

CRITICAL CARE ORDER SET

Acute Kidney Injury

Assessment and management of AKI in the ICU. Stage it by KDIGO, localize the lesion to pre-renal, intrinsic, or post-renal, then treat the cause — restore perfusion, relieve obstruction, remove nephrotoxins, and support until recovery. Know your dialysis triggers cold. Adapt every threshold to your protocol and the patient.

01 Definition & KDIGO staging

DEFINE AKI = any one of — $\uparrow$ creatinine ≥ 0.3 mg/dL within 48 h · $\uparrow$ creatinine to $\geq 1.5\times$ baseline within 7 days · urine output < 0.5 mL/kg/h for ≥ 6 h.

Stage	Serum creatinine	Urine output
1	1.5–1.9 $\times$ baseline, or $\uparrow \geq 0.3$ mg/dL	< 0.5 mL/kg/h for 6–12 h
2	2.0–2.9 $\times$ baseline	< 0.5 mL/kg/h for ≥ 12 h
3	$\geq 3.0\times$ baseline, or ≥ 4.0 mg/dL, or RRT started, or eGFR < 35 (< 18 y)	< 0.3 mL/kg/h for ≥ 24 h, or anuria ≥ 12 h

Differentiating pre-renal · intrinsic · post-renal

Feature	Pre-renal (hypoperfusion)	Intrinsic / renal (ATN)	Post-renal (obstruction)
Mechanism	↓ renal perfusion; tubules intact	Tubular / glomerular / interstitial / vascular injury	Urinary tract obstruction
Typical causes	Hypovolemia, hemorrhage, sepsis, HF, cirrhosis, NSAIDs, ACEi/ARB	Ischemic / septic ATN, nephrotoxins (contrast, aminoglycosides), AIN, GN, rhabdo, TLS	BPH, stones, clot, tumor, neurogenic bladder, catheter blockage
BUN : Cr ratio	> 20 : 1	10–15 : 1	Variable (often > 15 early)
Urine osmolality	> 500 mOsm/kg (concentrated)	< 350 mOsm/kg (isosthenuric ~300)	Variable
Urine Na⁺	< 20 mEq/L	> 40 mEq/L	Variable
FE_{Na}	< 1%	> 2%	Variable (> 1–2% if prolonged)
FE_{Urea} (if on diuretics)	< 35%	> 50%	Variable
Urine sediment	Bland; hyaline casts	Muddy-brown granular casts (ATN); WBC casts (AIN); RBC casts / dysmorphic RBC (GN)	Bland ± crystals, hematuria
Imaging (US)	Normal	Normal / echogenic cortex	Hydronephrosis , distended bladder
Response to fluids	Improves with volume / perfusion	No improvement	Improves with decompression (catheter / stent / nephrostomy)

CAVEAT Urinary indices are **adjuncts, not arbiters** — FE_{Na} is unreliable on diuretics, in CKD, or non-oliguric ATN (use $FE_{Urea} < 35\%$ if recently diuresed). FE_{Na} can be low despite intrinsic injury in contrast nephropathy, early sepsis, rhabdomyolysis, and hepatorenal syndrome. Interpret in clinical context. $FE_{Na} = (U_{Na} \times P_{Cr}) \div (P_{Na} \times U_{Cr}) \times 100$.

03 Initial assessment & workup

HISTORY & EXAM

- ☐ Establish **baseline creatinine** (prior records) to separate AKI from CKD; review timeline of UOP & creatinine
- ☐ Volume status (orthostatics, JVP, skin turgor, edema), recent hemorrhage / sepsis / heart failure / cirrhosis
- ☐ **Medication review** — nephrotoxins, recent contrast, new drugs (AIN); bladder symptoms / prostate history (obstruction)

LABORATORY

- ☐ BMP, Mg, phosphate, Ca; **VBG/ABG** for acid–base
- ☐ **Urine Na, Cr, urea, osmolality** → FE_{Na} / FE_{Urea}
- ☐ If GN / vasculitis suspected — ANA, ANCA, anti-GBM, C3/C4, complements, SPEP/UPEP & free light chains
- ☐ CBC; **urinalysis with microscopy** (casts, cells, crystals)
- ☐ Urine protein:creatinine ratio; CK (rhabdo), uric acid / LDH / K / phos (TLS) if suspected
- ☐ Eosinophils / eosinophiluria if AIN suspected (low sensitivity)

IMAGING & ACCESS

- ☐ **Renal ultrasound** — rule out obstruction / hydronephrosis; assess size & echogenicity (small echogenic = CKD)
- ☐ **Bladder scan ± Foley** to assess for / relieve outlet obstruction and track hourly UOP

04 General management & supportive care

PROTECT THE KIDNEYS (KDIGO BUNDLE)

- ☐ **Stop nephrotoxins** — NSAIDs, aminoglycosides, contrast (defer elective), ACEi/ARB, vancomycin/piperacillin if alternatives exist; hold metformin & SGLT2i
- ☐ **Renally dose-adjust** all medications (pharmacy consult); avoid hydroxyethyl starch
- ☐ **Optimize hemodynamics** — target MAP ≥ 65 (consider higher in chronic HTN); vasopressors for vasodilatory shock (norepinephrine first-line)
- ☐ Strict **I/O & hourly UOP**, daily weights; glucose 140–180 mg/dL

AVOID / USE WITH CAUTION

NO BENEFIT **Diuretics do not treat AKI** — use only for volume overload, not to "convert" oliguric to non-oliguric AKI or improve outcomes. **No low-dose dopamine, no fenoldopam, no routine natriuretic peptides** for AKI prevention / treatment.

NUTRITION

- ☐ Enteral preferred; **20–30 kcal/kg/day**, protein **0.8–1.0 g/kg/day** (up to 1.7 if on RRT / hypercatabolic); restrict K, phosphate, Na as indicated

05

Cause-specific management

Pre-renal — restore perfusion

- ☐ **Balanced crystalloid** (LR / Plasma-Lyte) for hypovolemia — **250–500 mL boluses**, reassess with dynamic measures; avoid chloride-rich saline excess & over-resuscitation
- ☐ Cardiorenal — treat HF / cardiogenic shock (decongestion, inotropes); hepatorenal — albumin + vasoconstrictors (terlipressin / norepinephrine), hepatology

Intrinsic — treat the lesion

- ☐ **ATN** — supportive; remove ischemic / nephrotoxic insult, maintain perfusion & euolemia, await recovery
- ☐ **AIN** — stop offending drug; consider corticosteroids (nephrology). **GN / vasculitis** — urgent nephrology, immunosuppression, biopsy
- ☐ **Rhabdomyolysis** — aggressive IV fluids to target UOP 200–300 mL/h. **TLS** — hydration, rasburicase / allopurinol, treat electrolytes

Post-renal — relieve obstruction

- ☐ **Bladder catheter** for outlet obstruction; **urology / IR** for ureteral stent or percutaneous nephrostomy in upper-tract obstruction
- ☐ Monitor for **post-obstructive diuresis** — hourly UOP, replace ~50–75% of losses, watch Na / K / Mg / phosphate

06 Managing complications

Hyperkalemia

Calcium → insulin/dextrose + albuterol → elimination (loop diuretic, binders, dialysis).
See ICR-HYK-038.

Metabolic acidosis

Sodium bicarbonate if pH < 7.1–7.2 or severe; treat the cause; RRT if refractory.

Volume overload

Loop diuretic trial; if diuretic-resistant / refractory → ultrafiltration / RRT.

Hyperphosphatemia / ↓ Ca / ↑ Mg

Phosphate binders; treat symptomatic hypocalcemia; hold Mg-containing agents.

Uremia

Encephalopathy, pericarditis, or bleeding (consider DDAVP) → indication for RRT.

Anemia / bleeding

Transfuse per thresholds; uremic bleeding — DDAVP 0.3 µg/kg, optimize platelets.

07 Renal replacement therapy

AEIOU Emergent dialysis indications — **A**cidosis (refractory) · **E**lectrolytes (refractory hyperkalemia) · **I**ntoxications (dialyzable — salicylate, lithium, toxic alcohols) · **O**verload (diuretic-resistant) · **U**remia (encephalopathy, pericarditis, bleeding).

- ☐ **Nephrology consult** early in Stage 2–3, oliguria, or any AEIOU feature; no benefit to "early / prophylactic" RRT absent a clear indication

MODALITY

CRRT

Preferred if hemodynamically unstable, on vasopressors, or with raised ICP; gentle, continuous clearance.

Intermittent HD

Stable patients, rapid correction (severe hyperkalemia, dialyzable toxins); SLED as a hybrid.

- ☐ Temporary **non-tunneled dialysis catheter** (right IJ preferred); avoid subclavian (stenosis); anticoagulation per protocol (regional citrate for CRRT)

08 Monitoring & recovery

- ☐ BMP **q6–12h** while unstable, then daily; hourly UOP; daily weight
- ☐ Track creatinine trend & UOP recovery; watch for diuretic / recovery-phase polyuria
- ☐ Continually **reconcile drug doses** to changing renal function (including as it recovers)
- ☐ Avoid further insults — contrast, nephrotoxins, hypotension during recovery

FOLLOW-UP AKI raises long-term CKD & cardiovascular risk — arrange **outpatient nephrology / creatinine follow-up within ~3 months**, document the episode, and reconcile held medications (ACEi/ARB, SGLT2i, metformin) at discharge.

EDUCATIONAL USE ONLY

Not a substitute for clinical judgement. Verify doses, allergies, renal/hepatic function, and contraindications. Urinary indices are adjuncts; interpret in clinical context. Adapt all thresholds, agents, and RRT decisions to your institutional protocol and the individual patient.

Spreading knowledge
Improving outcomes