

RENAL • HEMATOLOGIC • PEDIATRIC

Hemolytic Uremic Syndrome (HUS)

*The "Burger Bug" triad — when *E. coli* attacks the kidneys*

NGN NCLEX 2026

PEDS AKI #1 CAUSE

TRIAD: MAHA + THROMBOCYTOPENIA + AKI

AGE PEAK: 6 MO - 5 YR

SOURCE DISCLOSURE

This topic was not present in Diane's uploaded personal study notes. Content has been built from standard NCLEX references: *Saunders Comprehensive Review for the NCLEX-RN* (Silvestri, 9th ed.), *ATI RN Adult Medical-Surgical Nursing*, *ATI RN Nursing Care of Children*, *Lippincott Pharmacology*, AAP clinical guidelines on STEC-HUS, and current CDC food-safety recommendations.



Definition & Overview

WHAT IT IS • WHY IT MATTERS

What is HUS?

- A life-threatening syndrome defined by the **classic triad**:
 1. Microangiopathic **hemolytic anemia** (MAHA)
 2. **Thrombocytopenia** (low platelets)
 3. Acute **kidney injury** (AKI)
- Microthrombi form in small vessels → shear RBCs, consume platelets, clog glomeruli.

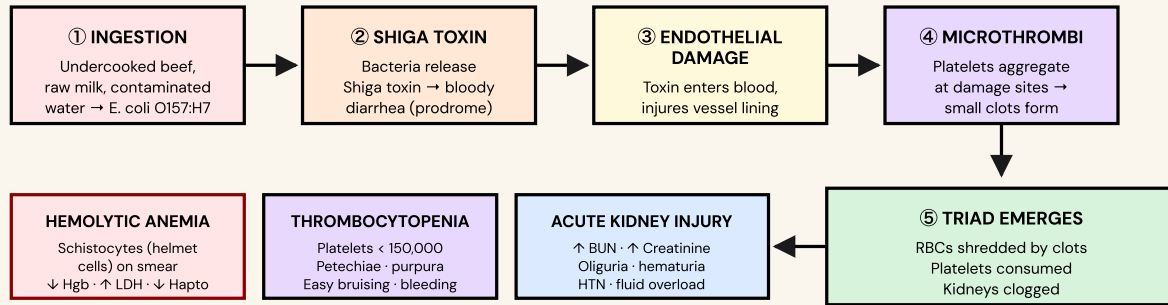
Why it matters

- **#1 cause of acute kidney injury in young children.**
- ~90% are **typical HUS** caused by Shiga-toxin-producing *E. coli* O157:H7 (STEC-HUS) — usually after bloody diarrhea.
- ~10% are **atypical HUS** (aHUS) — complement dysregulation, no diarrhea prodrome, often genetic.
- Mortality ~3–5%; up to 25% have long-term renal sequelae.

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Pathophysiology

THE CASCADE — STEP BY STEP



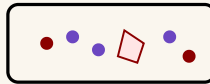
Glomeruli clogged with microthrombi



Schistocyte (helmet cell)



Normal RBC



Microthrombus shearing RBCs in capillary

⚠ KEY POINT

The damage is NOT from dehydration — it's from **microthrombi** clogging renal capillaries.

Antibiotics may make it WORSE by releasing toxin.

3 Signs & Symptoms

PRODROME → TRIAD → SEVERE

🕒 Prodrome (5–10 days)

- **Bloody diarrhea** 🚩 (hallmark)
- Severe abdominal cramping
- Vomiting
- Low-grade fever
- Then — diarrhea may stop just before triad appears

⚠️ Triad Onset

- **Pallor**, fatigue, jaundice (anemia)
- **Petechiae**, purpura, easy bruising (low plts)
- **↓ Urine output**, tea-colored urine, edema, **HTN** (AKI)
- Irritability, lethargy

RED FLAGS

- **Anuria** (no urine > 12 h)
- **Seizures** / altered LOC
- Severe HTN with encephalopathy
- Pulmonary edema (crackles, dyspnea)
- Hyperkalemia → dysrhythmias
- GI bleeding, intussusception

🔪 Diagnostic Labs (memorize the pattern)

LAB	FINDING	WHY
CBC — Hgb/Hct	↓ (anemia)	RBCs sheared by clots
Platelets	↓ < 150,000	Consumed in microthrombi
Peripheral smear	Schistocytes (helmet cells) 🚩	Mechanically destroyed RBCs
BUN / Creatinine	↑↑	Glomeruli clogged → AKI
LDH	↑	Cell lysis
Haptoglobin	↓	Bound up clearing free Hgb
Urinalysis	Hematuria, proteinuria	Renal injury
Stool culture / Shiga toxin assay	+ E. coli O157:H7	Identifies STEC source
Coombs test	NEGATIVE	Non-immune hemolysis (distinguishes from autoimmune)

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Priority Nursing Interventions

ABC + SAFETY FRAMEWORK

A Airway

- **Assess LOC q1–2h** — encephalopathy from uremia/HTN can compromise airway.
- Seizure precautions: pad rails, suction at bedside.

B Breathing

- Auscultate lungs q4h — listen for **crackles** (fluid overload).
- Monitor SpO₂; HOB elevated 30°.
- Report dyspnea / tachypnea immediately.

C Circulation (priority!)

- **Strict I&O q1h**; weigh **daily, same scale, same time**.
- BP q1–2h — treat HTN per protocol.
- Monitor for bleeding: petechiae, gum/nose bleeds, hematuria, melena.
- Cardiac monitor for hyperkalemia: **peaked T waves**.
- Restrict fluids if oliguric/anuric; **do not over-hydrate**.

D Safety & Supportive Care

- **Fall & bleeding precautions** (low platelets) — soft toothbrush, no IM injections, avoid rectal temps.
- Neuro checks q2–4h.
- Cluster care; minimize stimulation if irritable.
- Emotional support to family — sudden, frightening illness.

E Anticipated Orders

- **PRBC transfusion** for severe anemia (Hgb < 6–7).
- **Platelet transfusion** only for active bleeding or before procedures — routine transfusion is *avoided* (can fuel more microthrombi).
- **Dialysis** (hemodialysis or peritoneal) for severe AKI, hyperkalemia, fluid overload, or uremia — needed in ~50% of cases.
- Antihypertensives (often **calcium channel blockers** — e.g., nifedipine, amlodipine).
- Electrolyte correction: **treat hyperkalemia** (kayexalate, insulin + D50, calcium gluconate).
- Nutritional support: low-K⁺, low-Na⁺, low-protein renal diet; NG/parenteral if not tolerating PO.
- **Eculizumab (Soliris)** for atypical HUS — complement C5 inhibitor.

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Pharmacology

WHAT TO GIVE — AND WHAT TO AVOID

DRUG / CLASS	MECHANISM	KEY SIDE EFFECTS	NURSING CONSIDERATIONS
Nicardipine / Amlodipine (Calcium channel blockers)	Vasodilation → ↓ BP	Hypotension, flushing, peripheral edema, reflex tachycardia	BP q15min during IV titration; hold for SBP < threshold; monitor HR
Calcium gluconate IV	Cardiac membrane stabilizer for hyperkalemia	Bradycardia, arrhythmias if pushed too fast; tissue necrosis if extravasated	Push slowly on cardiac monitor; protect IV site; does NOT lower K ⁺ — buys time
Insulin (regular) + D50	Drives K ⁺ into cells	Hypoglycemia, hypokalemia overshoot	Check blood glucose q1h × 4; monitor K ⁺ closely
Sodium polystyrene sulfonate (Kayexalate)	Exchanges Na ⁺ for K ⁺ in gut → excreted in stool	Constipation, bowel necrosis (esp. post-op), Na ⁺ overload	Verify bowel sounds; not for ileus; monitor K ⁺ , Na ⁺
Furosemide (Lasix)	Loop diuretic — only if making urine	Hypokalemia, hypotension, ototoxicity	Useless if anuric; daily weights; I&O
Eculizumab (Soliris) — <i>atypical HUS</i>	Monoclonal Ab → blocks complement C5	↑ infection risk (esp. <i>Neisseria meningitidis</i>), HA, GI upset	Meningococcal vaccine ≥ 2 wk before ; teach signs of meningitis; very expensive
✗ AVOID — Antibiotics (in STEC-HUS)	Kill E. coli → BURST of Shiga toxin released	Worsens HUS, increases mortality	Withhold; treat infection only if life-threatening alternative source
✗ AVOID — Antidiarrheals (loperamide / Imodium)	Slow gut motility → toxin retained longer	↑ severity & duration of HUS	Educate parents NEVER to give OTC antidiarrheals to a child with bloody diarrhea
✗ AVOID — NSAIDs	Nephrotoxic; reduce renal perfusion	Worsens AKI	Use acetaminophen for pain/fever

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NCLEX Test Traps

WRONG VS RIGHT — COMMON CONFUSIONS

TRAP ✗

"Child with bloody diarrhea — start ceftriaxone."

Antibiotics for STEC are tempting but wrong.

TRUTH ✓

Supportive care only. Antibiotics cause bacterial cell lysis → MORE Shiga toxin released → worse HUS.

TRAP ✗

"Give loperamide (Imodium) to stop the diarrhea."

TRUTH ✓

Never. Antimotility agents keep the toxin in contact with gut longer — worsen disease.

TRAP ✗

"Push fluids aggressively — kidneys need volume."

TRUTH ✓

Cautious fluid management. If oliguric/anuric, fluid overload causes pulmonary edema and HTN crisis. The kidneys aren't dehydrated — they're *clogged with clots*.

TRAP ✗

"Platelets are low → transfuse platelets prophylactically."

TRUTH ✓

Only for active bleeding or pre-procedure. Routine platelet transfusion can fuel more microthrombi.

TRAP ✗

"HUS is the same as ITP — both have low platelets."

TRUTH ✓

ITP = isolated low platelets, NO kidney issue, NO hemolysis, Coombs negative, often post-viral. **HUS** = the full *triad* + AKI + bloody diarrhea history.

TRAP ✗

"HUS and TTP are interchangeable."

TRUTH ✓

TTP pentad = MAHA + thrombocytopenia + AKI + *fever* + *neuro changes*; adults; ADAMTS13 deficiency. **HUS** = mostly kids, kidney-dominant, post-diarrhea, Shiga toxin.

TRAP ✗

"Discharge after symptoms resolve — no follow-up needed."

TRUTH ✓

Long-term renal follow-up required. Up to 25% develop CKD, HTN, or proteinuria years later. Monitor BP, urine, and renal function for years.

TRAP ✗

"Priority assessment is bowel sounds."

TRUTH ✓

Priority = circulation/urine output/BP. AKI, fluid overload, and hyperkalemia kill faster than ileus.

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Patient & Family Education

PREVENTION IS THE CURE



Food Safety (Prevention)

- Cook ground beef to **internal 160°F (71°C)** — use a meat thermometer; no pink inside.
- Drink only **pasteurized** milk, juice, and cider.
- Wash all fruits & vegetables thoroughly.
- Don't drink untreated well or lake water; avoid swallowing water at pools/lakes.
- Separate raw meats from produce; sanitize cutting boards.



Hygiene & Daycare

- Handwashing after bathroom, diaper changes, and after touching animals.
- Children must wash hands after **petting zoos, farms, reptiles**.
- Children with diarrhea should stay home from daycare/school.
- Report bloody diarrhea to HCP **immediately** — early diagnosis matters.



Sick-Day Rules

- **Never** give Imodium / loperamide to a child with bloody diarrhea.
- Avoid NSAIDs (ibuprofen, naproxen) — use acetaminophen.
- Offer small sips of oral rehydration solution as tolerated.
- Seek care for: bloody stools, decreased urination, pallor, bruising, lethargy.



After Discharge

- Follow-up with nephrology — BP, urine, BUN/Cr at scheduled intervals for years.
- Monitor home **BP** and report headaches, vision changes.
- Renal-friendly diet if instructed (low Na⁺, low K⁺, controlled protein).
- Avoid nephrotoxic drugs lifetime (NSAIDs, aminoglycosides, contrast dye without nephrology clearance).
- Update vaccines — especially if eculizumab used (meningococcal).

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Memory Boosters

MNEMONICS & PATTERN RECOGNITION

"HUS" = the Triad

H U S

- Hemolytic anemia (schistocytes, ↓ Hgb)
- Uremia / AKI (↑ BUN/Cr, oliguria)
- Low platelets (thrombocytopenia)

"BURGER" — risk picture

B U R G E R

- Bloody diarrhea
- Under-5 child
- Raw / undercooked beef
- Glomeruli clogged
- E. coli O157:H7
- Reduced urine output

"3 NO's" — what NEVER to give

A A N

- NO Antibiotics (releases toxin)
- NO Antidiarrheals (traps toxin)
- NO NSAIDs (nephrotoxic)

HUS vs TTP — "Kids vs Adults"

- **HUS = Kidneys + Kids** — both start with K. Triad. Post-diarrhea.
- **TTP = Two more (5 total)** — adds fever + neuro. Adults. ADAMTS13.
- Both have MAHA + thrombocytopenia + AKI.

Pattern: "Bloody → Bruised → Bloated"

- **Bloody** diarrhea (prodrome)
- **Bruised & pale** (low platelets + anemia)
- **Bloated** (oliguria → edema, HTN)

Lab Pattern Quick Read

- ↓ Hgb · ↓ Platelets · ↑ BUN/Cr → **think HUS** (especially if peds + recent bloody diarrhea)
- Schistocytes on smear = mechanical hemolysis = HUS/TTP/DIC
- Coombs **negative** (rules out autoimmune hemolysis)

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NCJMM Clinical Judgment Scenario

NCSBN 6-STEP MODEL — PRACTICE CASE

Scenario: A 3-year-old child is brought to the ED by parents. Five days ago, the child developed bloody diarrhea and abdominal pain after attending a family barbecue. Today, the parents report decreased urine output, pallor, irritability, and "bruises that just appeared." VS: T 99.1°F, HR 138, RR 28, BP 138/92, SpO₂ 96%. Labs: Hgb 7.2, plts 48,000, BUN 62, Cr 2.8, K⁺ 5.9. Peripheral smear shows schistocytes. Stool PCR is positive for Shiga-toxin-producing E. coli.

STEP 1 RECOGNIZE

Recognize cues

Key cues: Age < 5 + bloody diarrhea prodrome + ↓ urine output + pallor + new bruising + hypertension + tachycardia + anemia + thrombocytopenia + ↑ BUN/Cr + ↑ K⁺ + **schistocytes on smear** + positive STEC PCR. Together = the classic HUS triad with hyperkalemia and HTN.

STEP 2 ANALYZE

Analyze cues

Shiga toxin damaged renal endothelium → microthrombi → hemolysis (Hgb 7.2, schistocytes), platelet consumption (48K), and AKI (Cr 2.8, BUN 62, oliguria). Hyperkalemia (5.9) is from AKI; HTN (138/92) is from fluid retention and renin activation. Bruising signals bleeding risk. The child is at risk for cardiac dysrhythmias, hypertensive encephalopathy, seizures, and worsening renal failure.

STEP 3 PRIORITIZE

Prioritize hypotheses

#1 Hyperkalemia (K⁺ 5.9 with AKI → arrhythmia risk = highest acuity). **#2 Hypertensive crisis** (138/92 in a 3-yr-old — risk for encephalopathy/seizure). **#3 Severe anemia** (Hgb 7.2 → tissue hypoxia). **#4 Bleeding risk** (plts 48K). **#5 Fluid balance / AKI management**. Lowest priority: prodromal diarrhea (now resolving).

STEP 4 GENERATE

Generate solutions

Place on cardiac monitor; obtain 12-lead ECG (peaked T waves?). Initiate IV access — small bore, careful (bleeding/bruising risk). Anticipate **calcium gluconate IV** (cardiac stabilization), then **insulin + D50** and/or **kayexalate** to lower K⁺. Anticipate **IV nicardipine** for HTN. Type & crossmatch for PRBCs. Strict I&O, daily weights, fluid restriction. Seizure precautions. NPO; prepare for possible dialysis. Educate parents. **Withhold antibiotics and antidiarrheals.**

STEP 5 TAKE ACTION

Take action

Apply cardiac monitor and pulse ox; obtain ECG. Establish IV access; draw repeat CBC, CMP, type & cross. Administer calcium gluconate IV per order with continuous cardiac monitoring. Follow with insulin/D50 protocol per order; check fingerstick glucose q1h. Start IV nicardipine titration; monitor BP q15min. Restrict fluids; insert Foley for strict hourly UO. Implement seizure and bleeding precautions. Notify nephrology for dialysis evaluation. Provide family education and emotional support.

STEP 6 EVALUATE

Evaluate outcomes

Expected: K⁺ < 5.0 within 1–2 h; ECG normalizes (no peaked T's); BP trends toward age-appropriate range; UO improves or dialysis initiated; no seizures; no new bleeding; Hgb stabilizes after transfusion; family verbalizes understanding of disease, treatment, and food-safety prevention.

If K⁺ remains > 5.5, BP uncontrolled, or anuric > 12 h → escalate to dialysis immediately.

Silvestri, L. A. (2023). *Saunders Comprehensive Review for the NCLEX-RN Examination* (9th ed.). Elsevier. · ATI Nursing Education. *RN Nursing Care of Children Review Module* (current ed.). · ATI Nursing Education. *RN Adult Medical-Surgical Nursing Review Module*. · Karch, A. M. *Focus on Nursing Pharmacology* (Lippincott). · American Academy of Pediatrics. Clinical guidance on STEC and HUS. · CDC. *E. coli (Escherichia coli) — Prevention*. · KDIGO Clinical Practice Guideline for the Evaluation and Management of CKD. · Hockenberry, M. J., Wilson, D., & Rodgers, C. C. *Wong's Essentials of Pediatric Nursing*.