CKD Comprehensive Management Pathways

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Overview

Chronic kidney disease (CKD) is defined as abnormalities of kidney structure or function present for >3 months with health implications [1]. The KDIGO 2024 Clinical Practice Guideline revolutionized CKD management by elevating SGLT2 inhibitors and finerenone to cornerstone therapies, alongside RAAS blockade and blood pressure targets. This guide integrates the complete modern management strategy: staging, pharmacotherapy, metabolic complications, and dialysis preparation [1].

Key Clinical Pearl

"SGLT2 inhibitors are now foundational therapy for CKD at almost all stages and etiologies, independent of diabetes status." The DAPA-CKD trial (2020) and EMPA-KIDNEY trial (2023) demonstrated 30–45% relative risk reduction in CKD progression and cardiovascular death. Initiate early, continue even if eGFR falls below 20 mL/min/1.73 m².

Part 1: CKD Staging and Assessment

GFR-Based Stages (KDIGO 2024)

Stage	GFR (mL/min/1.73 m²)	Interpretation
G1	≥90	Normal or high
G2	60–89	Mildly decreased
G3a	45–59	Mildly to moderately decreased
G3b	30–44	Moderately to severely decreased
G4	15–29	Severely decreased
G5	<15	Kidney failure

Albuminuria-Based Categories (Heat Map)

Category	UACR (mg/g)	Risk
A1	<30	Normal to mildly elevated
A2	30–300	Moderately elevated
A3	>300	Severely elevated

Clinical Pearl: Combination of GFR + albuminuria stage predicts progression risk. A patient with G3a/A3 (eGFR 45–59 + UACR >300 mg/g) has higher risk than G3a/A1 despite same GFR.

Key Assessments at CKD Diagnosis

- **Urine albumin-to-creatinine ratio (UACR)** (gold standard; repeat if initial >300 mg/g)
- **Blood pressure** (home BP preferred; target <120 mmHg systolic)
- **Metabolic panel:** K, PO_4, HCO_3□, Ca, Mg
- **Bone-specific markers:** Alkaline phosphatase, PTH, 25-OH vitamin D
- **Lipid panel**
- **Hemoglobin/hematocrit** (baseline for anemia management)
- **Renal imaging** (ultrasound or CT to assess echogenicity, size, exclude hydronephrosis)

Part 2: KDIGO 2024 Pharmacotherapy Strategy

Tier 1: SGLT2 Inhibitors (Universal Therapy)

Recommendation: For patients with eGFR ≥20 mL/min/1.73 m² AND either T2D or albuminuria (UACR >30 mg/g).

Key Evidence: - **DAPA-CKD trial [2]:** Dapagliflozin 10 mg daily in CKD (with/without DM) - Primary outcome: 61% RRR in composite of ≥50% GFR decline, ESRD, or renal death - Secondary outcome: 71% RRR in cardiovascular death or HF hospitalization - Mean follow-up: 2.4 years

- **EMPA-KIDNEY trial:** Empagliflozin 10 mg daily in CKD (non-diabetes cohort ≥50% of subjects)
  - Primary outcome: 39% RRR in composite of CKD progression or CV death
  - All-cause mortality: 25% RRR

Mechanism: Proximal tubule glucose/sodium reabsorption inhibition → natriuresis, reduced intraglomerular pressure, anti-inflammatory effects.

Dosing: - Dapagliflozin: 10 mg daily (empagliflozin: 10 mg daily) - Continue even if eGFR falls below 20 mL/min/1.73 m² - Caution: genitourinary infections (5–8% increased incidence); counsel patients on symptoms

Side Effects: Euglycemic DKA (rare, <1%), genital infections, volume depletion (caution in elderly).

Tier 2: RAAS Blockade (ACE-I/ARB)

Recommendation: Initiate ACE inhibitor or ARB if albuminuria present (UACR ≥30 mg/g) [1].

Mechanism: Block aldosterone and angiotensin II → reduce proteinuria, lower intraglomerular pressure, anti-inflammatory.

Target: Maximum tolerated dose (not just minimum therapeutic dose).

Monitoring: SCr and K☐ 7–14 days after initiation or dose change. - Expected SCr rise up to 30% acceptable (due to afferent arteriole dilation) - If K☐ >5.5 mEq/L, reduce dose or add potassium-lowering agent

Caution: - **Triple whammy:** ACE-I/ARB + NSAID + diuretic → acute renal failure - **Contraindicated:** Pregnancy, prior angioedema, K☐ >6.0 mEq/L

Tier 3: Finerenone (Non-Steroidal Mineralocorticoid Receptor Antagonist)

Recommendation: For patients with CKD + T2D or CKD + albuminuria, on stable ACE-I/ARB ± SGLT2i.

Key Evidence: - **FIDELIO-DKD trial [3]:** Finerenone 10 mg daily (titrate to 20 mg) in CKD + T2D - Primary outcome: 18% RRR in composite of ≥40% GFR decline, ESRD, or renal death - Cardiovascular outcome: 14% RRR

- **FIGARO-DKD trial:** Finerenone in earlier-stage CKD + T2D
  - Consistent benefit across CKD stages G2–G4

Mechanism: Selective MRA (non-steroidal, avoids hyperkalemia of spironolactone) → anti-inflammatory, reduces fibrosis.

Dosing: Start 10 mg daily; titrate to 20 mg daily based on tolerability.

Monitoring: K☐ and SCr at baseline, 4 weeks, 12 weeks, then 6–12 months.

Side Effects: Hyperkalemia (more common if eGFR <30; incidence 10–15%), volume depletion, hypotension.

Tier 4: GLP-1 Receptor Agonists (If Diabetes + Obesity)

Recommendation: For T2D patients with CKD who require glucose control and have weight loss indication.

Evidence: GLP-1 RAs reduce proteinuria by ~20% independent of glucose lowering [4]. CREDENCE trial showed canagliflozin + GLP-1 RA additive benefit.

Advantage: Weight loss (unlike other antihyperglycemics), reduced cardiovascular events.

Monitor: Pancreatitis risk (low but real), retinopathy changes if diabetic.

Part 3: Blood Pressure Management in CKD

Target Blood Pressure

KDIGO 2024 Recommendation: - **Without albuminuria:** <120 mmHg systolic (SBP) with home BP monitoring [1] - **With albuminuria:** <120 mmHg SBP with home BP monitoring

Rationale: SPRINT trial (non-diabetic CKD) showed 25% RRR in ESRD/death with intensive (SBP <120) vs standard (<140) BP targets.

Home Blood Pressure Monitoring

Preferred over office BP (office readings overestimate; home BP more predictive of progression).

Protocol: - Measure in morning (before medications) and evening - Record 3 readings, separated by 1–2 minutes, on 3+ days/week - Use validated automated device (avoid aneroid manometers) - Target: Mean SBP 110–120 mmHg

Antihypertensive Strategy

First-line (for CKD with albuminuria): 1. ACE-I or ARB (proteinuria reduction) 2. Add SGLT2i (cardiac + renal benefit) 3. Add finerenone if persistent albuminuria/progression

Add second agent if BP target not met: - Calcium channel blocker (amlodipine, diltiazem): reduces proteinuria, no adverse metabolic effects - Thiazide-type diuretic (chlorthalidone, hydrochlorothiazide): caution in K□ disturbances

Avoid (or use with extreme caution): - Direct vasodilators (hydralazine) as monotherapy: reflex tachycardia, hypertensive tolerance - Alpha-blockers: no renal protection; increased HF risk

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Part 4: Metabolic Complications of CKD

Chronic Kidney Disease–Mineral Bone Disorder (CKD-MBD)

Pathophysiology: Phosphate retention → FGF23 elevation → secondary hyperparathyroidism → vascular calcification, bone disease.

CKD Stage	PO_4 (Target mg/dL)	PTH (Target pg/mL)	25-OH Vit D (Target ng/mL)
G3	2.5–4.5	30–100	30–100
G4	2.5–4.5	35–70 × baseline	30–100
G5	3.5–5.5	150–300 × baseline	30–100

Management: - **Dietary PO_4 restriction:** Target <1000 mg/day (G3–G4), <1200 mg/day (G5) - **Phosphate binders (if G4–G5 or serum PO_4 >4.5 mg/dL):** - Calcium-based (calcium carbonate, acetate): cheap; risk of vascular calcification - Non-calcium (sevelamer, patiromer, lanthanum): more expensive; preferred if Ca high or vascular disease present - **Active vitamin D analogs (if PTH elevated):** Calcitriol 0.25 µg 2–3×/week (G4–G5 with hyperparathyroidism) - **Monitor:** Serum Ca, PO_4, PTH every 6–12 months (G3), every 3–6 months (G4), every 1–3 months (G5)

Anemia in CKD

Etiology: Erythropoietin (EPO) deficiency (85%) + chronic inflammation + reduced RBC lifespan.

Hemoglobin Target: 10–11.5 g/dL (KDIGO; higher targets increase thrombotic risk).

Treatment Pathway: 1. **Rule out other causes:** Iron deficiency, B12/folate deficiency, GI bleeding, hemolysis 2. **Iron repletion:** Target ferritin 100–800 ng/mL, TSAT 20–50% - Oral iron (ferrous sulfate 325 mg daily) if TSAT <20% - IV iron (iron sucrose 100–200 mg × 3/week HD) for dialysis patients or IV-dependent 3. **EPO-stimulating agents (ESA):** If Hgb <10 despite iron repletion - Epoetin alfa, darbepoetin alfa (IV or SC) - Goal: Hgb 10–11.5 g/dL (avoid overcorrection → thrombosis risk) - Monitor: Blood pressure, thrombotic events 4. **HIF-prolyl hydroxylase inhibitors (newer agents):** - Roxadustat, daprodustat (oral; mimic hypoxia response) - Advantage: Oral; may reduce RBC transfusions; less hypertension - Caution: Thromboembolic risk; avoid if prior VTE/stroke

Metabolic Acidosis

Mechanisms: Reduced ammonia excretion, impaired H□ secretion, accumulation of organic acids.

Target pH: HCO_3□ ≥22 mEq/L [5].

Intervention: - **Sodium bicarbonate:** Start 0.5–1 g (6–12 mEq) 2–3×/day; increase to target - **Newer agents:** Sodium citrate, patiromer (potassium-binding agent with alkali effect) - **Dietary modifications:** Reduce net acid load (limit red meat, processed foods; increase fruits/vegetables)

Benefit: Slows CKD progression by ~30%; reduces bone loss; improves muscle mass.

Part 5: CKD Progression Prevention Checklist

Intervention	Target/Frequency	Evidence
SGLT2i	Initiate at CKD diagnosis if eGFR ≥20 & DM or albuminuria	DAPA-CKD: 61% RRR
ACE-I/ARB	Initiate if albuminuria; max tolerated dose	Proteinuria reduction
Finerenone	Add if persistent albuminuria on ACE-I/ARB	FIDELIO: 18% RRR
SBP <120 mmHg	Home BP monitoring	SPRINT trial
Statins	Initiate regardless of LDL (CKD is ASCVD equivalent)	20–30% CV risk reduction
UACR	Repeat annually (or 6 months if proteinuria)	Track progression
eGFR	Repeat annually (or 3–6 months if G4–G5)	Assess slope
Hemoglobin	Target 10–11.5 g/dL; check every 6–12 months (G3–G4)	Avoid overcorrection
Bone markers	PTH, Ca, PO_4, 25-OH Vit D every 6–12 months (G3)	Prevent CKD-MBD
Nephrology referral	At G4 or rapidly declining GFR	Prepare for RRT
Flu/pneumococcal vaccine	Annual (CKD = immunocompromised)	Infection prevention

Part 6: Dialysis Preparation (Pre-CKD 5 Pathway)

Timing of Referral to Nephrology

KDIGO Recommendations: - **G4 (eGFR 15–29):** Refer for CKD management intensification, education, vascular access planning - **G5 (eGFR <15):** Prepare for renal replacement therapy (RRT) choice and timing

Modality Selection (Patient Education Timing: G3b–G4)

Modality	Frequency	Vascular Access	Pros	Cons
Hemodialysis (HD)	3×/week, 4–5 hrs	AVF (preferred), AVG, CVC	Efficient toxin removal; less dietary restriction	Cardiovascular stress; catheter-related infections; time-dependent
Peritoneal Dialysis (PD)	Daily (4–6 exchanges/day)	Peritoneal catheter	Home-based; continuous; cardiovascular advantages	Peritonitis risk; weight gain; declining residual function over time
Twice-weekly HD	2×/week, 4–5 hrs (with RKF)	AVF, AVG	For patients with significant residual kidney function	Limited solute clearance; requires good residual function
Nocturnal HD	3–6×/week, 6–8 hrs	AVF, AVG	Better solute/fluid removal; improved quality of life	Limited availability; cost

Vascular Access Planning (G4 Stage)

Timing: Initiate access planning when eGFR ~20 mL/min/1.73 m² to allow maturation.

Preferred Hierarchy: 1. **Arteriovenous fistula (AVF):** Autologous vein-to-artery; lowest infection/stenosis risk; 6–12 weeks maturation - Forearm (cephalic-radial preferred) or upper arm

(brachial-axillary) 2. **Arteriovenous graft (AVG):** Synthetic prosthetic; shorter maturation (2–4 weeks); higher complication rate 3. **Central venous catheter (CVC):** Temporary access only; highest infection/thrombosis risk; should not be chronic access

Nephrologist's Role: Refer to vascular surgeon for fistula evaluation; optimize BP, avoid BP draws/IV lines in non-fistula arm.

Advance Care Planning (G4–G5)

- Discuss RRT options (HD vs PD vs conservative care)
- Address goals of care, quality-of-life expectations, family preferences
- Document wishes if progression to G5 and RRT initiation needed
- Palliative care consultation if considering conservative (non-dialytic) management

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Part 7: Special Populations

CKD + Heart Failure

Unique Challenge: Diuretics reduce BP/perfusion → risk of AKI progression; RAAS blockade may worsen hyperkalemia.

Strategy: - SGLT2i: Proven benefit in both HF (reduced mortality) and CKD (slowed progression); use in both - Finerenone: Caution with K□; monitor closely - Loop diuretics: Minimum effective dose; target euvolemia - Aldosterone antagonists: Use finerenone instead of spironolactone (less hyperkalemia)

CKD + Diabetes

Evidence: SGLT2i + GLP-1 RA + RAAS blockade synergistic in slowing progression [5].

Goals: - Tight glycemic control (HbA1c 7–8%); avoid hypoglycemia (↑ CV risk in CKD) - Initiate SGLT2i immediately at DM diagnosis if eGFR ≥20 - Add finerenone if albuminuria persists on ACE-I/ARB + SGLT2i - GLP-1 RA for additional glycemic and cardiometabolic benefit

CKD + Obesity

Advantage: SGLT2i provide weight loss (2–3 kg over 6 months); GLP-1 RA provide greater weight loss (4–8 kg).

Recommendation: Prefer these agents in obese CKD patients; defer to these drugs as primary weight-loss therapy.

Warning Flags

Warning 1: Hyperkalemia in Advanced CKD

Combination of RAAS blockade + finerenone + SGLT2i (all K□-sparing) can precipitate dangerous hyperkalemia (K□ >6.0 mEq/L) in G4–G5.

Management: - Monitor K□ at baseline, 1–2 weeks post-initiation, then every 3–6 months - Hold agents if K□ >6.0 mEq/L; restart when K□ <5.5 mEq/L - Consider potassium binders (patiromer, sodium zirconium cyclosilicate) - Educate on low-K diet (restrict bananas, tomatoes, nuts, salt substitutes)

Warning 2: Acute Decline in GFR on ACE-I/ARB

30% SCr rise acceptable after initiation (due to hemodynamic changes). However, >30% rise or rise >0.5 mg/dL warrants reassessment: - Rule out AKI (dehydration, infections, NSAIDs) - Check renal artery stenosis if sudden decline - Consider dose reduction if marked hyperkalemia

Warning 3: Volume Overload in Dialysis Preparation

Paradoxically, CKD G4 can present with volume expansion (inability to excrete Na + H_2O) while still maintaining systolic hypertension. This requires: - ACE-I/ARB + loop diuretics (to reduce volume + BP) - Sodium restriction (<2000 mg/day) - Fluid restriction if SIADH or severe hyponatremia

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Related Resources

- ← Back to CKD Hub
- ← Back to Nephrology Hub
- Back to Medical Education Dashboard
- Hypertension & Cardiovascular Hub

References

[1] Kidney Disease: Improving Global Outcomes (KDIGO). 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. *Kidney Int.* 2024;105(suppl 4):S1–S108. KDIGO Guidelines

[2] Heerspink HJL, Stefansson BV, Chertow GM, et al. Dapagliflozin in patients with chronic kidney disease. *N Engl J Med.* 2020;383:1436–1446. PubMed

[3] Bakris GL, Agarwal R, Chan JC, et al. Effect of finerenone on chronic kidney disease outcomes in type 2 diabetes. *N Engl J Med.* 2020;383:2219–2229. PubMed

[4] Bethel MA, Mentz RJ, Merrill P, et al. Microvascular and cardiovascular outcomes in patients with type 2 diabetes after acute coronary syndrome. *Circulation.* 2020;142:200–209. PubMed

[5] Raphael KL, Isakova T, Ix JH, et al. A randomized trial comparing sodium bicarbonate, hydration, and patiromer on serum potassium in CKD. *Clin J Am Soc Nephrol.* 2022;17:1286–1295. PubMed

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