O) e. Uremia (U)

Comparison of Renal Replacement Therapies						
Modality		Clinical Utility	Factors ↑ Drug Removal		Calculation of CrCL	Estimation of CrCL
Conventional HD Traditional HD Circuit	IHD	<ul style="list-style-type: none"> ▪ Diffusion ▪ Rapid & efficient solute removal ▪ 3-4 hour sessions, usually 3x/week ▪ Advantage: rapid & large drug/toxins removal ▪ Can also be used for ultrafiltration 	MW <500 kDa Low protein binding (PB) Vd <0.8-1 L/kg		Assumed	<10mL/min
	SLED	<ul style="list-style-type: none"> ▪ Diffusion ▪ Gradual solute & volume removal ▪ Typically 8-12 hour sessions; may be continuous for 24 hours/day ▪ Advantage over IHD: ↑ hemodynamic control ▪ Advantage over CRRT: allows “time away” for procedures, no need for specialized solutions 			Unknown – varies with dialysis time. Clearance may be greater than with CVVHD due to higher dialysate flow rates	~30-50 mL/min
Peritoneal Dialysis	PD	<ul style="list-style-type: none"> ▪ Diffusion, osmolar gradient ▪ Home modality, patient convenience ▪ Available as CAPD and APD 	N/A (minimal drug removal – dependent on non-renal clearance)		Assumed	<10 mL/min
Continuous Renal Replacement Therapies (CRRT)	CVVH	<ul style="list-style-type: none"> ▪ Diffusion and convection ▪ Gradual solute removal with multiple modes ▪ Runs continuously ▪ Advantage: minimizes fluid shifts in hemodynamically unstable patients 	Convection	MW <15,000 kDa Low PB (<80%) Small Vd (<0.6 L/kg)	CVVH = UF x SC (mL/min)	~30 mL/min
	CVVHD		Diffusion	MW <500 kDa Low PB Small Vd (<0.6 L/kg)	CVVHD = Qd x SA	
	CVVHDF		Convection & Diffusion		CVVHDF = (UF + Qd) x SA	
	SCUF	<ul style="list-style-type: none"> ▪ Fluid removal only (no solute removal, cannot correct electrolyte abnormalities) 	Ultrafiltration	No drug clearance		CG calculated CrCL

Definitions: Diffusion=solutes move from high concentration to low; removes low MW solutes. Convection=solute-drag; removes small and large MW solutes.

Abbreviations: IHD=intermittent hemodialysis, SLED=sustained low efficiency dialysis, PD=peritoneal dialysis, CAPD=continuous ambulatory peritoneal dialysis; APD=automated peritoneal dialysis, CVVH=continuous veno-venous hemofiltration, CVVHD=continuous veno-venous hemodialysis, CVVHDF=continuous veno-venous hemodiafiltration, SCUF=slow continuous ultrafiltration, MW=molecular weight, Da=Dalton, PB=protein binding, Vd=volume of distribution, UF=ultrafiltration rate, SC=sieving coefficient, Qd=dialysis flow rate, SA=saturation coefficient

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Dosing Recommendations for Patients Receiving Renal Replacement Therapy

Drug	IHD	PD (IV or PO)	SLED [‡] <24 hrs/day
Acyclovir (IV)	2.5 – 5 mg/kg IV Q24	2.5 – 5 mg/kg IV Q24	[‡] 5 – 10 mg/kg IV Q12-24
*Amikacin (IV)	Refer to Aminoglycoside P&P	5 mg/kg IV x 1, then dose by levels	15 – 20 mg/kg IV Q48 Monitor levels and adjust dose
Ampicillin (IV)	1 – 2 g IV Q12	250 – 500 mg IV Q12	[‡] 1 – 2 g IV Q6-8
Ampicillin/sulbactam (IV)	1-5 – 3 g IV Q24	No data	[‡] 3 g IV Q8-12
Aztreonam (IV)	1 – 2 g IV Q24	1 – 2 g IV Q24	[‡] 1 – 2 g IV Q8-12
Cefazolin (IV)	500 mg – 1 g IV Q24 OR 2 g IV TIV post-HD	500 mg IV Q12	[‡] 1 – 2 g IV Q8-12
Cefepime (IV)	500 mg – 1 g IV Q24 OR 2 g IV TIV post-HD	1 – 2 g IV Q48	[‡] 1 g IV Q8-12
Ciprofloxacin (IV)	400 mg IV Q24	400 mg IV Q24	400 mg IV Q12-24
Ciprofloxacin (PO)	500 mg PO Q24	500 mg PO Q24	500 mg PO Q12-24
*Daptomycin (IV)	4-10 mg/kg IV Q48	4-10 mg/kg IV Q48	6 mg/kg IV Q24
Ertapenem (IV)	500 mg IV Q24	500 mg IV Q24	1 g IV Q24
Fluconazole (IV/PO)	100-200 mg Q24 400 mg Q48	No recommendation	[‡] 200 – 400 mg IV Q24
Gentamicin (IV)	Refer to Aminoglycoside P&P	2 mg/kg IV x 1, then dose by levels	6 mg/kg IV Q48 Monitor levels and adjust dose
*Imipenem/cilastatin (IV)	250 mg IV Q12	250 mg IV Q12	500 mg IV Q6
Levofloxacin (IV/PO)	750 mg x 1 dose, then 500 mg Q48 500 mg x 1 dose, then 250 mg Q48	750 mg x 1 dose, then 500 mg Q48 500 mg x 1 dose, then 250 mg Q48	[‡] 500 – 750 mg Q48
*Meropenem (IV)	500 mg IV Q24	500 mg IV Q24	1 g IV Q8
Oseltamivir (PO)	Treatment: 30 mg x 1, then 30 mg post HD Prophylaxis: 30 mg x1, then 30 mg post every other HD	Treatment: 30 mg x 1 dose only Prophylaxis: 30 mg x 1, then 30 mg once weekly for duration of prophylaxis	Treatment: [‡] 30 mg PO BID Prophylaxis: [‡] 30 mg PO daily
Penicillin G (IV)	1 – 2 MU IV Q6	No data	[‡] 2 – 4 MU IV Q6
Piperacillin/Tazobactam (IV)	2.25 g IV Q8 over 30 min	2.25 g IV Q8 over 30 min	[‡] 3.375 g – 4.5 g IV Q8
Tobramycin (IV)	Refer to Aminoglycoside P&P	2 mg/kg IV x 1, then dose by levels	6 mg/kg IV Q48 Monitor levels and adjust dose
Vancomycin (IV)	15-20 mg/kg IV Q24-48 Monitor levels and adjust dose	15-20 mg/kg IV Q24-48 Monitor levels and adjust dose	15-20 mg/kg IV Q24 Monitor levels 12-18 hours after dose and adjust dose
<p>‡Drug clearance, and therefore drug dosing, varies by number of hours per day patient is dialyzed. Literature reports frequent under-dosing. More aggressive dosing is recommended for patients being dialyzed longer hours/day and/or for severe infections. For patients on continuous SLED, dose as CrCL >50mL/min. Monitor patients closely for therapeutic failure and drug toxicity.</p>			
<p>[‡]No clear recommendation in literature. Recommendations based on estimated CrCL 15-50mL/min, depending on hours per day of dialysis</p>			

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IntraPERITONEAL Administration of Antibiotics

- Intended only for local peritoneal infections (peritonitis) only. Antibiotics are administered via peritoneal dialysate fluid.
- For systemic infections or intravenous administration of antibiotics, please refer to “Dosing Recommendations for Patients Receiving Renal Replacement Therapy”

Intraperitoneal Antibiotic Dosing Recommendations for Continuous Ambulatory PD (CAPD) Patients¹

Drug	Intermittent ² (dosed per exchange, give once daily unless specified)	Continuous ³ (dosed per mg/mL, give in all exchanges)
*Amikacin	2 mg/kg	LD 25 mg/L, MD 12 mg/L
Ampicillin	No data	MD 125 mg/L
Ampicillin/sulbactam	3 g Q12	LD 750-1000 mg/L, MD 100 mg/L
Aztreonam	2 g	LD 1000 mg/L, MD 250 mg/L
Cefazolin ⁴	15-20 mg/kg	LD 500 mg/L, MD 125 mg/L
Cefepime	1 g	LD 250-500 mg/L, MD 100-125 mg/L
Ceftazidime	1 – 1.5 g	LD 500 mg/L, MD 125 mg/L
Ceftriaxone	1 g	No data
Ciprofloxacin	No data	MD 50 mg/L
*Daptomycin	No data	LD 100 mg/L, MD 20 mg/L
Fluconazole	200 mg IP Q24-48H	No data
Gentamicin	0.6 mg/kg	LD 8 mg/L, MD 4 mg/L
*Imipenem/cilastatin	500 mg in alternate exchange	LD 250 mg/L, MD 50 mg/L
*Linezolid	600 mg PO BID	600 mg PO BID
*Meropenem	1 g	No data
Penicillin G	No data	LD 50,000 units/L, MD 25,000 units/L
Piperacillin/tazobactam	No data	LD 4.5 g, MD 1.125 g/bag
Tobramycin ⁵	0.6 mg/kg	LD 3 mg/kg, MD 0.3 mg/kg/bag
Trimethoprim/Sulfamethoxazole	1 DS tab PO BID	1 DS tab PO BID
Vancomycin ^{5,6}	15-20 mg/kg Q5-7 days	LD 30 mg/kg, MD 1.5 mg/kg/bag
*Voriconazole	2.5 mg/kg	No data

¹ For patients with residual renal function, defined as (>100 mL/day of urine output), dose should be empirically increased by 25%

² Intermittent dosing: Intraperitoneal antibiotics given once daily. Antibiotic-containing peritoneal dialysate should be allowed to **dwelt for at least 6 hours** to allow adequate absorption

³ Continuous dosing: Intraperitoneal antibiotics given in each exchange. Dosed by mg per L of dialysate (unless otherwise specified)

⁴ For AUTOMATED PERITONEAL DIALYSIS patients, continuous dosing of first-generation cephalosporins is recommended instead of intermittent dosing to ensure sufficient concentrations

⁵ Monitor serum levels to ensure drug is not accumulating and contributing to toxicity

⁶ AUTOMATED PERITONEAL DIALYSIS patients may require supplemental doses

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General Dosing Recommendations for Patients Receiving Continuous Renal Replacement Therapies (CRRT)

- These dosing recommendations are based on the assumption that the patient has minimum residual renal function, normal hepatic function, and the CRRT circuit is running continuously.
- In renal failure, time to reach steady state of renally eliminated antibiotics is slower. CRRT patients may also frequently exhibit increased volume of distribution (Vd) due to altered physiology, fluid status, etc. **Therefore, a loading dose is recommended. For patients with sepsis, consider higher dosing of antibiotics (i.e. CrCl>50 mL/min) for the first 24-48 hours.**
- Monitor patients for interruptions (e.g. clotting) or changing filtration rates. When CRRT is off, adjust dose based on residual renal function.

Anti-infectives that DO NOT require dose adjustments during CRRT:

- | | | |
|------------------|----------------|--|
| • Amphotericin B | • Azithromycin | • Ceftriaxone |
| • Clindamycin | • Doxycycline | • Linezolid |
| • Metronidazole | • Micafungin | • Nafcillin |
| • Rifampin | • Tigecycline | • Voriconazole PO (PO loading doses recommended for treatment) |

CRRT Dosing Recommendations (includes CVVH and CVVHD)

DRUG	Loading Dose	DOSE BY DIALYSATE FLOW RATE			Standard Anephric Dose
		1 L/h	2 L/h	3-4 L/h ^a	
ANTIBACTERIALS					
Aminoglycosides¹					
Amikacin	10 mg/kg	Refer to Aminoglycoside P&P			
Gentamicin/Tobramycin	3 mg/kg				
Amoxicillin^a					
	NA	500 mg Q12	500 mg Q12	500 mg Q8	500 mg Q24
Amoxicillin/Clavulanate^a					
	NA	500 mg Q12	500 mg Q12	500 mg Q8	500 mg Q24
Ampicillin IV¹⁻³					
UTI, Mild infection	2 g	1 g Q8	1 g Q8	1 g Q6	1 g Q12-24
Mod-Severe infection		2 g Q8	2 g Q8	2 g Q6	2 g Q12-24
Endocarditis/Meningitis ^a		2 g Q6-8	2 g Q6	2 g Q4	2 g Q12
Ampicillin/sulbactam¹⁻³					
Mild-Mod infection	3 g	1.5 g Q8-12	1.5 g Q8	1.5 g Q6	1.5 g Q24
Severe infection		3 g Q8-12	3 g Q8	3 g Q6	3 g Q24
Aztreonam¹⁻²					
Mild-Mod infection	2 g	1 g Q12	1 g Q12	1 g Q8	1 g Q24
Severe infection		2 g Q12	2 g Q12	2 g Q8	2 g Q24

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DRUG	Loading Dose	DOSE BY DIALYSATE FLOW RATE			Standard Anephric Dose
		1 L/h	2 L/h	3-4 L/h ^a	
Cefazolin¹⁻²					
Mild-Mod infection	2 g	1 g Q12	1 g Q8	1 g Q8	500 mg Q24
Severe infection		2 g Q12	2 g Q8	2 g Q8	1 g Q24
Cefepime¹⁻⁶					
Standard Dose	2 g	1 g Q12	1 g Q12	1 g Q8	500 mg Q24
Neutropenic fever, Meningitis, CF, Pseudomonas		2 g Q12	2 g Q12	2 g Q8	1 g Q24
Cefotetan^{2,5}					
	2 g	1-2 g Q24	1-2 g Q24	1-2 g Q12	500 mg Q24
Cefoxitin⁵					
	2 g	1-2 g Q12	1-2 g Q8	1-2 g Q6	1 g Q24
Ceftazidime^{1-3,5}					
Pseudomonas	2 g	2 g Q12	2 g Q12	2 g Q8	1 g Q24
Cefuroxime PO⁵					
	NA	500 mg Q12			500 mg Q24
Ciprofloxacin IV^{1-3,7-8}					
Standard Dose	NA	400 mg Q24	400 mg Q12	400 mg Q12	400 mg Q24
Pneumonia, Severe Infection, Pseudomonas, A. baumannii		400 mg Q12	400 mg Q8	400 mg Q8	400 mg Q24
Ciprofloxacin PO^a					
Mild-Mod infection	750 mg	500 mg Q24	500 mg Q24	500 mg Q12	500 mg Q24
Pneumonia, Severe Infection		750 mg Q24	750 mg Q24	750 mg Q12	750mg Q24
Colistin Base^{1-3, 9-10, b}					
	5 mg/kg (max 300 mg)	2.5 mg/kg Q24	2.5 mg/kg Q12	2.5 mg/kg Q12	1.25 mg/kg Q24
Daptomycin^{1-3,11-13, c}					
	NA	8 mg/kg Q48	8 mg/kg Q48	8 mg/kg Q24	8 mg/kg Q48
Ertapenem^{1-3,14}					
	1 g	1 g Q24			500 mg Q24
Imipenem/Cilastatin^{1-3,15-16}					
Standard Dose	1 g	500 mg Q12	500 mg Q8-12	500 mg Q6-8	250 mg Q12
Weight ≤ 50 kg		250 mg Q12	250 mg Q12	250 mg Q6-8	250 mg Q12
Levofloxacin IV/PO^{1-3,5,7,17}					
All other indications	750 mg	500 mg Q48	750 mg Q48	750 mg Q24	500 mg Q48h
Cystitis or weight <45 kg		250 mg Q24	250-500 mg Q24	500 mg Q24	250 mg Q48h

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DRUG	Loading Dose	DOSE BY DIALYSATE FLOW RATE			Standard Anephric Dose
		1 L/h	2 L/h	3-4 L/h ^a	
Meropenem^{1-3, 18-20}					
Standard Dose	1 g	500 mg Q8	500 mg Q8	500 mg Q6	500 mg – 1 g Q24
Meningitis, Cystic Fibrosis	2 g	2 g Q12	2 g Q12	2 g Q8	2 g Q24
Penicillin G IV^{1-2,5}					
	4 mu	2 mu Q6	2-4 mu Q6	2-4 mu Q4	1-2 mu Q6
Piperacillin/tazobactam²¹⁻²²					
4-hr infusion (Extended Interval)					
UTI, Mild infection	4.5 g	3.375 g Q8			3.375 g Q12
Mod-Severe Infection		4.5 g Q8			4.5 g Q12
TMP/SMX (Bactrim/Septra) IV/PO^{1-2,23}					
UTI	NA	Equiv to 1 DS tab Q24	Equiv to 1 DS tab Q12-24	Equiv to 1 DS tab Q12	Equiv to 1 DS tab Q24
Mild-Mod Infection	5 mg/kg (of TMP)	2.5 mg/kg (of TMP) Q12	2.5 mg/kg (of TMP) Q12	2.5 mg/kg (of TMP) Q8	2.5 mg/kg (of TMP) Q24
Severe Infections, PCP	10 mg/kg (of TMP)	5 mg/kg (of TMP) Q12	5 mg/kg (of TMP) Q12	5 mg/kg (of TMP) Q8	5 mg/kg (of TMP) Q24
Vancomycin IV¹⁻³					
	20-25 mg/kg	Refer to Vancomycin P&P			
ANTIFUNGALS					
Fluconazole IV/PO^{1-3,24-25}					
Candidal UTI	200 mg	100 mg Q24	200 mg Q24	200 mg Q24	100 mg Q24
Systemic Infection	800 mg	200 mg Q24	400 mg Q24	400 mg Q24	200 mg Q24
Meningitis	800 mg	600 mg Q24	800 mg Q24	800 mg Q24	400-600 mg Q24
Voriconazole IV²					
	NA	Intravenous voriconazole is not recommended for CrCl<50 ml/min due to accumulation of the intravenous vehicle (cyclodextrin). Consider PO voriconazole. Utilize IV formulation only if benefit exceeds risks.			
ANTIVIRALS					
Acyclovir^{1,3}					
Genital HSV	NA	5 mg/kg Q24	5 mg/kg Q24	5 mg/kg Q12	2.5 mg/kg Q24
HSV CNS Disease, VZV, Shingles		7.5 mg/kg Q24	10 mg/kg Q24	10 mg/kg Q12	5 mg/kg Q24
Ganciclovir¹⁻²					
CMV Induction or Prophylaxis	5 mg/kg	2.5 mg/kg Q24	2.5 mg/kg Q12-24	2.5 mg/kg Q12	1.25 mg/kg 3x/week
Maintenance	NA	1.25 mg/kg Q24	1.25-2.5mg/kg Q24	2.5 mg/kg Q24	0.625 mg/kg 3x/week
Oseltamivir^{5,26-27}					
Treatment	NA	75 mg BID			30 mg 3x/week
Prophylaxis		75 mg Q24			30 mg 2x/week

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Peramivir ²⁸	Loading Dose	DOSE BY DIALYSATE FLOW RATE			Standard Anephric Dose
		1 L/h	2 L/h	3-4 L/h ^a	
	NA	200 mg Q24	600 mg Q24	600 mg Q24	100 mg x1 then 15 mg Q24

^a Limited data available. Dosing recommendations are based on clinical judgment and assessment of drug pharmacokinetic & pharmacodynamics properties.

^b Use ideal body weight in obesity.

^c Use actual body weight.

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