LOS ANGELES COUNTY DEPARTMENT OF HEALTH SERVICES
HARBOR-UCLA MEDICAL CENTER

SUBJECT: RENAL DOSE ADJUSTMENTS FOR ADULTS **POLICY NO.** 325H

CATEGORY: Provision of Care	**EFFECTIVE DATE:** 12/14
POLICY CONTACT: Jennie Ung, PharmD	**UPDATE/REVISION DATE:** 7/22
REVIEWED BY COMMITTEE(S): Pharmacy and Therapeutics	

PURPOSE:
To ensure appropriate dosing of specified medications in renally compromised adult patients to reduce the potential for toxicity.

POLICY:
The pharmacists at Harbor-UCLA Medical Center will monitor and adjust medication therapy for adult patients with compromised renal function. The adjustments will be made automatically according to the medical staff-approved therapeutic guidelines.

DEFINITIONS:
Acute Kidney Injury (AKI): rise in serum creatinine (SCr) by 0.3mg/dL or ≥ 1.5 times the baseline serum creatinine value within 48 hours, or an increase ≥ 1.5 times the baseline serum creatinine value within 7 days; urine volume <0.5mL/kg/hr for 6 hours.

Cockroft and Gault Equation to calculate creatinine clearance (CrCl):
Creatinine clearance in adults is estimated with the following equations:
Males: CrCl (mL/min) = [(140-age) x IBW] / (SCr x 72)
Females: CrCl (mL/min) = [(140-age) x IBW x 0.85] / (SCr x 72)

Ideal Body Weight (IBW):
Patients taller than 5 feet:
Males: IBW (kg) = 50 + (2.3 x height in inches over 5 feet)
Females: IBW (kg) = 45.5 + (2.3 x height in inches over 5 feet)

Patients shorter than 5 feet:
Males IBW (kg) = 50 - (2.3 x height in inches under 5 feet)
Females IBW (kg) = 45.5 - (2.3 x height in inches under 5 feet)

REVISED: 10/16, 4/17, 2/19, 7/22
REVIEWED: 12/14, 10/16, 4/17, 2/19, 7/22

APPROVED BY:

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Obese: Patient weighing more than 130% of IBW
Patient weighing more than 130% of IBW: Use Adjusted Body Weight (Adj BW)
Adj BW = IBW + [(Actual body weight – IBW) x 0.4]

Patient weighing less than IBW, use actual body weight (ABW)

PROCEDURE:

1. For patient without AKI, upon order verification, the pharmacist will estimate renal function based on SCr and calculate CrCl using the Cockroft-Gault equation (See Definitions section), urine output, and other renal modalities such as intermittent hemodialysis and continuous renal replacement therapy.
   a. For patients with SCr below 0.8mg/dL or patients with muscular dystrophy or other conditions with reduced skeletal muscle mass or extremity amputation, the pharmacist will round SCr up to 0.8mg/dL to prevent over-estimation of CrCl.
2. At the time the medication order is received by the pharmacy, the pharmacists may order BUN and SCr if:
   a. No results available in the past 72 hours for patients with stable renal function.
   b. No results available in the past 24 hours for patients with unstable renal function or patients with AKI.
   3. For patient with AKI:
      a. If serum creatinine is increasing by greater than 0.3mg/dL per 24 hours, CrCl of less than 15 mL/min should be used for dosing certain medications (see Appendix A).
      b. If serum creatinine is fluctuating by less than 0.3mg/dL or decreasing per 24 hours, use the Cockroft and Gault equation.
      c. When drug levels are available for dosing, use levels to dose.
4. The pharmacist shall make any necessary dose and/or frequency modifications using the approved renal dosing guidelines (See Appendix A). The modified order will be entered into the electronic health record (eHR) as “Per Protocol—No Cosign Required”.
5. If and when the renal function improves, the pharmacist will readjust dose and/or frequency using the approved renal dosing guidelines (Appendix A).
6. The pharmacist will make any necessary dose and/or frequency modification recommendations to the prescriber for pediatric and neonatal patients.

The pharmacist will document interventions in the pharmacy intervention program and specify which medications were adjusted.

Reviewed and approved by:
Medical Executive Committee 07/2022

Beverley A. Petrie

Beverley A. Petrie, M.D.
President, Professional Staff Association

APPENDIX A: Renal Dosing Guideline for Adult Patients (CrCl less than 60mL/min)

Drug	CrCl (mL/min)	Dosing Recommendations	Dialysis Dosing Information & other comments
Acetazolamide[1] (Diamox)	>50 10-50 <10	250mg q6-12h 250mg q12h Avoid	High risk in AKI- can cause AMS
Acyclovir[1,2] (Zovirax)	**IV**: >50 25-50 10-24 <10 **Oral:** ≥10 <10 ≥10 <10 >25 10-25 <10	**IV**: 5-10 mg/kg q8h (max 20mg/kg/dose for varicella-zoster in immunocompromised patients) 5-10 mg/kg q12h 5-10 mg/kg q24h 2.5-5 mg/kg q24h **Oral:** **Initial genital herpes infections (400 mg for initial rectal herpes)** 200mg q4h, 5x/day 200mg q12h **Chronic prophylaxis of recurrent episodes of genital herpes infections** 400mg q12h 200mg q12h **Acute herpes zoster in non-immunocompromised adults (For herpes zoster opthalmicus in non-immunocompromised adults, 600 mg q4h, 5x/day)** 800mg Q4h, 5x/day 800mg Q8h 400mg Q12h	Use ABW or Adj BW if obese HD: Dose post HD 2.5-5mg/kg q24h PD: 2.5mg/kg q24h CVVHDF: 5-10 mg/kg q12-24h High risk can cause AKI if dosed too high
Allopurinol (Zyloprim)	>60 10-60 <10	Up to 800mg(max) daily 100 to 200mg daily (for tumor lysis syndrome: 50% dose reduction) 100mg q2-3 days	Based on standard MD of 300mg daily HD: 100mg post HD (can increase to 300mg based on response); supplement 50% of dose post HD if on daily dialysis
Amantadine (Symmetrel)	>50 30-50 15-29 <15	100mg q12h 200mg x1, then 100mg q24h 200mg x1, then 100mg q48h 200mg every 7 days	HD: 200mg every 7 days
Amikacin	Renally eliminated, contact provider with dose adjustment recommendation		
Amoxicillin/ Clavulanate (Augmentin)	≥30 10-<30 <10	250-500mg q8h or 875mg q12h 250-500mg q12h 250-500mg q24h	HD: 250-500mg q24h post HD PD: 250mg q12h CrCl < 30: Do not use 875mg tablet or extended release
Ampicillin Sodium Inj	≥50 30-<50 15-<30 <15 ≥50 30-<50 15-<30 <15	1-2g q6h 1-2g q8h 1-2g q12h 1-2g q24h **Septicemia/endocarditis/meningitis**: 2g q4h 2g q6h 2g q8h 2g q12h	HD: 1-2g q24h post HD PD: 1-2g q24h CVVHDF: 2g q8h HD: Dose post HD 2g q12h PD: 2g q12h CVVHDF: 2g q6h
Ampicillin / Sulbactam Sodium (Unasyn) **Restricted to ID**	≥30 15-29 5-14	1.5g-3g q6h (Max:12g/day) 1.5g-3g q12h 1.5g-3g q24h	HD: Dose post HD 1.5-3 q12h-24h PD: 1.5g q12h or 3g q24h CVVHDF: 1.5-3g q6-8h

Drug	CrCl (mL/min)	Dosing Recommendations	Dialysis Dosing Information & other comments
Aztreonam (Azactam) **Restricted to ID, Peds ID**	≥30 10-30 <10	1-2g q6-8h 1-2g LD then 0.5-1g q6-12h 1-2g LD then 0.25-0.5g q6-12h	HD: 1-2g LD then 0.5g q12h PD: 1-2g LD then 0.5g 12h CVVHDF: 1g q8h or 2g q12h
Cefazolin[2] (Ancef)	>34 11-34 ≤10	1-2g q8h 0.5-1g q12h 0.5-1g q24h	HD: Dose post HD 0.5-1g q24h PD: 0.5g q12h or 1g q24h CVVHDF: 1g q8h or 2g q12h
Cefepime (Maxipime) **2g dose: Restricted to ID, Peds ID**	>60 30-60 11-29 <11 >60 30-60 11-29 <11	1g q8h 1g q12h 1g q24h 500mg q24h **2g dose Restricted (neutropenic fever/meningitis/ nosocomial Pseudomonas)** 2g q8h 2g q12h 2g q24h 1g q24h	HD: Dose post HD 0.5-1g q24h PD: 1-2g q48h CVVHDF: 1-2g q8h
Cefotaxime[2] (Claforan) **Restricted to ID, (Peds ID, Neonatology, pt < 2 months old)**	>50 10-50 <10	1-2g q6-8h (up to q4h for brain abscess or meningitis) 1-2g q8-12h 1-2g q24h	HD: 1-2g q24h PD: 0.5-1g q24h CVVHDF: 1-2g q6-8h
Cefotetan (Cefotan)	>30 10-30 <10	1-2g q12h (Max: 4g/day) 1-2g q24h (or 0.5-1g q12h) 1-2g q48h (or 0.25-0.5g q12h)	HD: 1-2g q48h PD: 1g q24h
Ceftaroline[2] (Teflaro) **Restricted to ID**	>50 31-50 15-30 <15 >50 31-50 15-30 <15	600mg q12h 400mg q12h 300 mg q12h 200 mg q12h **MRSA bacteremia salvage therapy** 600mg q8h 400mg q8h 300 mg q8h 200 mg q8h	HD: Dose post HD 200mg q12h PD: 200mg q12h CVVHDF: 400mg q12h HD: 200mg q8h dose post HD PD: 200mg q8h CVVHDF: 400mg q8h
Ceftazidime (Fortaz) **2g dose: Restricted to ID**	>50 30-50 10-30 <10	1-2g q8h 1-2g q12h 1-2g q24h 1-2g q48h (2 g for Osteomyelitis, Meningitis, Neutropenic fever)	HD: Dose post HD 0.5-1g q24h PD: 0.5-1g q24h CVVHDF: 1g q8h or 2g q8h
Ceftolozane/Tazobactam (Zerbaxa) **Restricted to ID**	 >50 30-50 15-29 <15 >50 30-50 15-29 <15	**If the usual recommended dose is 1.5 g every 8 hours** 1.5g q8h 750mg q8h 375mg q8h No dosage adjustments provided in manufacturer's labeling **If the usual recommended dose is 3 g every 8 hours** 3g q8h 1.5g q8h 750mg q8h No dosage adjustments provided in manufacturer's labeling	HD: Dose post HD 750mg x1, then 150mg q8h CVVHDF: 1.5 g q8h HD: 2.25g x1, then 450mg q8h post HD CVVHDF: 1.5 g q8h

SUBJECT: RENAL DOSE ADJUSTMENTS FOR ADULTS **POLICY NO.** 325H

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Cefotetan (Cefotan)	>30 10-30 <10	1-2g q12h 1-2g q24h 1-2g q48h	HD: 25% dose q24h on non-HD days & 50% on HD days post HD; PD: 1g q24h CVVHDF: 1-2g q24h
Cefoxitin (Mefoxin)	>50 30-50 10-29 5-9 <5	1-2g q6-8h CrCl ≤ 50: LD: 1-2g followed by maintenance dose according to CrCl Maintenance Dose: 1-2g q8-12h 1-2g q12-24h 0.5-1g q12-24h 0.5-1g q24-48h	HD: LD 1-2g after each HD; MD based on CrCl
Cefuroxime (Inj – Zinacef) (Oral – Ceftin) **Restricted to ID, HIV, Pulm, Head & Neck Surg, Cardiac Thoracic Surgery prophylaxis or cardiac surgery**	**IV:** >20 10-20 <10	**IV:** 0.75-1.5g q8h 0.75-1.5g q12h 0.75-1.5g q24h **Oral:** 0.25-0.5g q12h	Renal or hepatic adjustments: Not required for oral dose
Cephalexin Oral (Keflex)	>49 10-49 <10	500mg-1000mg q6h 500mg q8-12h 250 mg q12-24h	HD: 250mg q12-24h post HD
Ciprofloxacin (Cipro)	**IV:** ≥30 5-29 **Oral**: >50 30-50 5-29	**IV**: 400mg IV q12h (q8h for empiric nosocomial pneumonia) 200mg IV q12h or 400mg IV q24h (400mg q12h for q8h regimen) **Oral**: 500-750mg q8-12h 250-500mg q12h 250-500mg q24h	HD: 200-400mg IV q24h dose post HD CVVHDF: 400mg q12-24h HD: 250-500mg po q24h dose post HD
Clarithromycin (Biaxin)	≥30 <30	250-500mg q12h 250 mg q12-24h	HD: dose post HD High risk for drug interactions
Colistin[2] (Colistimethate) **Restricted to ID, Peds ID**	≥80 50-79 30-49 10-29	5 mg/kg (300mg max) x1 LD, then in 24hrs, 2.5mg/kg q12h 2.5-3.8 mg/kg/day (divided into 2 doses/day) 2.5mg/kg/day (daily or divided into 2 doses/day) 1.5mg/kg q36h	Use IBW HD: 1.5mg/kg q24-48h CVVHDF: 2.5 mg/kg q24-48h
Daptomycin[2,3] (Cubicin) **Restricted to ID, Peds ID**	≥30 <30	4-10mg/kg q24h 4-10mg/kg q48h (8-10mg/kg q24h for complicated Bacteremia or I.E.)	Use ABW or Adj BW if obese HD: 3x/wk on HD day post HD CVVHDF: 4-6mg/kg q24h or 8mg/kg q48h
Enoxaparin (Lovenox)	**Treatment** ≥30 <30 **Prophylaxis** ≥30 <30 **Prophylaxis** ≥30 <30	**Treatment VTE, NSTEMI, UA** 1 mg/kg subQ q12h 1mg/kg subQ q24h **Prophylaxis knee/ hip surgery/trauma patients:** 30mg subQ q12h or 40mg subQ q24h (hip) 30mg subQ q24h **Prophylaxis other surgery** 40mg subQ q24h 30mg subQ q24h	HD: No supplemental dose recommended PD: Significant drug removal is unlikely **Refer to PI or LMWH form for STEMI dose adjustment**

Drug	CrCl (mL/min)	Dosing Recommendations	Dialysis Dosing Information & other comments
Famotidine (Pepcid)	**IV:** ≥50 <50 **Oral:** ≥60 30-59 <30	**IV:** 20mg q12h 20mg q48h **Oral:** 20mg q12h 20mg q24h 20mg q48h	To limit potential CNS adverse effects HD: 20mg post HD on HD days PD: 20mg q48h
Fluconazole[2] (Diflucan)	**IV & Oral** normal dose >50 ≤50	 100-1200mg q24h Normal dose q24h LD (w/ normal dose), then 50% of normal dose q24h	Systemic fungal infection may require upper range of normal dose (range: 6-12mg/kg/day) HD: LD then 100% of recommended dose post HD 3 times/wk or LD then 50% dose q24h (post HD) PD: LD then 50% dose q24h CVVHDF: 100% dose q24h
Ganciclovir (Cytovene) **Restricted to ID**	Induction: ≥70 50-69 25-49 10-24 <10 Maintenance ≥70 50-69 25-49 10-24 <10 Maintenance ≥70 50-69 25-49 10-24 <10	**IV:** 5mg/kg q12h 2.5mg/kg q12h 2.5mg/kg q24h 1.25mg/kg q24h 1.25mg/kg 3 times/week **IV:** 5mg/kg q24h 2.5mg/kg q24h 1.25mg/kg q24h 0.625mg/kg q24h 0.625mg/kg 3x/week **Oral:** 1000mg tid or 500mg q3hwhileawake (6x/day) 1500mg qdaily or 500mg tid 1000mg qdaily or 500mg bid 500mg qdaily 500mg 3x/wk (post HD)	Induction therapy for 14-21 days HD: I: 1.25mg/kg q48-72h; M: 0.625mg/kg q48-72h (post HD) PD: Same dose as CrCl <10ml/min post PD CVVHDF: I: 2.5mg/kg q12h; M: 2.5mg/kg q24h I: Induction; M: Maintenance
Gentamicin	Renally eliminated, contact provider with dose adjustment recommendation		
Levofloxacin (Levaquin)	≥50 20-49 10-19 >50 20-50 10-19	500mg q24h 500mg x1 then 250mg q24h 500mg x1 then 250mg q48h **PNA or complicated skin or skin structure infection or treatment of pseudomonas** 750mg q24h 750mg x1 then 750mg q48h 750mg x1then 500mg q48h	HD & PD: LD x1 then 250-500mg q48h CVVHDF: 250-750mg q24h
Meperidine (Demerol)	>50 10-50 < 10	50-150mg q2-4h prn (Limit therapy to 48h & do not exceed 600mg/24h) AVOID (Cautiously administer 75% of normal dose & limit therapy to 24-48h & do not exceed 400-450mg/24h) AVOID (Cautiously administer 50% of normal dose & limit therapy to 24h & do not exceed 200-300mg/24h)	Reduce dose in severe hepatic impairment and elderly patients. Not recommended for management of chronic pain. When used for acute pain (in pts w/o renal or CNS dz), limit TX to 48h & doses not to exceed 600mg/24h. Repeated use in renal impairment should be avoided due to potential accumulation of neuroexcitatory metabolite normeperidine.

SUBJECT: RENAL DOSE ADJUSTMENTS FOR ADULTS **POLICY NO.** 325H

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Meropenem (Merrem) **Restricted to ID, Peds ID**	>50 26-≤50 10-≤25 <10	1g q8h or 2g q8h (bacterial meningitis) usual dose q12h one-half usual dose q12h one-half usual dose q24h	HD: 0.5g-1g q24h, dose post HD CVVHDF: 1g q8h
Meropenem/Vaborbactam (Vabomere) **Restricted to ID**	Based on eGFR	≥50 mL/min/1.73 m^2: 4g q8h 30-49 mL/min/1.73 m^2: 2g q8h 15-29 mL/min/1.73 m^2: 2g q12h <15 mL/min/1.73 m^2: 1g q12h	HD: adj dose based on renal impairment, dose post HD
Metoclopramide (Reglan)	≥40 <40	10mg q6h 50% of normal dose. Dose adjustment is based on tolerance.	HD: dose supplementation not necessary post HD
Nitrofurantoin (Macrodantin)	≥60 30-<60 <60	50-100mg q6h (UTI); 50-100mg qhs (UTI prophylaxis) Limited data suggest-safe and effective for short term treatment of uncomplicated acute cystitis.AVOID	QID dosing HD/PD/CVVHDF: Avoid use
Nitrofurantoin Monohydrate (Macrobid)	≥60 30-<60 <30	100mg q12h (UTI); 100mg qhs (UTI prophylaxis) Limited data suggest-safe and effective for short term treatment of uncomplicated acute cystitis. AVOID	BID dosing HD/PD/CVVHDF: Avoid use
Oseltamivir (Tamiflu)	 >60 >30-60 >10-30 >60 >30-60 >10-30	**Treatment:** 75mg po bid x 5 days 30mg po bid x 5 days 30mg po qday x 5 days **Prophylaxis:** 75mg po qday 30mg po qday 30mg po q48h	**ESRD not on HD**: not recommended **ESRD on HD**: Treatment: 30mg x 1, then 30mg three times/week post HD x5days Prophylaxis: 30mg x1, then 30mg on alternate HD cycles, post HD x5days **PD**: Treatment: 30mg x 1 Prophylaxis: 30mg x1, then 30mg qwk **CVVHDF**: Treatment: 30mg qday x 5 days Prophylaxis: no data
Penicillin G (Aqueous)	>50 10-50 <10 ***Or*** 30-50 10-30 <10	2 to 4 MU q4-6h Reduce to 75% of dose Reduce to 20-50% of dose 100% of dose q6h 100% dose q8h 100%of dose q12h	Max 6 MU/day in ESRD HD: Normal dose LD x1, then 25-50% dose q4-6h, or 50-100% dose q8-12h PD: Dose same as CrCl<10 CVVHDF: 2-4 MU q4-6h
Piperacillin/ Tazobactam (Zosyn) **Restricted to ID, Peds ID,**	>20 ≤20	3.375 g q8h over 4h 3.375 g q12h over 4h	HD: Dose post HD 3.375g q12h over 4h (HD dosing: reschedule post HD to administer right after HD) PD: 3.375g iv q12h over 4h CVVHDF: 3.375g q8h over 4h
Tobramycin	Renally eliminated, contact provider with dose adjustment recommendation		
Trimethoprim/ Sulfamethoxazole[3] (Bactrim or Septra) DS=160/800 mg SS=80/400 mg 1 amp = 1 SS = 16/80 mg/ml x 5 ml	>30 15-30 <15 >30 10-30 <10	10-20mg/kg/day in q8-12h 5-10mg/kg/day in q8-12h Not recommended For PCP/Stenotrophomonas treatment: 5mg/kg q8h 5mg/kg q12h 5mg/kg q24h	Use ABW or Adj BW if obese mg/kg: based on trimethoprim component. TMP:SMX in a 1:5 ratio. HD: 2.5-10mg/kg q24h or 5-20mg/kg three times/week post HD; drug is moderately dialyzable. Dose post HD.(PCP: 7-10mg/kg post HD) CVVHDF: 2.5-7.5mg/kg q12h (PCP may require up to 10mg/kg q12h)

SUBJECT: RENAL DOSE ADJUSTMENTS FOR ADULTS **POLICY NO.** 325H

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Valganciclovir (Valcyte) Oral **Restricted to ID** (not restricted for prophylaxis dose for post renal transplant)	**Induction:** >59 40-59 25-39 10-25 <10 **Maintenance:** >59 40-59 25-39 10-25 <10	**Induction:** 900mg bid 450mg bid 450mg qday 450mg q48h AVOID (not on HD) **Maintenance:** 900mg qday 450mg qday 450mg q48h 450mg two times per week AVOID (not on HD)	Induction therapy for 21 days HD: **Induction:** 200mg three times/week post HD **Maintenance:** 100mg three times/week post HD
Vancomycin[1,3] **Restricted to Peds ID**	**IV**: Usual Dose **Oral**:	**IV:** Renally eliminated, see "Vanco Per Pharmacy Protocol" or contact provider with dose adjustment recommendation **Oral**: Not to be used for systemic treatment; oral use is used for treatment of: *Staphylococcus enterocolitis/ Clostridium difficile diarrhea*	Use ABW or Adj BW if obese High risk drug to flag for AKI

[1] High risk in AKI: If serum creatinine is increasing by greater than 0.3mg/dL per 24 hours, CrCl of less than 15 mL/min should be used for dosing
[2] Higher doses have been used, contact ID fellow prior to reducing the dose if ordered by ID
[3] Obese: Patient weighing more than 130% of IBW, use Adj BW for dosing