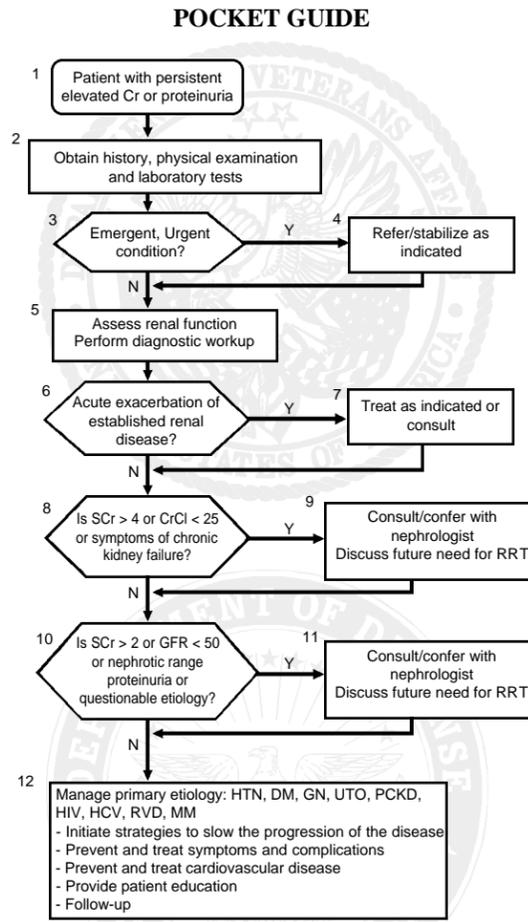


Metabolic and Hematologic Complications of Chronic Kidney Disease

Abnormality	Issue	Treatment
Potassium >6.5 mEq/L 5.5-6.4 mEq/L < 3.5 mEq/L	ER treatment Precipitants: Drugs: ACEI, ARBs, non-selective beta blockers, potassium-sparing diuretics, NSAIDS, trimethoprim-sulphamethoxazole Other: Volume depletion High intake of K-rich foods, Acidosis/RTA Hyperglycemia or starvation in DM Urinary tract obstruction Precipitants: Diuretics Diarrhea Malnutrition High renin/aldosterone states	Instruct patient to present to ER Specific Discontinue offending drug Correct dehydration Restrict dietary K (2-3 g per day) Treat cause, bicarb if < 20 Control hyperglycemia & ensure adequate nutrition General measures: Kayexalate 30-60g qd or qod Loop diuretics Discontinue or reduce dose Treat volume depletion Provide nutritional counseling Supplement K cautiously with close follow-up
Calcium < 8 mg/dL >11 mg/dL	Rare in CRI unless the CrCl is < 30 ml/min Results from hyperphosphatemia and decreased production and activity of 1,25-dihydroxyvitamin D3 If low serum albumin, check ionized calcium Usually related to the use of calcium supplements or vitamin D Consider conditions such as myeloma, granulomas and neoplasms	Serum PO ₄ > 4.5 mg/dL Dietary PO ₄ restriction Calcium acetate or carbonate with meals Serum PO ₄ normal: Calcium acetate or carbonate between meals Refractory hypocalcemia: Use 1,25-dihydroxyvitamin D3 Reduce Ca supplements, Vit D Specific treatment of underlying condition
P > 4.5 mg/dL	Hyperphosphatemia usually begins to occur when the CrCl is < 30 m./min	Restrict dietary PO ₄ to 0.6 to 1.2 grams/day Use PO ₄ binders (calcium acetate or carbonate) with meals

VA/DoD Clinical Practice Guideline for Management of Chronic Kidney Disease & Pre-ESRD in Primary Care



VA access to full guidelines: <http://www.oqp.med.va.gov/cpg/cpg.htm>

DoD access to full guidelines: <http://www.cs.amedd.army.mil/Qmo>

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Specialized Laboratory Studies for the Diagnosis of Kidney Disease

Laboratory Test	Significance
Serum Complement Levels (C3,C4)	May be decreased in: Post-streptococcal glomerulonephritis Endocarditis-associated glomerulonephritis Immune-complex glomerulonephritis Membranoproliferative glomerulonephritis Lupus nephritis; Cryoglobulinemia Atheroembolic disease
ANA	Positive in Lupus nephritis
Anti-neutrophil cytoplasmic antibody (ANCA)	Positive in: Wegener's granulomatosis (C-ANCA) Microscopic polyangiitis (P-ANCA) Pauci-immune RPGN (P-ANCA)
Anti-glomerular basement membrane antibodies(anti-GBM)	Positive in: Goodpasture's syndrome Anti-GBM associated RPGN
Serum protein electrophoresis (SPEP) Urine protein electrophoresis (UPEP)	Positive for monoclonal antibody in: Multiple myeloma Amyloid Light-chain deposition disease
Cryoglobulins	Positive in: Cryoglobulinemia
Hepatitis B surface antigen	Associated with: Membranous nephropathy Polyarteritis nodosa Membranoproliferative nephritis
Hepatitis C serologies	Associated with: Mixed cryoglobulinemia Membranoproliferative glomerulonephritis Membranous nephropathy
HIV serologies	Associated with Focal and segmental glomerulosclerosis(FSGS)
Eosinophiluria	Associated with: Acute interstitial nephritis Atheroembolic disease May be positive in any condition with eosinophilia or pyuria

Renal Imaging Studies

Imaging study	Significance
Renal ultrasound	Diagnosis of: Obstructive renal disease Polycystic renal disease Assessment of renal size: Enlarged in diabetic nephropathy, amyloid Small in chronic renal disease Asymmetric in renovascular disease
Renal dopplers	Diagnosis of: Renovascular disease Renal vein thrombosis
Radioisotope renal scan	Diagnosis of: Renovascular disease Obstructive uropathy Assessment of split renal function
CT scan	Assessment of: Renal masses Atypical renal cysts
Magnetic resonance angiography	Diagnosis of: Renovascular disease
Renal angiography	Diagnosis of: Renovascular disease (gold standard) Renal artery thrombosis/ thromboembolism Polyarteritis nodosa
Retrograde ureterogram	Diagnosis of: Upper-tract obstruction
Intravenous pyelogram	Not indicated in renal insufficiency

Complications Of Chronic Kidney Disease

Issues	Treatment
Albumin < 3.5 g/dL	Associated with increased mortality. General causes of hypoalbuminemia include abnormal metabolism, chronic inflammation, liver disease. Specific causes that could be addressed are: Reduced intake Nephrotic syndrome Acidosis Poorly controlled diabetes
Hct Hct < 33% Hgb < 11g/dL (Premenopausal female)	Usual causes of anemia Must be excluded before attributing to kidney disease Common causes in chronic renal insufficiency: Inadequate erythropoiesis Reduced RBC half-life Coagulopathy
Hct < 37% Hgb < 12g/dL (Male & post-menopausal female)	Erythropoietin levels are not helpful for diagnosis of suspected anemia of kidney disease Initiate oral Fe treatment if the transferrin saturation is < 20% and/or the ferritin is < 100 ng/ml If the patient is symptomatic, or the HCT < 30% and /or Hgb is < 10 despite iron therapy, refer to nephrology for consideration of erythropoietin therapy
HCO ₃ < 20 mEq/L	Other causes of acidosis must be considered prior to ascribing to kidney disease, especially if the HCO ₃ is < 15 mEq/L Common in CRI. Kidney causes include: Impaired kidney acidification Accumulation of organic acids

Drug	Comments
Antihypertensives	
Diuretics	Loop diuretics preferred because of superior efficacy in low GFR states. Higher doses or combination (e.g. furosemide + metolazone) may be required to obtain clinical response. Spironolactone and other K+ sparing diuretics should be used with caution to avoid hyperkalemia.
ACEI/ARB	Beneficial effects in patients with diabetic nephropathy, heart failure, and some kidney diseases. May decrease GFR in some patients with kidney insufficiency or kidney artery stenosis. Serum k+ should be monitored.
Beta Blocker	Metoprolol is the preferred b-blocker due to hepatic excretion.
Calcium Antagonists	Generally safe to use in patients with kidney disease.
Alpha Blockers	Beneficial in patients with prostatic hypertrophy.
Clonidine	Generally safe to use in patients with kidney disease.
Vasodilators	Generally safe to use in patients with kidney disease, although may cause sodium retention. Not usual first line therapy, although hydralazine is useful substitute for patients who do not tolerate ACEI/ARB
Antibiotics	Dosage adjustments frequently required in kidney failure. Acyclovir, other antivirals, and sulfa drugs may cause crystaluria. Acyclovir/gancyclovir dose must be decreased to avoid encephalopathy. Trimethoprim can cause hyperkalemia.
NSAIDS	Use with caution in patients with kidney disease. Frequent cause of acute kidney failure. COX 2 agents are not kidney protective. Other side effects include worsening of hypertension, hyperkalemia, and sodium retention.
Lipid lowering agents	No dosage changes generally required in patients with kidney disease. Maintain usual monitoring of CPK and liver function tests.
Hypoglycemic Agents	
Insulin	Half life prolonged in patients with kidney disease and dosage of insulin must be decreased accordingly.
Oral agents	Biguanides (e.g. metformin) contraindicated in patients with decreased GFR. Kidney insufficiency prolongs ½ life of many agents, requiring dosage adjustment to avoid hypoglycemia.
Cardiac glycosides	Half life prolonged with kidney insufficiency and dosage must be decreased. For example, typical dosage of digoxin in end stage kidney disease is 0.125 mg 2 or 3 times per week.
Gout therapy	Allopurinol dosage should be decreased in patients with kidney insufficiency. Allopurinol may cause interstitial nephritis and should be stopped if kidney function deteriorates acutely. Colchicine should be used with caution in patients with kidney disease to avoid neutropenia and GI side effects.
Anti-epileptics	Dosage adjustments often required with decreased GFR.
OverCounter Meds	
Antacids	Avoid magnesium or aluminum containing antacids. In general, calcium carbonate or acetate is safe in kidney failure.
Salt substitutes	Often contain potassium and may cause hyperkalemia.
Decongestants/antihistamines	May be associated with worsening hypertension and urinary retention.
Herbal remedies	Effects on kidney function and other organs unknown. Ephedrine containing products worsen hypertension. Some weight loss therapies can cause volume depletion.
Vitamins	Multivitamins and folate generally beneficial in patients with kidney disease. Vitamin A and D usage should be monitored to avoid toxicity and hypercalcemia.
Alkalinizing agents	Sodium bicarbonate is used to treat chronic acidosis of kidney disease and is preferred to Shohl's solution. Both agents contain sodium and volume status should be monitored. Avoid aluminum containing antacids when using Shohl's solution.
Phosphate binding agents	Calcium carbonate/acetate preferred. New non-calcium containing agents are becoming available but are expensive and generally no more efficacious than calcium carbonate, but may be useful in special situations..
Anemia therapy	Anemia management module of this guideline should be referenced