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Ministry of Health
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Neonatal & Pediatric Common & Emergency Care Guide

BY PEDIATRICIANS | FOR PEDIATRICIANS

- EVIDENCE BASED
- PRACTICAL
- CLINICALLY RELEVANT
- FOR EVERY CHILD



First Edition

SCAN FOR THE
ELECTRONIC VERSIONS

KUWAIT PEDIATRIC COUNCIL · BEDSIDE REFERENCE

Neonatal & Pediatric Common & Emergency Care Guide

VERSION 1.95 · Updated 20 October 2026

A searchable, algorithmic bedside companion for pediatricians and primary care physicians — every medication listed separately with weight-based dosing, first- to third-line therapy, and the can't-miss diagnoses. Tap any topic to open it.

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Disclaimer and scope of use. This guide is a clinical decision-support resource for pediatricians and primary care physicians practising within their scope in the governmental and private sectors of the State of Kuwait; it is not intended for patients or the public. Its recommendations do not establish a standard of care, are not legally binding, and do not indicate an exclusive course of action; variation according to the circumstances of the individual patient may be appropriate. It does not replace the clinical judgment of the treating physician, consultation with the relevant specialist, or Ministry of Health regulations, protocols and institutional policies, which take precedence where they differ.

The content reflects the evidence and guidelines available at the date of issue. Where higher-quality evidence or an updated guideline becomes available before the scheduled review, the newer evidence should take precedence. Weight-based doses should be confirmed against the approved product labelling and a current pediatric drug reference before administration. Drug-availability notes (◈) identify agents that may not be stocked in Kuwait and suggest alternatives. External links are provided for convenience; their content is outside the control of the authors and the Council.

Professional responsibility (State of Kuwait).

Medical practice, the standard of care and professional accountability in Kuwait are governed by Law No. 70 of 2020 on the practice of the medical and allied health professions, patients' rights and health facilities,[1] and by the decisions of the Authority for Medical Responsibility established under it. This guide does not alter the treating physician's obligations under that law, including licensure and practice within scope, adherence to accepted medical practice, informed consent, and accurate and confidential medical records. Clinical decisions remain the responsibility of the treating physician and the treating institution.

Age & scope. This guide covers the newborn through the adolescent. A **neonate** is a baby aged **≤ 28 days**; a **pediatric patient** is any child from birth **up to 18 years** of age. This mirrors Kuwait's **Child Rights Law No. 21 of 2015**, which defines a child as every person who has not completed 18 years.[2] In Kuwait the age of full legal (civil) majority is **21 years**; for any patient under 18, **consent to assessment and treatment is given by a parent or legal guardian**, while the older child/adolescent is involved according to their capacity. Individual services may apply their own operational age cut-offs, so confirm local policy.

Preparation. This guide was drafted, edited, and formatted with the assistance of an AI-based large language model used under direct human supervision. The tool was not an author and made no clinical judgments. All clinical recommendations, medication names and doses, diagnostic thresholds, and references were written by the author, checked against the primary sources and current guidelines, and reviewed by the review panel named below; the content is their work, not the AI tool's. Prepared in line with ICMJE guidance on the use of AI-assisted technologies and with the Ministry of Health **Practical Guide for the Use of Language-based Artificial Intelligence Tools in Healthcare Practice**, adopted and published as a guiding framework for staff of all MOH health facilities by Administrative Decision No. 6189 of 2026 of the Undersecretary of the Ministry of Health (issued under Law No. 70/2020 and Ministerial Decision No. 373/2025 on the code of ethics for health-sector workers).

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Reviewers: the review panel named above — reviewed the final version.
The author and reviewers have read this version and support its use as a reference alongside clinical judgment.
Every effort has been made to ensure that the information in this guide is accurate and current at the time of issue. Errors or omissions may nevertheless occur; readers are asked to report them to the address below so that they can be corrected.
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What the colors mean

- **01 · Resuscitation** — cardiopulmonary arrest & the universal approach
- **02 · Behavioral & Psychiatric** — agitation, self-harm, drug-induced syndromes
- **03 · Cardiac & Shock** — arrhythmias, all types of shock, hypercyanotic spell
- **04 · Common Acute Conditions** — everyday clinic & ED infections and presentations
- **05 · Complex & Technology-Dependent Care** — tracheostomy, feeding tubes, ECMO, post-ICU, transport
- **06 · Endocrine & Metabolic** — diabetes, adrenal, inborn errors, electrolytes
- **07 · Focused Specialty Emergencies** — eye, dental, dermatologic, ENT & neurosurgical
- **08 · Gastroenterology & Hepatology** — liver failure, GI bleeding, pancreatitis, hepatitis, cholestasis
- **09 · Hematologic & Oncologic** — neutropenia, tumor lysis, sickle cell, bleeding
- **10 · Neonatal** — newborn-specific emergencies
- **11 · Neurologic** — seizures & status epilepticus
- **12 · Orthopedic & Musculoskeletal** — the limping child, SCFE, compartment syndrome, fractures

- **13 · Pediatric Trauma & TBI** — primary/secondary survey, traumatic brain injury
- **14 · Renal & Urology** — AKI, HUS, hypertensive emergency, acute scrotum & testicular torsion
- **15 · Respiratory, Allergy & Immunology** — airway, breathing, anaphylaxis, allergy & immunology
- **16 · Rheumatologic** — cytokine storm (HLH/MAS) & Kawasaki
- **17 · Surgical Emergencies** — recognize, resuscitate, refer
- **18 · Toxicology & Environmental** — poisoning, burns, heat, drowning, smoke inhalation

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Each topic also carries an **urgency tag** showing how fast to act:

`MINUTES` immediately life-threatening — act now

`HOURS` urgent — stabilize and treat early

`ASSESS` evaluate and manage on its own pathway

Call vs refer — in a **hospital**, **call** the in-house specialist team (on site); in a **polyclinic** — or any facility **where the specialty is not available** — **refer** the patient to a facility that has it.

Abbreviations

CPS — Canadian Pediatric Society

GINA — Global Initiative for Asthma

KDIGO — Kidney Disease: Improving Global Outcomes

KNCPP — Kuwait National Child Protection Program

NASPGHAN — North American Society for Pediatric Gastroenterology, Hepatology and Nutrition

PES — Pediatric Endocrine Society

PIDS — Pediatric Infectious Diseases Society

NTSP — National Tracheostomy Safety Project

AAP — American Academy of Pediatrics

NRP — Neonatal Resuscitation Program

AARC — American Association for Respiratory Care

AUA — American Urological Association

BTF — Brain Trauma Foundation

CDC — Centers for Disease Control and Prevention

ELSO — Extracorporeal Life Support Organization

EMA — European Medicines Agency

ESPGHAN — European Society for Pediatric Gastroenterology, Hepatology and Nutrition

EULAR — European Alliance of Associations for Rheumatology

FDA — US Food and Drug Administration

AHA — American Heart Association

IDSA — Infectious Diseases Society of America

ASHP — American Society of Health-System Pharmacists

ANMF — Australasian Neonatal Medicines Formulary

ESC — European Society of Cardiology

ISMP — Institute for Safe Medication Practices

SIDP — Society of Infectious Diseases Pharmacists

AES — American Epilepsy Society

EAN — European Academy of Neurology

PNS — Peripheral Nerve Society

RCPCH — Royal College of Paediatrics and Child Health (UK)

ILAE — International League Against Epilepsy

ISPAD — International Society for Pediatric and Adolescent Diabetes

MOH — Ministry of Health

BTS — British Thoracic Society (UK)

NAEMSP — National Association of EMS Physicians (US)

NICE — National Institute for Health and Care Excellence (UK)

WHO — World Health Organization

DRACMA — Diagnosis and Rationale for Action against Cow's Milk Allergy (WAO)

WAO — World Allergy Organization

ACR — American College of Rheumatology

APSA — American Pediatric Surgical Association

BSH — British Society for Haematology

CSTE — Council of State and Territorial Epidemiologists (US)

EAACI — European Academy of Allergy and Clinical Immunology

EAU — European Association of Urology

ECCO — European Crohn's and Colitis Organisation

ESPID — European Society for Paediatric Infectious Diseases

ILCOR — International Liaison Committee on Resuscitation

NAEPP — National Asthma Education and Prevention Program (US)

NCS — Neurocritical Care Society

NHLBI — National Heart, Lung, and Blood Institute (US)

RCS — Royal College of Surgeons (UK)

SSC — Surviving Sepsis Campaign

UHMS — Undersea and Hyperbaric Medical Society

AAO-HNS — American Academy of Otolaryngology–Head and Neck Surgery

BNF — British National Formulary (UK)

LITFL — Life in the Fast Lane (clinical education site)

ATLS — Advanced Trauma Life Support (course)

APLS — Advanced Paediatric Life Support (course)

AAF — amino acid formula

ABC — airway, breathing, circulation

ABCDE — airway, breathing, circulation, disability, exposure

ABG — arterial blood gas

ABO — ABO blood-group system

ACE — angiotensin-converting enzyme (inhibitor)

ACS — acute chest syndrome; also American College of Surgeons (trauma)

ADAMTS13 — von Willebrand factor-cleaving protease (ADAMTS13)

ADHD — attention-deficit / hyperactivity disorder

AED — automated external defibrillator; also antiepileptic drug

aEEG — amplitude-integrated electroencephalography

AEIOU — alcohol, epilepsy, insulin, opioids/overdose, uremia (coma mnemonic)

AGEP — acute generalized exanthematous pustulosis

AHI — apnea–hypopnea index

AHO — acute hematogenous osteomyelitis

AHT — abusive head trauma

aHUS — atypical hemolytic uremic syndrome

AKI — acute kidney injury

ALT — alanine aminotransferase

ALTE — apparent life-threatening event

AMPLE — allergies, medications, past history, last meal, events (history mnemonic)

AMR — antimicrobial resistance

AMS — altered mental status

ANC — absolute neutrophil count

AOM — acute otitis media

APGAR — Appearance, Pulse, Grimace, Activity, Respiration (score)

APML — acute promyelocytic leukemia

aPTT — activated partial thromboplastin time

ARDS — acute respiratory distress syndrome

ARF — acute rheumatic fever

ASD — atrial septal defect

AST — aspartate aminotransferase

ATOMAC — Arizona-Texas-Oklahoma-Memphis-Arkansas Consortium (pediatric trauma guidelines)

ASH — American Society of Hematology

ASO — antistreptolysin O

ATA — American Thyroid Association

ATP — adenosine triphosphate

AUC — area under the (concentration–time) curve

AV — atrioventricular

AVM — arteriovenous malformation

AVPU — alert / voice / pain / unresponsive (conscious-level scale)

AVSD — atrioventricular septal defect

B19 — parvovirus B19

BSA — body surface area

B symptoms — lymphoma constitutional symptoms (Ann Arbor staging): unexplained fever > 38 °C, drenching night sweats, weight loss > 10%

BCG — bacille Calmette–Guérin (vaccine)

BID — twice daily

BMI — body mass index

BNP — B-type natriuretic peptide

BP — blood pressure

BRUE — brief resolved unexplained event

BSPED — British Society for Paediatric Endocrinology and Diabetes

BUN — blood urea nitrogen

BWPS — Burch–Wartofsky Point Scale (for thyrotoxicosis)

BXO — balanitis xerotica obliterans

C1-INH — C1-esterase inhibitor

C3, C4 — complement components 3 and 4

CAH — congenital adrenal hyperplasia

CAP — community-acquired pneumonia

CBC — complete blood count

CCHD — critical congenital heart disease

CD46 — membrane cofactor protein (complement regulator)

CDH — congenital diaphragmatic hernia

CFU — colony-forming units

CH50 — total hemolytic complement

CHD — congenital heart disease

CICO — can't intubate, can't oxygenate

CK — creatine kinase

CKD — chronic kidney disease

CMC — children with medical complexity

CMPA — cow's milk protein allergy

CMV — cytomegalovirus

CNO — chronic nonbacterial osteomyelitis

CNS — central nervous system

CO — carbon monoxide

COG — Children’s Oncology Group

COHb — carboxyhemoglobin

CPAP — continuous positive airway pressure

CPEG — Canadian Pediatric Endocrine Group

CPR — cardiopulmonary resuscitation

CRMO — chronic recurrent multifocal osteomyelitis

CRP — C-reactive protein

CRASH-2 / CRASH-3 — Clinical Randomisation of an Antifibrinolytic in Significant Haemorrhage trials (tranexamic acid in trauma / head injury)

CRRT — continuous renal replacement therapy

CSF — cerebrospinal fluid

CT — computed tomography

CVC — central venous catheter

CVID — common variable immunodeficiency

CVS — cardiovascular system

CXR — chest radiograph (chest X-ray)

CYP2D6 — cytochrome P450 2D6 (codeine/tramadol metabolism)

D10 — 10% dextrose

DAT — direct antiglobulin (Coombs) test

DDAVP — desmopressin

DEFG — don't ever forget glucose (coma mnemonic)

DIC — disseminated intravascular coagulation

DIVA — difficult intravenous access

DKA — diabetic ketoacidosis

DL — direct laryngoscopy

DMD — Duchenne muscular dystrophy

DNase — deoxyribonuclease (dornase alfa)

DOPES — displacement, obstruction, pneumothorax, equipment, stomach (sudden deterioration of a ventilated child)

DRESS — drug reaction with eosinophilia and systemic symptoms

DSD — difference / disorder of sex development

DTaP — diphtheria, tetanus, acellular pertussis (pediatric)

EBV — Epstein–Barr virus

ECG — electrocardiogram

ECMO — extracorporeal membrane oxygenation

ECPR — extracorporeal cardiopulmonary resuscitation

ED — emergency department

EEG — electroencephalogram

eGFR — estimated glomerular filtration rate

EHF — extensively hydrolyzed formula

EMLA — eutectic mixture of local anesthetics

ENT — ear, nose and throat (otolaryngology)

ERCP — endoscopic retrograde cholangiopancreatography

ESBL — extended-spectrum β-lactamase

ESETT — Established Status Epilepticus Treatment Trial

ESC-NOW — Eat, Sleep, Console approach for Neonatal Opioid Withdrawal (trial)

ESR — erythrocyte sedimentation rate

ET — endotracheal (route)

ETT — endotracheal tube

EVD — external ventricular drain

eFAST — extended Focused Assessment with Sonography for Trauma (adds lung views for pneumothorax)

FAST — Focused Assessment with Sonography for Trauma (bedside ultrasound for free fluid)

FBC — full blood count

FEIBA — factor eight inhibitor bypassing activity

FFP — fresh frozen plasma

FHH — familial hypocalciuric hypercalcemia

FiO_2 — fraction of inspired oxygen

FIS — flexible intubation scope

FN — febrile neutropenia

FPE — food protein-induced enteropathy

FPIAP — food protein-induced allergic proctocolitis

FPIES — food protein-induced enterocolitis syndrome

FTT — failure to thrive

FVC — forced vital capacity

G6PD — glucose-6-phosphate dehydrogenase

GA²LEN — Global Allergy and Asthma European Network (anaphylaxis criteria)

GAS — group A Streptococcus

GBS — group B *Streptococcus*; also Guillain–Barré syndrome

GCS — Glasgow Coma Scale

GER — gastroesophageal reflux

GERD — gastroesophageal reflux disease

GFR — glomerular filtration rate

GGT — gamma-glutamyl transferase

GH — growth hormone

GI — gastrointestinal

GIR — glucose infusion rate

GJ — gastrojejunal (tube)

GU — genitourinary

H2-antagonist — histamine H2-receptor antagonist

HA — hypoallergenic (partially hydrolyzed formula label)

HAE — hereditary angioedema

HAST — hypoxia-altitude simulation test

HbA1c — glycated hemoglobin

HBO — hyperbaric oxygen

HBV — hepatitis B virus

HCN — hydrogen cyanide

HCO_3^- — bicarbonate

HCT — hematocrit

HDU — high-dependency unit

HEEADSSS — Home, Education, Eating, Activities, Drugs, Sexuality, Suicide, Safety (adolescent interview)

HFNC — high-flow nasal cannula

HHS — hyperosmolar hyperglycemic state

HHV-6 — human herpesvirus 6

HIV — human immunodeficiency virus

HLA — human leukocyte antigen

HLH — hemophagocytic lymphohistiocytosis

HME — heat and moisture exchanger

HR — heart rate

HSP — Henoch–Schönlein purpura (IgA vasculitis)

HSV — herpes simplex virus

HUS — hemolytic uremic syndrome

IABP — intra-aortic balloon pump

IBD — inflammatory bowel disease

IBI — invasive bacterial infection (bacteremia or bacterial meningitis)

ICP — intracranial pressure

ICU — intensive care unit

ID — infectious diseases

IDM — infant of a diabetic mother

IE — infective endocarditis

IEI — inborn errors of immunity

IEM — inborn error of metabolism

IgA — immunoglobulin A

IgE — immunoglobulin E

IgG — immunoglobulin G

IgM — immunoglobulin M

IGRA — interferon-γ release assay

IM — intramuscular

iNO — inhaled nitric oxide

INR — international normalized ratio

IO — intraosseous

IPNA — International Pediatric Nephrology Association

ITP — immune thrombocytopenia

IU — international units

IUGR — intrauterine growth restriction

IV — intravenous

IVA — isovaleric acidemia

IVIG — intravenous immunoglobulin

JAK — Janus kinase (inhibitor)

JIA — juvenile idiopathic arthritis

JVP — jugular venous pressure

KCl — potassium chloride

KCNQ2, SCN2A — neonatal-onset epilepsy genes

KPCC — Kuwait Poison Control Center

LAD — leukocyte adhesion deficiency

LCHADD — long-chain 3-hydroxyacyl-CoA dehydrogenase deficiency

LDH — lactate dehydrogenase

LFTs — liver function tests

LGMD — limb-girdle muscular dystrophy

LGA — large for gestational age

LMA — laryngeal mask airway

LMWH — low-molecular-weight heparin

LP — lumbar puncture

LOC — loss of consciousness

LR — likelihood ratio

LRINEC — Laboratory Risk Indicator for Necrotizing Fasciitis (score)

LTV — long-term ventilation

LV — left ventricle / ventricular

MAP — mean arterial pressure

MAS — macrophage activation syndrome

MCAD — medium-chain acyl-CoA dehydrogenase deficiency

MCP — membrane cofactor protein (CD46)

MDRO — multidrug-resistant organism

MEDIF — airline Medical Information Form

MEN — multiple endocrine neoplasia

MenACWY — quadrivalent meningococcal conjugate vaccine (serogroups A, C, W, Y)

MenB — serogroup B meningococcal vaccine

MEP — maximal expiratory pressure

MIC — minimum inhibitory concentration

MIP — maximal inspiratory pressure

min — minutes

MIRM — *Mycoplasma pneumoniae*-induced rash and mucositis

MIS-C — multisystem inflammatory syndrome in children

MMA — methylmalonic acidemia

MMR — measles, mumps and rubella (vaccine)

MMRV — measles–mumps–rubella–varicella vaccine

MRCP — magnetic resonance cholangiopancreatography

MRI — magnetic resonance imaging

MRP — most responsible physician

MRSA — methicillin-resistant Staphylococcus aureus

MSSA — methicillin-susceptible Staphylococcus aureus

MTP — massive transfusion protocol

MSUD — maple syrup urine disease

NAAT — nucleic acid amplification test

NAC — N-acetylcysteine

NaCl — sodium chloride

NAGS — N-acetylglutamate synthase

NAI — non-accidental injury

NEC — necrotizing enterocolitis

NEJM — The New England Journal of Medicine

NEWS2 — National Early Warning Score 2

NG — nasogastric

NGT — nasogastric tube

NICU — neonatal intensive care unit

NIF — negative inspiratory force

NIV — non-invasive ventilation

NJT — nasojejunal tube

NK — natural killer (cell)

NMS — neuroleptic malignant syndrome

NPA — nasopharyngeal airway

NPO — nil per os (nothing by mouth)

NSAID — non-steroidal anti-inflammatory drug

NT-proBNP — N-terminal pro-B-type natriuretic peptide

NTM — nontuberculous mycobacteria

ODT — orally disintegrating tablet

OGT — orogastric tube

OHP — 17-hydroxyprogesterone (17-OHP)

OI — oxygenation index

OME — otitis media with effusion

OPA — oropharyngeal airway

OPV — oral poliovirus vaccine

OR — odds ratio

ORS — oral rehydration solution

ORT — oral rehydration therapy

OSA — obstructive sleep apnea

OSI — oxygenation saturation index

PA — propionic acidemia; also posteroanterior (radiograph view)

PALF — pediatric acute liver failure

PALS — Pediatric Advanced Life Support

PaO_2 — arterial partial pressure of oxygen

PARDS — pediatric acute respiratory distress syndrome

PAS — Pediatric Appendicitis Score

PAT — Pediatric Assessment Triangle

PCR — polymerase chain reaction

PCT — procalcitonin

PDA — patent ductus arteriosus

PE — phenytoin equivalents

PEA — pulseless electrical activity

PECARN — Pediatric Emergency Care Applied Research Network

PED-TRAX — Pediatric Trauma and Tranexamic Acid study (observational)

PEEP — positive end-expiratory pressure

PEG — percutaneous endoscopic gastrostomy

PEN-FAST — penicillin-allergy risk-assessment score

PEP — post-exposure prophylaxis

PEWS — Pediatric Early Warning Score

PH — portal hypertension

PICC — peripherally inserted central catheter

PICS-p — post-intensive care syndrome — pediatric

PICU — pediatric intensive care unit

PIGN — post-infectious glomerulonephritis

PJP — *Pneumocystis jirovecii* pneumonia

PLP — pyridoxal-5-phosphate

PMA — postmenstrual age

PNPO — pyridox(am)ine 5′-phosphate oxidase (deficiency)

PO — by mouth (oral)

POC — portable oxygen concentrator

POCUS — point-of-care ultrasound

PPHN — persistent pulmonary hypertension of the newborn

PPI — proton pump inhibitor

PPV — positive-pressure ventilation

PR — per rectum (rectal route); also PR interval on ECG

PRAM — Pediatric Respiratory Assessment Measure

PRBC — packed red blood cells

PRN — as required (pro re nata)

PROPPR — Pragmatic, Randomized Optimal Platelet and Plasma Ratios trial

PSG — polysomnography

PSGN — post-streptococcal glomerulonephritis

PT — prothrombin time

PTH — parathyroid hormone

PTHrP — parathyroid hormone-related peptide

PTSD — post-traumatic stress disorder

PTU — propylthiouracil

PUCAI — Pediatric Ulcerative Colitis Activity Index

PVC — premature ventricular contraction

PVR — pulmonary vascular resistance

pVT — pulseless ventricular tachycardia

QID — four times daily

QRS — QRS complex (ECG)

QT — QT interval (ECG)

QTc — corrected QT interval

RADT — rapid antigen detection test

RAPD — relative afferent pupillary defect

RBC — red blood cell

RBS — random blood sugar

RBUS — renal and bladder ultrasound

RCA — right coronary artery

RCT — randomized controlled trial

RDS — respiratory distress syndrome

rFVIIa — recombinant activated factor VII

RIG — rabies immunoglobulin

RIME — reactive infectious mucocutaneous eruption

RLQ — right lower quadrant

ROSC — return of spontaneous circulation

ROTEM — rotational thromboelastometry

RR — respiratory rate

RSI — rapid sequence intubation

RSV — respiratory syncytial virus

RT — respiratory therapist

RV — right ventricle

s — seconds

SA — septic arthritis

SBP — systolic blood pressure

SC — subcutaneous

SCAR — severe cutaneous adverse reaction (RegiSCAR / J-SCAR criteria)

SCFE — slipped capital femoral epiphysis

sCD25 — soluble CD25 (soluble interleukin-2 receptor-α)

SCID — severe combined immunodeficiency

SCIWORA — spinal cord injury without radiographic abnormality

SGA — small for gestational age

SIADH — syndrome of inappropriate antidiuretic hormone secretion

SIDS — sudden infant death syndrome

SIP — spontaneous intestinal perforation

SIPA — shock index, pediatric age-adjusted

sJIA — systemic juvenile idiopathic arthritis

SJS — Stevens–Johnson syndrome

SOPA — suction, open mouth, pressure increase, airway alternative (NRP corrective steps)

SpO_2 — peripheral oxygen saturation

SPUR — severe, persistent, unusual, recurrent (immunodeficiency pattern)

SSSS — staphylococcal scalded skin syndrome

SSTI — skin and soft-tissue infection

STAT — immediately (statim)

STEC — Shiga toxin–producing E. coli

STI — sexually transmitted infection

SVC — superior vena cava

SVR — systemic vascular resistance

SVT — supraventricular tachycardia

T1DM — type 1 diabetes mellitus

T2DM — type 2 diabetes mellitus

T3 / T4 — triiodothyronine / thyroxine

TB — tuberculosis

TBI — traumatic brain injury

TBSA — total body surface area

TBW — total body water

TCA — tricyclic antidepressant

TcB — transcutaneous bilirubin

Tdap — tetanus, diphtheria, acellular pertussis (adolescent/adult)

TEN — toxic epidermal necrolysis

TEN-4-FACESp — bruising clinical decision rule (Torso, Ears, Neck in a child ≤ 4 y or any bruise < 4 months; Frenulum, Angle of jaw, Cheek, Eyelid, Sclera; patterned)

TEG — thromboelastography

TFI — total fluid intake

TID — three times daily

TIF — tracheo-innominate fistula

TIPS — transjugular intrahepatic portosystemic shunt

TLS — tumor lysis syndrome

TM — tympanic membrane

TMA — thrombotic microangiopathy

TMP-SMX — trimethoprim-sulfamethoxazole

TOF — tetralogy of Fallot

tPA — tissue plasminogen activator

TRAb — TSH-receptor antibody

TREC — T-cell receptor excision circle

TREKK — Translating Emergency Knowledge for Kids

TSB — total serum bilirubin

TSH — thyroid-stimulating hormone

TSI — thyroid-stimulating immunoglobulin

TTE — transthoracic echocardiography

TTP — thrombotic thrombocytopenic purpura

TTS — tight-to-shaft (tracheostomy cuff)

TWIST — Testicular Workup for Ischemia and Suspected Torsion (score)

TXA — tranexamic acid

UCD — urea cycle disorder

ULN — upper limit of normal

UTI — urinary tract infection

V_d — volume of distribution

VA — venoarterial (ECMO)

VAD — ventricular assist device

VATS — video-assisted thoracoscopic surgery

VCUG — voiding cystourethrogram

VF — ventricular fibrillation

VKDB — vitamin K deficiency bleeding

VL — videolaryngoscopy

VLCADD — very-long-chain acyl-CoA dehydrogenase deficiency

VP — ventriculoperitoneal (shunt)

VRE — vancomycin-resistant enterococci

VSD — ventricular septal defect

VT — ventricular tachycardia

VTE — venous thromboembolism

VUR — vesicoureteral reflux

VV — venovenous (ECMO)

VZV — varicella-zoster virus

WBC — white blood cell (count)

WOB — work of breathing

WPW — Wolff–Parkinson–White (syndrome)

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Find It by Symptom

The front door — start here: a presentation routes you to the card

Presentation → card index

NAVIGATOR `Presentation → card`

You see a presentation, not a diagnosis. Start here and jump to the card.

Chip colour = the guide section the card is in

Solid chip = MINUTES card — act now

AIRWAY & BREATHING

Stridor

- Croup
- Choking (Foreign-Body Obstruction)
- Anaphylaxis
- Retropharyngeal Abscess

Wheeze

- Acute Asthma
- Bronchiolitis
- Anaphylaxis

Apnea / brief resolved event

- BRUE (Brief Resolved Unexplained Event)
- Pertussis (Whooping Cough)

CIRCULATION, SHOCK & BLEEDING

Shock / poor perfusion

- Shock — Recognition & Type
- Septic Shock

Anaphylaxis / urticaria + collapse

- Anaphylaxis

Major hemorrhage / trauma

- Massive Transfusion & Blood Products
- Major Trauma — Primary Survey & Resuscitation

Cyanosis / the blue baby

- Hypercyanotic (Tet) Spell
- Neonatal & Infant CHD
- Critical CHD — Pulse Oximetry Screening

Petechiae / purpura

- Immune Thrombocytopenia (ITP)
- IgA Vasculitis (Henoch–Schönlein Purpura)
- Septic Shock

Bruising / abnormal bleeding

- Immune Thrombocytopenia (ITP)
- Acute Bleeding in Hemophilia
- Vitamin K Deficiency Bleeding (VKDB)
- Child Protection & Safeguarding

FEVER & INFECTION

Fever in the young infant

- Fever in the Young Infant

Fever + non-blanching rash

- Septic Shock
- Bacterial Meningitis & Encephalitis

Painful swollen joint + fever

- Transient Synovitis vs Septic Arthritis
- Osteoarticular Infections

BRAIN & BEHAVIOR

Seizure

- Convulsive Status Epilepticus
- Febrile Seizure
- Neonatal Seizures

Floppy infant / acute weakness

- Guillain–Barré Syndrome / Acute Flaccid Paralysis
- The Child with Neuromuscular Disease
- Neonatal Sepsis (rapid approach)

Agitation / behavioral crisis

- Acute Severe Agitation
- Self-Harm / Intentional Ingestion

ABDOMEN, GUT & URINE

Bilious vomiting (green)

- Malrotation / Midgut Volvulus

Severe abdominal pain

- Acute Appendicitis
- Intussusception
- Malrotation / Midgut Volvulus
- Diabetic Ketoacidosis

Bloody diarrhea

- Hemolytic Uremic Syndrome
- Acute IBD Flare & Toxic Megacolon
- Gastroenteritis & Dehydration

Acute scrotal pain

- Acute Scrotum
- Testicular Torsion

Dark / tea-colored urine

- Rhabdomyolysis
- Acute Kidney Injury
- Gross Hematuria

Jaundiced neonate

- Neonatal Hyperbilirubinemia
- Neonatal Cholestasis

GLUCOSE & POISONING

High glucose / ketones

- Diabetic Ketoacidosis
- Hyperglycemic Hyperosmolar State (HHS)

Hypoglycemia

- Hypoglycemia (Beyond the Newborn)
- Metabolic Crisis (Inborn Error)
- Neonatal Hypoglycemia

Poisoning / ingestion

- Poisoning & Toxic Ingestion
- Button (Lithium) Battery Ingestion
- Caustic (Corrosive) Ingestion

LIMBS & SPECIAL SITUATIONS

The limping / non-weight-bearing child

- The Limping Child
- Transient Synovitis vs Septic Arthritis
- Slipped Capital Femoral Epiphysis (SCFE)

The unwell child with a device

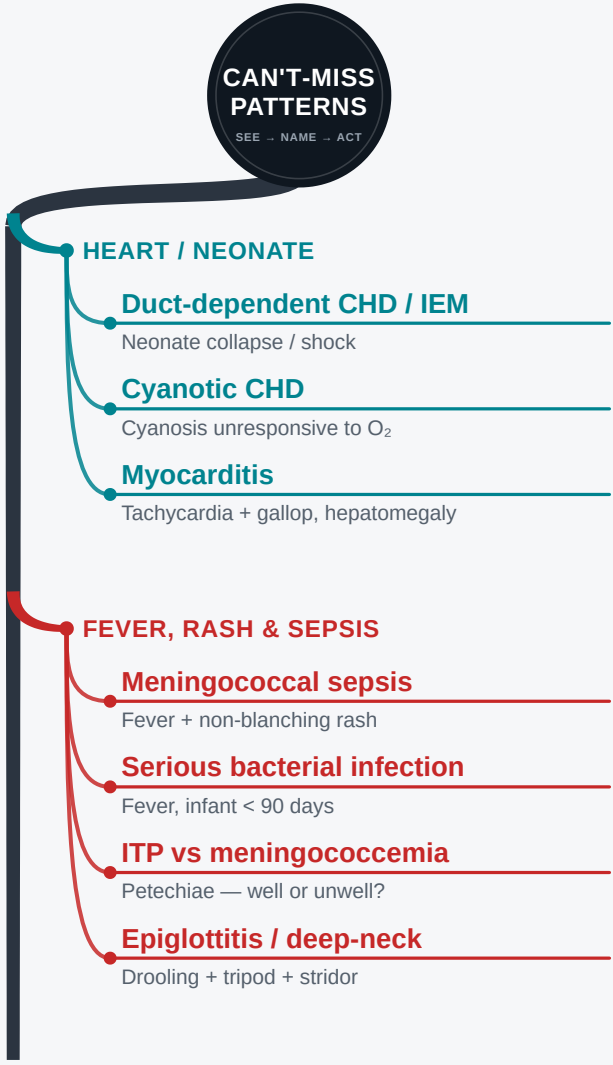
- Tracheostomy Emergencies
- Gastrostomy (Feeding) Tube Problems
- The Child with Medical Complexity

◈ HOW TO USE

- This routes the commonest bedside **PRESENTATIONS** to the relevant cards — it is a starting point, not a differential.
- Tap a card name to jump straight to it. Chip colour shows the section the card is in; a solid chip is a MINUTES card (act now).
- The full alphabetical index and the section colors remain the other two ways in.

Can’t-miss patterns — recognition map

See it → name the danger → act. Each branch ends in a sentinel pattern — tap it to jump to the full card (workup + doses). Not exhaustive; the section cards remain the source of truth.



SURGICAL / ABDOMEN

Malrotation + volvulus

Bilious (green) vomiting, infant

Testicular torsion

Acute scrotal pain / swelling

Caustic injury

Button / lithium battery

BRAIN, CORD & BP

Raised ICP / brain tumor

Morning headache + vomiting

Cord compression

Night back pain + leg weakness

Neuromuscular / botulism

Floppy infant, weak cry

Hypertensive emergency

Very high BP + seizure

METABOLIC, BONE & BLOOD

DKA ± cerebral edema

Vomiting + polyuria + high glucose

Septic arthritis

Limp + fever, won't bear weight

Acute hemolysis

Sudden pallor + jaundice

Inflicted injury

Bruise, non-mobile infant

Reconsider diagnosis

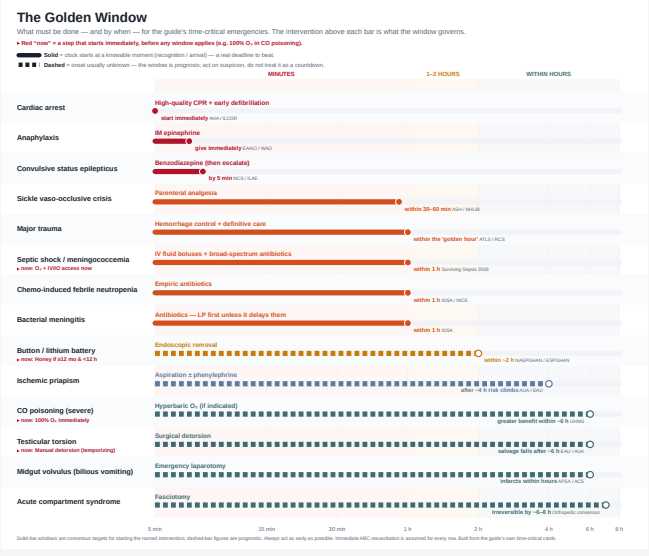
“Gastroenteritis”, no diarrhea

01 Resuscitation

PALS 2025 (AHA/AAP)

Time-critical emergencies at a glance

Solid bar = clock starts at a knowable moment (a real deadline). Dashed bar = onset usually unknown — prognosis, act on suspicion.



Cardiopulmonary Arrest MINUTES

Unresponsive, apneic, pulseless within 10 seconds → CPR now.

HIGH-QUALITY CPR IS THE PRIORITY

- Rate **100–120 per minute**; depth ⅓ of chest depth (~4 cm infant, ~5 cm child); full recoil; minimal interruptions[3].
- Ratio **30:2** (single rescuer) · **15:2** (two rescuers). **Adolescent (post-pubertal): 30:2 for both single and two rescuers** (adult BLS)[3,4].
- **With an advanced airway (all ages):** continuous chest compressions with **1 breath every 2–3 seconds (20–30 breaths/min)**[3], without pausing compressions.

DURING CPR

- Attach a monitor/defibrillator; establish access — **immediate IO in cardiac arrest if an IV is not already in place** (for other emergencies, limit peripheral IV attempts — ERC 2021: at most 2 attempts / 5 min — then go IO[5]); consider an **advanced airway** (then continuous compressions with one breath every 2–3 s); give oxygen.[3]
- Do not delay epinephrine or defibrillation for access or intubation[3].

DECISION

Rhythm on the monitor?

SHOCKABLE · VF / pVT

Defibrillate as early as possible — 2 J/kg → 4 J/kg → ≥4 J/kg (subsequent shocks; up to 10 J/kg or the adult dose[3], ≈ 200 J biphasic / 360 J monophasic).

- **Resume high-quality CPR** immediately after every shock[3].
- **Check the rhythm every 2 min**[3], pausing compressions ≤ 10 s; check a central pulse (brachial in infants; femoral/carotid in children) only if an organized rhythm or signs of return of circulation appear. If VF/pVT persists, shock again and resume CPR.
- **Epinephrine** during CPR **after the 2nd shock**[3] (don't pause compressions), then every 3–5 min.
- **Amiodarone** (or lidocaine) **after the 3rd shock**[3] for refractory VF/pVT.

Sequence (a continuous cycle): shock → shock → epinephrine → shock → amiodarone → **↻ back to shock** — keep repeating the 2-min CPR–shock cycle, epinephrine every 3–5 min and a further amiodarone dose as needed[3].

NON-SHOCKABLE · asystole / PEA

Give epinephrine during CPR as soon as possible, then every 3–5 minutes. Continue high-quality CPR without unnecessary interruptions; check rhythm every 2 minutes. If a shockable rhythm appears, **cross over to the shockable[3] (VF/pVT) pathway** and defibrillate.

EVERY CYCLE — REVERSIBLE CAUSES

- **6 H's:** hypoxia, hypovolemia, hydrogen ion (acidosis), hypo-/hyperkalemia, hypoglycemia, hypothermia[3].
- **5 T's:** tension pneumothorax, tamponade (cardiac), toxins, thrombosis (pulmonary), thrombosis (coronary)[3].

ROSC

Post-arrest: start post-arrest care · secure the airway · wean oxygen to target SpO_2 94–99% (avoid hyperoxic reperfusion injury[3]) and normal carbon dioxide · systolic and/or mean arterial BP > 10th centile for age · targeted normothermia (36–37.5 °C) · correct metabolic derangements · treat seizures (EEG if persistent encephalopathy).

MEDICATIONS & ENERGY

Epinephrine (adrenaline)

DOSE

`0.01 mg/kg (max 1 mg)`

ROUTE & NOTES

IV/IO, 0.1 mg/mL (1:10,000)[3] concentration; give during CPR without pausing compressions, every 3–5 min

Amiodarone

DOSE

`5 mg/kg (max 300 mg)`

ROUTE & NOTES

IV/IO bolus for refractory VF/pVT; may repeat up to twice (3 doses total; **repeat doses max 150 mg each** — PALS 2025; max 15 mg/kg). Avoid in prolonged QT (further prolongs QT)[3]

Lidocaine

DOSE

`1 mg/kg`

ROUTE & NOTES

IV/IO alternative to amiodarone[3]

Defibrillation

DOSE

`2 → 4 → ≥4 J/kg`

ROUTE & NOTES

Unsynchronized;[3] up to 10 J/kg or adult dose (≈ 200 J biphasic / 360 J monophasic)

⚠ REMEMBER

- Respiratory failure is the leading cause of cardiac arrest in pediatrics — oxygenate and ventilate early[3].
- Intraosseous access is fast — in **cardiac arrest go straight to IO if an IV is not already in place** (in other emergencies, IO if IV fails after 2 attempts / 5 min — ERC 2021[5]); do not delay epinephrine waiting for a vein[3].

◈ ALGORITHMS

- Full AHA PALS flowcharts (cardiac arrest

- bradycardia
- tachycardia
- post-arrest) — cpr.heart.org .

ADMIT · DISCHARGE · REFER

- **Admit** — every child with return of circulation → **start post-arrest care** (oxygenation/ventilation targets, hemodynamic support, treat the cause, neuroprotection, avoid fever and hypo/hyperglycemia).[3]
- **Home from the emergency department** — not applicable — care after unsuccessful resuscitation follows the death-confirmation and bereavement pathway.
- **Refer — now** — the specialty for the reversible cause (6 Hs / 5 Ts): cardiology, surgery, toxicology, or metabolic; involve the resuscitation team early.

SEE ALSO Situation-specific resuscitation: **Neonatal Resuscitation** · **Shock — Recognition & Type** · **Anaphylaxis** · **Difficult Airway** · **Major Trauma — Primary Survey**.

Code Blue — team roles & positions

Assign each role out loud and close the loop: Team Leader (hands-off), Airway Manager, Compressor, Defib Operator / CPR Coach, Medications & Vascular Access (×2), and Recorder / Documenter.



Human-prompted, AI-generated image, reviewed and approved by the panel.

02

Behavioral & Psychiatric

Agitation · self-harm · drug-induced syndromes

Acute Severe Agitation MINUTES

Keep child and staff safe; look for a treatable cause.

① EXCLUDE AN ORGANIC CAUSE FIRST

Check glucose, oxygenation, head injury, intoxication/withdrawal, pain. Agitation is a symptom — treat the cause where present[6].

↓

② NON-DRUG MEASURES FIRST

Calm low-stimulation environment, verbal de-escalation, familiar caregiver; offer oral medication, including the child's own regular medication, when available.[6]

↓ **severe / unsafe**

③ PHARMACOLOGIC (PER LOCAL PATHWAY)

Choose by cause (BETA): **delirium** → second-generation antipsychotic (avoid benzodiazepines/anticholinergics); **intoxication/withdrawal or anxiety** → benzodiazepine (± haloperidol if severe); **autism/developmental delay** → extra dose of the child's own medication, avoid IM where possible; **psychiatric/unknown, severe** → olanzapine alone, or haloperidol + lorazepam. Prefer PO before IM. Physical restraint = brief last resort, continuous monitoring[6].

Olanzapine

DOSE (APPROXIMATE)

2.5–5 mg (< 40 kg); 5–10 mg (≥ 40 kg); IM dose ½–¼ of the oral dose

ROUTE & NOTES

PO/IM/ODT; the **ODT** (orally disintegrating — Zyprexa Zydis) is easiest in an agitated child. Do **not** give within 1 h of a benzodiazepine (respiratory depression)[6]

Risperidone

DOSE (APPROXIMATE)

0.25–1 mg

ROUTE & NOTES

PO; well tolerated[6]

Lorazepam

DOSE (APPROXIMATE)

0.05–0.1 mg/kg (max 2 mg)

ROUTE & NOTES

PO/IM/IV; for substance- or anxiety-driven agitation[6]

Haloperidol

DOSE (APPROXIMATE)

0.5–5 mg (IM dose half the oral dose); max 6 mg/day at 15–40 kg, 15 mg/day > 40 kg

ROUTE & NOTES

PO/IM; watch for dystonia/QT — second-generation agents preferred[6]

Diphenhydramine

DOSE (APPROXIMATE)

1 mg/kg/dose (12.5–50 mg)

ROUTE & NOTES

IV/IM/PO; **antidote for an acute dystonic reaction** from an antipsychotic (haloperidol/risperidone). BETA also lists it as an option for mild agitation/anxiety in younger children, but it is not preferred here (avoid in delirium; paradoxical disinhibition)[6]

⚠ CAUTION WITH BENZODIAZEPINES

- Avoid benzodiazepines and diphenhydramine in **delirium** — can worsen confusion (paradoxical disinhibition)[6].
- Also avoid or use with caution in **developmental delay and autism**,

where benzodiazepines commonly cause **paradoxical reactions (more agitation)**[6].

ADMIT · DISCHARGE · REFER

- **Admit** — ongoing risk, a medical cause, or need for continued sedation/monitoring.
- **Home** — settled, medically cleared, with a safety plan and follow-up.
- **Refer — now** — psychiatry; medical/toxicology for organic causes.

Self-Harm / Intentional Ingestion

HOURS

Stabilize the patient medically first, then address psychological safety.

① MEDICAL STABILIZATION

ABCDE, glucose, ECG, and a pregnancy test (β-hCG) in all post-menarchal females[7]. For any ingestion: identify agent and timing, check an acetaminophen level at ≥ 4 h after ingestion (if drawn earlier, repeat at 4 h before plotting on the nomogram) and a salicylate level, and contact poisons information (Kuwait Poison Control Center) for agent-specific advice[8]. Treat per the specific antidote pathway.

② SAFETY

Continuous one-to-one observation, safe environment, involve a trusted adult/caregiver. Do not discharge before a mental-health assessment[7].

Refer for psychiatric/psychosocial assessment; arrange follow-up and support before discharge[7].

◈ **CROSS-REFERENCE** General approach, antidotes, and Kuwait Poison Control hotline: see **Poisoning & Toxic Ingestion** (Toxicology, Trauma & Environmental).

◣ **ADMIT · DISCHARGE · REFER**

- **Admit** — medical risk from the ingestion/injury, or ongoing suicidality → admit and monitor.
- **Home** — medically cleared AND psychiatrically assessed as safe, with follow-up and means restriction.[7]
- **Refer — now** — psychiatry (risk assessment), social work/safeguarding, and toxicology.

Drug-Induced Hyperthermia Syndromes

MINUTES

Three look-alikes with different triggers — and different antidotes.

Neuroleptic malignant syndrome

CLUE

Antipsychotic; **"lead-pipe" rigidity**, slow onset, high creatine kinase[9]

KEY TREATMENT

Stop drug; cool; fluids; benzodiazepine; dantrolene; bromocriptine[9]

Serotonin syndrome

CLUE

Serotonergic drug; **clonus & hyperreflexia**, rapid onset, agitation[10]

KEY TREATMENT

Stop drug; cool; benzodiazepine; cyproheptadine[10]

Malignant hyperthermia

CLUE

Volatile anesthetic / succinylcholine[11]; rigidity, rising CO_2

KEY TREATMENT

Stop trigger; **dantrolene 2.5 mg/kg IV rapid bolus**, repeated until hypercarbia, tachycardia, rigidity and temperature are controlled (no fixed upper limit; reconsider the diagnosis if > 10 mg/kg is needed); aggressive cooling; treat hyperkalemia/rhabdomyolysis; urgent PICU/anesthesia[11]

⚠ ALL THREE

- Active cooling, IV fluids; treat hyperkalemia and rhabdomyolysis[11].
- Secure airway; transfer to PICU.

◣ ADMIT · DISCHARGE · REFER

- **Admit** — all → PICU (cooling, sedation, dantrolene as indicated).
- **Home from the ward** — not acutely; after resolution and review of the causative agent.
- **Refer — now** — toxicology/PICU; psychiatry/pharmacy for a medication review.

Cardiac & Shock

03

Shock recognition & types · septic shock · arrhythmias · myocarditis / heart failure · congenital heart disease · hypercyanotic spell

Shock — Recognition & Type

MINUTES

Circulatory failure: tissues not getting enough oxygen. Hypotension is a late sign.

RECOGNIZE EARLY (BEFORE HYPOTENSION)

- Tachycardia, prolonged or flash capillary refill, cool or mottled skin, weak pulses, altered mental status, reduced urine output, rising lactate.[12,13]

UNIVERSAL FIRST STEPS

Start with ABCDEs · Oxygen · IV/IO access · monitor · check glucose & lactate · identify the type below[12].

DECISION

Which type of shock?

Hypovolemic

CAUSE

Vomiting/diarrhea, hemorrhage, burns

KEY TREATMENT

Crystalloid or balanced solution 10–20 mL/kg boluses[14]; **blood products (packed red cells) early** if hemorrhage[15,16]; stop ongoing losses

Distributive

CAUSE

Sepsis, anaphylaxis, neurogenic

KEY TREATMENT

Fluids + early vasoactive; treat the cause (see **Septic shock**, **Anaphylaxis**)

Cardiogenic

CAUSE

Myocarditis, arrhythmia, heart disease

KEY TREATMENT

Cautious fluid 5 mL/kg slowly; inotrope/inodilator; treat arrhythmia; early cardiology consult and PICU escalation[17]

Obstructive

CAUSE

Tension pneumothorax, tamponade, duct-dependent lesion, pulmonary embolism

KEY TREATMENT

Relieve the obstruction (decompress a tension pneumothorax, drain a tamponade, and — for example — prostaglandin for a duct-dependent lesion; massive/high-risk PE → thrombolysis + heparin, specialist-directed)[3]

⚠ MIMICS SHOCK — NOT CIRCULATORY FAILURE

- **Carbon monoxide, cyanide, hydrogen sulfide, and methemoglobinemia** impair oxygen **delivery or use at the hemoglobin / cellular level**, not the circulation — so this is **not true shock**, and the usual endpoints (blood pressure, capillary refill) can look normal. **Suspect it** when perfusion and BP appear adequate but there is **unexplained lactic acidosis / tissue hypoxia** with a suggestive history (fire / smoke, enclosed space, oxidizing drugs). **SpO_2 is unreliable** — confirm with **co-oximetry / blood gas**[18,19].
- It will **not respond to fluids or vasopressors**: give **100% oxygen** and the specific antidote[18,19,20,21] (see **Smoke Inhalation & CO** and **Poisoning**).

Balanced crystalloid

DOSE

10–20 mL/kg (5 mL/kg if cardiogenic)

NOTES

Ringer's lactate preferred; normal saline if a balanced fluid is unavailable. Bolus; reassess for fluid overload after each

Epinephrine (adrenaline) infusion

DOSE

0.05–0.3 mcg/kg/min

NOTES

Titrate to response; first-line vasoactive — epinephrine or norepinephrine (neither is preferred)[12]. May start peripherally with close observation for extravasation until central access is obtained

Norepinephrine (noradrenaline) infusion

DOSE

Start 0.05–0.1 mcg/kg/min titrate with the PICU a second agent is commonly considered once norepinephrine reaches ~0.1–0.3 mcg/kg/min (American and Asian/Middle-East practice; European units often wait until ~0.3–1 mcg/kg/min) [22]

NOTES

Titrate to response; first-line alternative — either epinephrine or norepinephrine is acceptable first-line; choose by physiology (epinephrine if low cardiac output/myocardial dysfunction, norepinephrine if vasodilated/low vascular resistance), local practice and clinician preference[12]. May start peripherally with close extravasation monitoring until central access is obtained

⚠ FLUID CAUTION

- Reassess after every bolus.
- Vasoactives may start alongside fluids if evidence of life-threatening end-organ hypoperfusion.
- Slow or stop fluids at first **signs of fluid overload** — new crackles, enlarging liver, gallop, worsening work of breathing, or overload on POCUS[12,13] — especially suspected cardiogenic shock.

◈ THERAPEUTIC ENDPOINTS (AIM FOR)

- Heart rate and blood pressure normal for age, capillary refill ≤ 2 s, warm extremities with normal pulses[12,13], normal mental status, urine output ≥ 1 mL/kg/h, falling / normalizing lactate (central venous O_2 saturation ≥ 70% where available).
- Reassess after every fluid bolus and every change in vasoactive support.

◣ ADMIT · DISCHARGE · REFER

- **Admit** — any child in shock → **call the PICU team to evaluate** (high-dependency/PICU); begin resuscitation before the type is confirmed.
- **Home from the ward** — only once the cause is treated and perfusion is normal off vasoactive support.
- **Refer — now** — by type — septic → PICU/infectious diseases; cardiogenic → cardiology; obstructive → treat the cause (tension pneumothorax, tamponade);

hypovolemic/hemorrhagic → surgery/trauma. **Involve PICU in parallel** for any child in shock.

Septic Shock MINUTES SSC

Infection + circulatory dysfunction. Defined by the Phoenix Sepsis Score in a child with suspected infection (≥ 2 points = sepsis; sepsis with ≥ 1 cardiovascular point = septic shock).

⚠ THE PHOENIX SCORE IS NOT A SCREENING TOOL

- The Phoenix Sepsis Score identifies **organ dysfunction** — by the time it is positive, sepsis is already established[23].
- It is **not** an early-screening tool.
- Keep using your standard pediatric **early-warning / sepsis-screening** triggers to catch the child **before** organ dysfunction develops[23].

FIRST HOUR — every minute counts

RESUSCITATE

- **Impaired perfusion** = altered mental status; tachycardia with weak or bounding pulses and wide pulse pressure (± hypotension); capillary refill > 2 s, mottled cool skin or pallor; oliguria < 1 mL/kg/h (adolescents < 0.5 mL/kg/h)[13,24].
- 100% oxygen via non-rebreather mask during resuscitation. Once shock has resolved (continuous monitoring/PICU), SSC 2026 suggests titrating oxygen to SpO_2 88–92% rather than > 94% (conditional)[12] — **not during active resuscitation**, and individualize in sickle cell disease/severe anemia, cyanotic heart disease, low cardiac output or ongoing oxygen debt, and neurological dysfunction.
- If intubating, avoid etomidate[12]
- two IV/IO
- **antibiotics within 1 hour**[12]
- Probable sepsis **without** shock: rapid assessment; if sepsis is still likely, antibiotics ideally within 3 hours[12]
- IV fluid boluses.
- **Labs:** glucose, CBC + differential, PCT or CRP, electrolytes, ionized calcium, renal and liver function,

coagulation, blood gas, lactate, cultures (blood ± urine).

- **Hypotension** (late sign) = systolic BP below, by age:
- < 60 mmHg — neonate
- < 70 mmHg — 1–12 mo
- < 70 + 2 × age(yr) — 1–10 yr
- < 90 mmHg — ≥ 10 yr (PALS age-based thresholds; manual text).[24]



FLUIDS

- **Balanced crystalloid** (Ringer's lactate preferred over 0.9% saline, except with hyponatremia or raised-ICP concern) 10–20 mL/kg boluses; reassess after each, up to 40–60 mL/kg in the first hour[12]. **Ringer's lactate contains calcium — never run ceftriaxone through the same line or Y-site** as Ringer's lactate or IV calcium: use the second IV/IO, or flush thoroughly with 0.9% saline before and after (age > 28 days)[25].
- Use crystalloids rather than albumin for initial resuscitation[12].
- **Watch for fluid overload** — new hepatomegaly, crackles, gallop, or B-lines on lung POCUS. Give further boluses only while shock persists without overload — titrate each bolus to markers of cardiac output and stop if shock resolves or overload develops[12]; FEAST showed harm from liberal boluses in children without ICU access[26].
- Use cardiac and lung point-of-care ultrasound (POCUS) to guide resuscitation where trained staff are available[12].

- Start vasoactives if shock persists after fluid boluses — no evidence-based volume threshold (before or after 40 mL/kg) — or earlier if overload develops[12].

`fluid-refractory`



VASOACTIVE

- **Call PICU immediately.**
- Start **epinephrine or norepinephrine** (either is acceptable first-line) — choose by **physiology** (epinephrine if low cardiac output/myocardial dysfunction, norepinephrine if vasodilated/low vascular resistance), local practice and clinician preference[12]; a well-sited peripheral IV is acceptable, with close extravasation monitoring while central access is arranged.
- **High-dose catecholamines** → add vasopressin or keep titrating the catecholamine[12].
- **Catecholamine-resistant shock** → consider hydrocortisone, especially with adrenal-insufficiency risk (purpura fulminans, recent/chronic steroids, hypothalamic–pituitary–adrenal disease)[12,13]; ACCM 2017 dosing ranges from 1–2 mg/kg/day (stress cover) up to 50 mg/kg/day titrated to shock reversal[13]
- Give stress-dose hydrocortisone for suspected/documented adrenal insufficiency. In catecholamine-resistant shock, hydrocortisone may reduce

catecholamine requirements, but pediatric evidence remains limited[12,13]. Call PICU.

- Do not start IV hydrocortisone for shock that fluids and vasoactives have already reversed[12] — **except in known or suspected adrenal insufficiency**, where stress dosing is given (and continued) regardless of hemodynamics.
- **Refractory shock** — persisting despite fluids, ≥ 2 vasoactives, and hydrocortisone, or **low cardiac output on high inotropic support → consider VA-ECMO as rescue therapy** and contact an ECMO center early[12].

MEDICATIONS

Ceftriaxone (empiric)

DOSE

100 mg/kg (max 4 g)

NOTES

IV; empiric regimen by focus (immunocompetent, community-acquired): no obvious focus → ceftriaxone ± vancomycin ± amikacin; meningitis/encephalitis → ceftriaxone + vancomycin ± acyclovir; pneumonia → ceftriaxone ± vancomycin; skin/soft-tissue → cefotaxime + vancomycin ± clindamycin; toxic shock or necrotizing fasciitis → piperacillin-tazobactam + vancomycin + clindamycin; intra-abdominal → piperacillin-tazobactam; neonate → cefotaxime + ampicillin (± acyclovir if HSV suspected, ± vancomycin if MRSA suspected). Immunocompromised or hospital-acquired: add antipseudomonal cover and consider antifungal. Send MRSA screening swabs. Agent choice by focus follows local practice (Kuwait Pediatric Council antibiotic policy)[27]. Meningitic ceftriaxone dose 50 mg/kg/dose every 12 h (100 mg/kg/day, max 4 g/day)[25] ⚠ **Calcium:** do not give ceftriaxone simultaneously with calcium-containing fluids (Ringer's lactate, calcium gluconate, parenteral nutrition) — separate line or flush. **Neonates ≤ 28 days:** ceftriaxone is contraindicated if calcium-containing IV fluids are or will be given, and in premature or jaundiced neonates — use cefotaxime (see Must-Avoid Drugs)[25].

Balanced crystalloid

DOSE

10–20 mL/kg

NOTES

Ringer's lactate preferred; normal saline if unavailable. Bolus, reassess after each

Epinephrine (adrenaline)

DOSE

Start 0.05–0.1 mcg/kg/min

NOTES

IV/IO infusion; escalate every 5–10 min to target — **escalation and titration must be done by the PICU team.** Central line preferred; peripheral is a bridge only with close extravasation monitoring until central access

Norepinephrine (noradrenaline)

DOSE

Start 0.05–0.1 mcg/kg/min
titrate with the PICU
a second agent is commonly considered once norepinephrine reaches ~0.1–0.3 mcg/kg/min (American and Asian/Middle-East practice; European units often wait until ~0.3–1 mcg/kg/min) [22]

NOTES

IV/IO infusion; escalate every 5–10 min to target — **escalation and titration must be done by the PICU team.** Central line preferred; peripheral is a bridge only with close extravasation monitoring until central access

Hydrocortisone

DOSE

1–2 mg/kg (max 100 mg)

NOTES

IV; give for suspected/documented adrenal insufficiency. No clear evidence for or against in catecholamine-resistant shock

◈ Vasoactive infusions — how to give them safely

- **EPINEPHRINE AND NOREPINEPHRINE INFUSIONS SHOULD BE GIVEN VIA A CENTRAL VENOUS CATHETER WHEREVER POSSIBLE.**[13] **DO NOT DELAY** initiation of vasoactive support to obtain central access (SSC Pediatric 2026)[12].
- Peripheral use is a **BRIDGE ONLY** — via a large vein, a dedicated dilute infusion, with site review **EVERY 15 MINUTES FOR THE FIRST HOUR THEN HOURLY**, and conversion to central access as soon as feasible.
- **DOSES ABOVE YOUR UNIT'S APPROVED CENTRAL OR PERIPHERAL MAXIMUM REQUIRE CONSULTANT APPROVAL,** documented in the notes. Escalation beyond **1 MCG/KG/MIN** should prompt reassessment of the shock phenotype and consideration of **VASOPRESSIN AND HYDROCORTISONE**[28], rather than relying solely on dose escalation.

◈ Preparing the infusion — where you have no local formulary

- **AMPOULES (GULF/ME):** epinephrine (adrenaline) **1 MG/ML (1:1,000)** is the stock ampoule (0.1 mg/mL / 1:10,000 is the pre-filled code syringe)[3,29,30];

norepinephrine (noradrenaline) **1 MG/ML** ampoules (2 mg/2 mL, 4 mg/4 mL). The strength printed on the ampoule is norepinephrine **BASE**: a 4 mg/4 mL ampoule contains **4 MG** — dose from the label strength.[31,32]

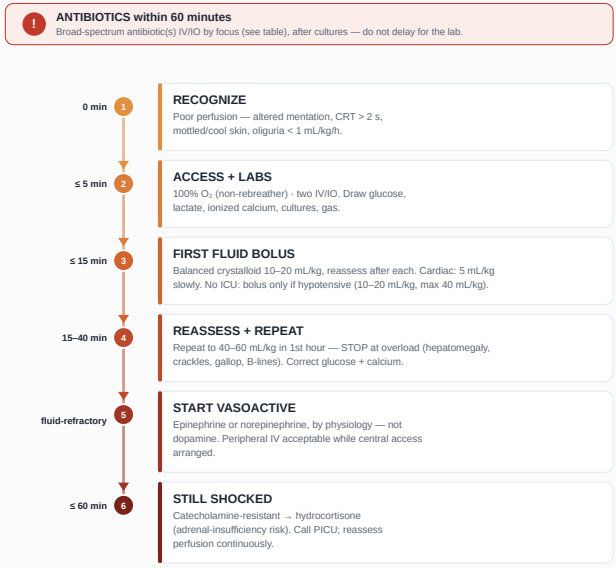
- **RULE OF 6 (WEIGHT-BASED):** put **0.3 MG/KG IN 50 ML** (or 0.6 mg/kg in 100 mL) of glucose 5% → **1 ML/H = 0.1 MCG/KG/MIN** (0.05 = 0.5 mL/h; 0.3 = 3 mL/h).[33]
- **STANDARD CONCENTRATION (SAFETY-PREFERRED):** epinephrine **10 / 20 / 40 MCG/ML**; norepinephrine (base) **16 / 32 / 64 MCG/ML**.[33,34] **RATE (ML/H) = DOSE (MCG/KG/MIN) × WEIGHT (KG) × 60 ÷ CONCENTRATION (MCG/ML).**[34] Use the most dilute for a peripheral bridge.[12,34]
- **DILUENT & SAFETY:** dilute in **GLUCOSE 5%** (0.9% saline alone: permitted by the UK norepinephrine label, not recommended by US epinephrine and norepinephrine labels) — **NOT** with bicarbonate/alkaline fluids; **PROTECT FROM LIGHT** and discard if discolored[29,31,32]; dedicated line; **NEVER BOLUS OR FLUSH** a vasoactive line[35]; independent double-check of drug, concentration, weight, and rate.[33,36]

ADMIT · DISCHARGE · REFER

- **Admit** — all → PICU/high-dependency; fluid-refractory or vasoactive-requiring shock is always PICU.
- **Home from the ward** — not from the acute episode — step down once off vasoactives with a controlled source.
- **Refer — now** — infectious diseases for source control and antimicrobials; surgery for a drainable focus; an ECMO center if refractory.

Septic shock — the first hour

The first hour, step by step: recognize → access + labs → fluids → reassess → vasoactive → hydrocortisone/PICU, with antibiotics inside the hour. Details in the card above.



Myocarditis / Acute Heart Failure

HOURS

The "gastroenteritis" or "asthma" that is really the heart — look for it.

RECOGNIZE

- Viral prodrome, then **tachycardia out of proportion** to the fever, poor feeding, lethargy, grunting or respiratory distress.

- **Hepatomegaly, gallop rhythm, weak pulses, cool peripheries.** Older child: chest pain, syncope, palpitations.
- Commonly mislabeled as gastroenteritis, sepsis, asthma, pneumonia, or bronchiolitis.[17]

CONFIRM

ECG (sinus tachycardia, low voltages, ST/T changes, arrhythmia, or heart block), chest X-ray (cardiomegaly, pulmonary edema), troponin and BNP raised, echocardiogram for reduced function.[17]

⚠ RESUSCITATE WITH CARE

- Oxygen and close monitoring. **Intubation is high-risk in ventricular dysfunction** (cardiac arrest at induction): do not intubate electively outside PICU; if unavoidable — most experienced operator, inotrope running and resuscitation drugs drawn up, PICU/cardiology (and the ECMO team where available) informed beforehand — **call PICU**.
- Do **not** give large fluid boluses (expert consensus).

- Use 5 mL/kg slowly and reassess for **signs of fluid overload** (worsening hepatomegaly, new crackles, a gallop, or respiratory distress).
- Start inotropes early (cardiology/PICU-directed) — milrinone (preferred if blood pressure allows — an inodilator that lowers afterload and can drop BP) or dobutamine.
- Tailor to hemodynamics: normotensive with cold peripheries and rising lactate → dobutamine or milrinone; hypotensive with poor perfusion → epinephrine.
- Check and correct electrolytes (calcium, potassium, magnesium, phosphate).
- Treat arrhythmia, give oxygen and ventilatory support.
- Early PICU and pediatric cardiology; refractory shock needs urgent PICU/cardiology transfer — advanced mechanical circulatory support is a specialist/PICU decision.[17]

Milrinone

DOSE

0.25–0.75 mcg/kg/min IV infusion

NOTES

Inodilator — first-line inotrope (AHA 2021), if the blood pressure allows.[17] Many units omit the 50 mcg/kg loading dose in acute shock to avoid hypotension (expert practice; not stated in the AHA statement).

Dobutamine

DOSE

2–20 mcg/kg/min IV infusion

NOTES

Normotensive with cold peripheries and rising lactate.

Epinephrine

DOSE

0.05–0.3 mcg/kg/min IV infusion

NOTES

Hypotensive with poor perfusion — reserve vasopressor-inotropes (epinephrine, dopamine) for hypotension or cardiogenic shock (more chronotropic and arrhythmogenic); calcium chloride or vasopressin can raise perfusion pressure without extra cardiac stimulation.[17] Consider mechanical circulatory support (ECMO/VAD) early.[17]

ADMIT · DISCHARGE · REFER

- **Admit** — all suspected cases → PICU/cardiology; arrhythmia, low output, or a troponin/BNP rise mandates continuous monitoring.
- **Home from the ward** — only after cardiology review, recovered function, and a heart-failure plan.
- **Refer — now** — cardiology urgently (echo, rhythm); a transplant/ECMO/mechanical-support center if low output or refractory arrhythmia.

Bradycardia + Poor Perfusion

MINUTES

Slow heart rate with shock — usually hypoxic.

FIRST

100% oxygen, support airway & breathing, monitor, IV/IO. **Ventilation corrects most pediatric bradycardia.**[3]

DECISION

HR < 60 with poor perfusion despite oxygenation & ventilation? Poor perfusion = acutely altered mental status, signs of shock, or low BP.

YES

Start CPR. Give epinephrine. Atropine for a vagal cause or heart block; consider pacing.[3] Treat the reversible cause; call PICU/cardiology early.

NO

Support, observe, treat the cause, seek cardiology input.

LOOK FOR THE CAUSE

- **Hypoxia is the commonest — oxygenate and ventilate first.**[3] Also: hypothermia; drugs/toxins; raised intracranial pressure (Cushing's triad — hypertension, bradycardia, irregular breathing) (see **Raised ICP**); increased vagal tone (e.g., suctioning, intubation); AV / heart block.
- A well, athletic, or sleeping child may be **physiologically** bradycardic.[3]

Epinephrine (adrenaline)

DOSE

0.01 mg/kg (max 1 mg)

NOTES

IV/IO, 0.1 mg/mL (1:10,000) concentration, every 3–5 min

Atropine

DOSE

0.02 mg/kg (min 0.1 mg, max single dose 0.5 mg); may repeat once

NOTES

IV/IO; for increased vagal tone or primary AV block[3]. Organophosphate/carbamate poisoning needs larger, escalating doses (0.02 mg/kg, doubled every 5 min until secretions dry) — see Poisoning

ADMIT · DISCHARGE · REFER

- **Admit** — all → PICU with continuous monitoring, including any child needing atropine, epinephrine, or pacing.
- **Discharge** — only after a reversible cause is corrected, the rhythm is stable, and cardiology has reviewed.
- **Refer** — cardiology for pacing or structural/conduction disease; treat reversible causes (hypoxia, vagal, raised ICP, toxins, electrolytes).

READING THE TRACING

- New to pediatric rhythms?
- See a stepwise approach to the pediatric ECG and common pediatric arrhythmias (LITFL ECG Library).

Supraventricular Tachycardia

MINUTES

Narrow QRS, no rate variability. HR > 220 infant / > 180 child.

THROUGHOUT

- Run a continuous ECG rhythm strip during every intervention — documents the moment of conversion; can unmask underlying WPW.[3]

DECISION

Hemodynamically unstable (shock, poor perfusion, reduced consciousness)?

UNSTABLE

Synchronized cardioversion; sedate only if it will not delay — use an agent that gives **amnesia**, not fentanyl alone (see sedation note). If IV/IO access is already in place, one rapid adenosine dose may be given while the defibrillator charges[3] — never delay the shock.

STABLE

Vagal maneuvers first — ice to the face in infants; Valsalva in older children (modified/postural Valsalva: pediatric experience is very limited)[3] — then adenosine.

✦ **MODIFIED VALSALVA**

- Sit child semi-recumbent; blow into a 10 mL syringe hard enough to just move the plunger (~15 s); then immediately lay flat and raise legs to ~45° for 15 s.[37]
- More effective than standard strain in the adult REVERT trial and a 2025 pediatric randomized trial.[37,38]

Adenosine (1st dose)

DOSE

`0.1 mg/kg (max 6 mg)`

NOTES

⚠ Technique is critical: use the most proximal IV; two-syringe or 3-way-stopcock method — rapid push, then an instant 5–10 mL saline flush while raising the arm[3]. Often needs two people.

Adenosine (2nd dose)

DOSE

`0.2 mg/kg (max 12 mg)`

NOTES

If no response to the first dose.

If the 2nd dose fails

DOSE

`Consult cardiology`

NOTES

Next steps (with cardiology): **synchronized cardioversion**, or **one** antiarrhythmic infusion — **amiodarone 5 mg/kg over 20–60 min** OR **procainamide 15 mg/kg over 30–60 min**; PALS 2025 adds **IV sotalol** as an option when SVT with compromise has failed vagal maneuvers, adenosine and cardioversion and no expert is reachable (dose and infusion time from the 2025 guideline/pharmacy protocol; it prolongs QT and depresses contractility). **Never mix antiarrhythmics.**[3]

Synchronized cardioversion

DOSE

`0.5–1 → 2 J/kg`

NOTES

For the unstable child. If it will not delay the shock, **sedate with an agent that provides amnesia** — do not rely on fentanyl alone (see the sedation note below).

⚠ SEDATION FOR CARDIOVERSION — AMNESIA, NOT JUST ANALGESIA

Fentanyl alone is a pitfall: it gives analgesia but **no amnesia** (pharmacology; PALS says only "consider sedation"), so the child may be awake and remember the shock; pushed rapidly it can cause **chest-wall rigidity**. **Ketamine**'s myocardial depression matters mainly in **prolonged, catecholamine-depleted** shock; in most children it is a net **sympathomimetic (positive inotrope)**, and ketamine or **etomidate** is standard for brief pediatric procedural sedation — there are no RCTs for this ~60-second window. **Involve a pediatric anesthesiologist** / follow your procedural-sedation protocol.

ADMIT · DISCHARGE · REFER

- **Admit** — first presentation, hemodynamic instability, or need for adenosine/cardioversion →

monitored bed/PICU.

- **Home from the emergency department** — a stable child who reverts and stays in sinus rhythm, feeding and well, with cardiology follow-up and a clear return plan.
- **Refer — clinic** — cardiology for all confirmed SVT (WPW screen, ablation planning) and for recurrent episodes.

READING THE TRACING

- Align terminology with PALS/cardiology: SVT = **narrow-complex tachycardia**, VT = **wide-complex tachycardia** (each with or without a pulse); cross-check the label with cardiology.
- New to pediatric rhythms?
- See a stepwise approach to the pediatric ECG and common pediatric arrhythmias (LITFL ECG Library).

Ventricular Tachycardia (with a pulse)

MINUTES

Wide-QRS tachycardia. Pulseless VT → use the arrest algorithm.

DECISION

Stable or unstable?

UNSTABLE

Synchronized cardioversion 0.5–1 → 2 J/kg. Sedate if it will not delay the shock — use an agent that gives amnesia, not fentanyl alone (see the sedation note in the Supraventricular Tachycardia card). Expert input.

STABLE

If **regular and monomorphic**, consider adenosine (diagnostic/therapeutic — may unmask SVT with aberrancy; not for irregular or polymorphic rhythms). **Polymorphic VT / torsades → magnesium sulfate 25–50 mg/kg IV (max 2 g)** and avoid QT-prolonging antiarrhythmics[3]. **Contact cardiology before starting antiarrhythmics** — a single infusion of amiodarone **or** procainamide (not both: additive QT prolongation)[3].

Amiodarone

DOSE

`5 mg/kg (max 300 mg)`

NOTES

IV over 20–60 min if perfusing; monitor BP[3] & QT

Procainamide

DOSE

`15 mg/kg`

NOTES

IV over 30–60 min; do not combine with amiodarone[3]

ADMIT · DISCHARGE · REFER

- **Admit** — all → PICU with continuous monitoring and a defibrillator at the bedside.

- **Home from the ward** — not from the acute episode — only after cardiology work-up and a management plan.
- **Refer — now** — cardiology urgently (structural disease, channelopathy, QT/electrolytes).
- **Refer — clinic** — consider genetics and family screening.

◈ READING THE TRACING

- New to pediatric rhythms?
- See a stepwise approach to the pediatric ECG and common pediatric arrhythmias (LITFL ECG Library).

Neonatal & Infant CHD MINUTES

RECOGNIZE BY PRESENTATION

Three ways congenital heart disease declares itself in the newborn — cyanosis, shock, or heart failure.

① CYANOSIS – CYANOTIC CHD ("5 T'S + 1");

DUCT-DEPENDENCE VARIES

- **T**ransposition of the great arteries (duct-dependent for mixing)
- **T**runcus arteriosus (not duct-dependent)
- **T**otal anomalous pulmonary venous drainage (not duct-dependent; obstructed type = surgical emergency — alprostadil does not relieve the obstruction)
- **T**ricuspid atresia
- **T**etralogy of Fallot — **only the critical / pulmonary-atresia type is duct-dependent** (ordinary TOF presents with tet spells; see below).
- **+ 1:** critical pulmonary stenosis / atresia.
- **Assess the response to oxygen — a formal hyperoxia test is no longer routinely recommended.**[39] High FiO_2 can accelerate ductal closure, dangerous in a duct-dependent lesion. Use pre-/post-ductal SpO_2, chest X-ray + blood gas, and echocardiography instead. In suspected duct-dependent CHD, **do not delay alprostadil** while waiting for a hyperoxia test[39].

② CARDIOGENIC SHOCK / COLLAPSE – DUCT-DEPENDENT SYSTEMIC FLOW (LEFT-HEART OBSTRUCTION)

- Hypoplastic left heart
- critical coarctation
- interrupted aortic arch
- critical aortic stenosis.
- Gray, mottled shock with **weak/absent femoral pulses**, a pre-/post-ductal saturation[39] & blood-pressure gap, and metabolic acidosis. **Avoid high inspired oxygen** — it lowers pulmonary vascular resistance and steals from systemic flow[39]. Start alprostadil.

③ HEART FAILURE – LEFT-TO-RIGHT SHUNTS

- VSD
- AVSD
- PDA
- (large ASD — rarely).
- **Present after the first weeks as pulmonary vascular resistance falls — not as immediate newborn emergencies;** ASD rarely causes neonatal heart failure.[40]

- Tachypnea, poor feeding, sweating with feeds, hepatomegaly, faltering growth.

Suspect a duct-dependent lesion → start Prostaglandin E1 (alprostadil) before the echocardiogram[39]

ANTICIPATE

Apnea (be ready to intubate), hypotension, fever. Urgent cardiology + transfer; carry the infusion on transfer.

Alprostadil (prostaglandin E1)

DOSE

Collapsed, acidotic or known left-heart obstruction: start 0.05 mcg/kg/min (50 ng/kg/min), up to 0.1 (rarely 0.1–0.2 on specialist advice).
Suspected, well and not acidotic: start 0.005–0.015 mcg/kg/min (5–15 ng/kg/min); double every 20 min if no response, to max 0.1.
Maintenance: lowest effective dose (often 0.01–0.02 mcg/kg/min)

ROUTE & NOTES

IV infusion (peripheral or central); two IV lines; never interrupt — not even for apnea. Apnea is the commonest side effect, mostly within the first hour and with doses above ~15 ng/kg/min; also hypotension, fever. Be ready to support ventilation.[39]

⚠ DON'T BE CAUGHT OUT

- The collapsed neonate labeled “sepsis,” “bronchiolitis,” or a “cyanotic spell” may be a closing duct.
- If shock or cyanosis does not respond to oxygen and fluids, **start alprostadil empirically** while arranging an urgent echocardiogram[39] — do not wait for imaging.
- SpO_2 targets: **75–85%** in duct-dependent systemic or pulmonary lesions (accept down

to 70% if lactate stays < 2 mmol/L); **> 75%** in transposition.[39]

- TGA or hypoplastic left/right heart with SpO_2 persistently < 70% and rising lactate → urgent tertiary cardiology call (emergency balloon atrial septostomy may be needed). Persistent acidosis or cyanosis (SpO_2 < 70%) despite maximum alprostadil → time-critical transfer.[39]

◈ **AVAILABILITY**

- Prescribe and label as **ALPROSTADIL** (the single unambiguous name[39] — avoid the ambiguous "prostaglandin E1" and any trade name).
- Stocked in neonatal and cardiac units.

◈ **ARRHYTHMIA**

- Tachycardia — **SVT** (narrow QRS) and **VENTRICULAR TACHYCARDIA** (wide QRS): see the Supraventricular Tachycardia and Ventricular Tachycardia cards; adenosine dosing is given on the SVT card.
- Screen every well newborn before discharge — see **Critical CHD —**

Pulse Oximetry Screening (Neonatal).

ADMIT · DISCHARGE · REFER

- **Admit** — any duct-dependent lesion or cyanosis/shock → NICU/PICU; keep the duct open with alprostadil.
- **Home** — only under cardiology, with a feeding/oxygen/weight plan and clear red-flag advice.
- **Refer — now** — pediatric cardiology urgently (echo) and a cardiac-surgical center; arrange safe transfer.

SEE ALSO Newborn screening & pulmonary hypertension: **Critical CHD — Pulse Oximetry Screening** · **Persistent Pulmonary Hypertension (PPHN)** (Neonatal).

Hypercyanotic (Tet) Spell MINUTES

TETRALOGY OF FALLOT

Sudden deep cyanosis, distress, and a quieter murmur in Tetralogy of Fallot.

① POSITION & CALM

Knee-to-chest position (or let the child squat). Keep calm — minimal handling. Give 100% oxygen.[41]

↓

② INCREASE RV PRELOAD

Morphine to settle the cycle; fluid bolus to increase filling.[41]

↓

③ INCREASE SYSTEMIC RESISTANCE / SLOW THE HEART

- Phenylephrine[41]; IV beta-blocker (esmolol or propranolol) **only on PICU/cardiology advice**[42] — watch for hypotension and myocardial depression. **Avoid agents that increase contractility** — they worsen the outflow obstruction.[41]
- Phenylephrine, IV beta-blocker, and bicarbonate (for persistent acidosis) are specialist-supported — **call PICU/cardiology early**.

↓

④ STILL HYPERCYANOTIC

Anesthesia/PICU: paralyze, intubate and ventilate; continue phenylephrine[41]; urgent cardiac-surgical referral.

Morphine

DOSE

0.1–0.2 mg/kg

NOTES

IV/IM/subcut; settles the spell[41]

Crystalloid bolus

DOSE

10–20 mL/kg

NOTES

IV, increases preload

Phenylephrine

DOSE

5–20 mcg/kg

NOTES

IV; raises systemic vascular resistance (formulary dosing)[42]

Propranolol

DOSE

0.05–0.1 mg/kg

NOTES

slow IV; alternative to esmolol (formulary dosing)[42]

Esmolol

DOSE

500 mcg/kg IV load over 1 min, then 50–300 mcg/kg/min infusion

NOTES

IV beta-blocker alternative to propranolol (formulary dosing)[42]

Sodium bicarbonate

DOSE

1 mmol/kg

NOTES

IV, if significant metabolic acidosis

ADMIT · DISCHARGE · REFER

- **Admit** — any spell → monitored bed/PICU; recurrent or severe spells need urgent intervention.
- **Home from the ward** — only after cardiology review, a spell-management plan (knee-chest, hydration, propranolol as advised), and caregiver education.
- **Refer — now** — pediatric cardiology urgently — a spell often brings surgical repair forward.

SEE ALSO Neonatal & Infant CHD for duct-dependent lesions and alprostadil.

Blocked Systemic-to-Pulmonary Shunt (BT / Sano)

MINUTES | Shunt-dependent CHD

Sudden cyanosis with a **lost shunt murmur** — the shunt is occluding; a peripheral-hospital emergency.

RECOGNIZE IT — THE SHUNT IS BLOCKING

- Known **shunt-dependent** cyanotic CHD (modified **Blalock–Taussig** or **Sano** shunt) with **acute, severe cyanosis**.[43,44] *Modified Blalock–Taussig shunt:* a tube graft from the subclavian or innominate artery to the pulmonary artery. *Sano shunt:* a tube graft from the right ventricle to the pulmonary artery, used in the first-stage (Norwood) operation for hypoplastic left heart syndrome.
- **Loss of the continuous shunt murmur** (a patent shunt has continuous turbulent flow; an occluded shunt has no flow).[45]
- **Sudden desaturation**, then **hypotension and metabolic acidosis**; falling PaO_2, rising lactate, falling cerebral NIRS from baseline.[43,44]

- **Echo: reduced or absent flow** across the shunt confirms it — but do **not** delay treatment for imaging.[44,45]

⚠ CALL FOR HELP NOW

- **Call cardiac ICU/PICU + cardiothoracic surgery + cardiology immediately**, and activate your retrieval service.[43,44]
- The physiology to fix it: **drive more blood across the shunt — raise systemic vascular resistance (SVR)** and **lower pulmonary vascular resistance (PVR)** — while you **anticoagulate**.[44]

① RESUSCITATE (airway & oxygen) — Secure the airway and ventilate; give **100% oxygen** and optimize oxygenation.[44] Urgent echo — but do not delay treatment.[44,45]

② RAISE SVR (push flow across the shunt) — Fluid bolus **5 mL/kg** aliquots (4% albumin), reassessing; add a vasoconstrictor — **phenylephrine 5–20 mcg/kg IV bolus** (infusion 0.1–0.5 mcg/kg/min), or **norepinephrine 0.025–0.3 mcg/kg/min**, or **epinephrine** infusion.[44]

↓

③ LOWER PVR (unload the lungs) — Deepen **sedation + paralysis**; **hyperventilate** to lower $PaCO_2$ (mild respiratory alkalosis); keep well oxygenated.[44] On cardiac-center advice, **magnesium sulfate 0.4 mmol/kg** (≈ 100 mg/kg = 0.2 mL/kg of the 50% solution; max 2 g) may be added: **dilute to ≤ 20% and infuse over 20–30 min — never as an IV push**; continuous BP monitoring with vasopressor support running (magnesium also lowers SVR).

↓

④ ANTICOAGULATE (stop the clot) — **Heparin 50–100 units/kg IV bolus** (AHA 2018, class IIa)[44], then **20 units/kg/h** infusion (infants: 25–30 units/kg/h)[46]. Restart **prostaglandin (alprostadil)** if the arterial duct has not been surgically ligated[39].

⑤ DEFINITIVE RESCUE — cardiac catheterization (balloon angioplasty, stent, or thrombolysis) or emergency surgical shunt revision; ECMO to bridge a deteriorating child.[44,47,48] **Confirm with echo and transfer to the cardiac center.**[44,45]

MEDICATIONS — HEPARIN, PHENYLEPHRINE AND NOREPINEPHRINE DOSES PER AHA 2018 (MARINO); ALBUMIN, EPINEPHRINE AND MAGNESIUM DOSES ARE EXPERT PRACTICE; CONFIRM AGAINST YOUR CARDIAC CENTER'S PROTOCOL

SVR Phenylephrine

DOSE

5–20 mcg/kg IV bolus; infusion 0.1–0.5 mcg/kg/min

NOTES

Raises SVR[44]; dilute before use (e.g., 10 mg in 100 mL, then 1 mL made up to 10 mL)

SVR Norepinephrine (noradrenaline)

DOSE

0.025–0.3 mcg/kg/min infusion

NOTES

Raises SVR[44]; central line preferred, peripheral as a bridge[12,13]

SVR Epinephrine (adrenaline)

DOSE

up to 0.05 mcg/kg/min infusion

NOTES

Inotrope/vasopressor support[44]

SVR Albumin 4%

DOSE

5 mL/kg aliquots

NOTES

Volume to support preload/SVR; reassess after each

PVR Magnesium sulfate 50%

DOSE

0.4 mmol/kg (≈ 100 mg/kg = 0.2 mL/kg of 50%; max 2 g) IV over 20–30 min

NOTES

Pulmonary vasodilator — helps lower PVR[49]. Dilute to ≤ 20% before infusion; never IV push; monitor BP (systemic vasodilator).

CLOT Heparin

DOSE

50–100 units/kg IV bolus[44]
→ 20 units/kg/h (infants: 25–30 units/kg/h)[46]

NOTES

Prevents clot propagation; monitor APTT / anti-Xa[44,46,50]

DUCT Prostaglandin E1 (alprostadil)

DOSE

per unit protocol

NOTES

If the duct is not ligated — may reopen ductal pulmonary flow[39]

✦ THE TRAP

The instinct to give a vasodilator, or deep vasodilating sedation without vasopressor support, **drops SVR and worsens shunt flow**.[44] Do the opposite — **raise SVR, lower PVR, heparinize**, and get the child to the cath lab or operating room.[44] **A lost shunt murmur**

in a cyanotic child is the shunt occluding until proven otherwise.[44,45]

Acute Rheumatic Fever DIAGNOSE

AHA 2015 · AHA 2009 · RHDAustralia 2020

Prevent the second attack — every recurrence adds valve damage.

DIAGNOSE — JONES 2015 (REVISED)

- Need **evidence of preceding group A strep** (rising/elevated ASO **or** anti-DNase B, a positive throat culture, or a positive rapid antigen test in a child with a high pre-test probability of streptococcal pharyngitis — a recent scarlet fever history is supportive but is not one of the 2015 criteria) **plus** either **2 major** or **1 major + 2 minor**[51].
- Recurrence also allows **3 minor**[51]. **Chorea** and **indolent carditis** can be diagnostic on their own.[52]
- Get an **echo in every suspected case** (repeat even if first is normal) — subclinical valve regurgitation counts as carditis[51].

⚠ USE THE MODERATE/HIGH-RISK COLUMN

- Kuwait has no recent ARF incidence data to show it meets the AHA low-risk definition (< 2 per 100,000 school-age children per year)[51], and many children seen here come from high-incidence regions — so this guide applies the **moderate/high-risk** column (local consensus), accepting lower specificity.
- In this group a **single joint (mono-arthritis or even mono-arthralgia)** and a **lower fever/ESR threshold** already count[51].

Major

LOW-RISK POPULATION

Carditis (clinical **or** subclinical on echo) · **migratory poly**arthritis (flitting, large joints) · chorea · erythema marginatum · subcutaneous nodules[51]

MODERATE / HIGH-RISK (GULF)

Same, except joints = **mono-arthritis or polyarthritis, or polyarthralgia only after other causes have been excluded**[51] — exclude septic arthritis before counting a single inflamed joint

Minor

LOW-RISK POPULATION

Polyarthralgia · fever ≥ 38.5 °C · ESR ≥ 60 mm/h and/or CRP ≥ 3.0 mg/dL (30 mg/L) · prolonged PR (if carditis not a major)[51]

MODERATE / HIGH-RISK (GULF)

Mono-arthralgia · fever ≥ 38 °C · ESR ≥ 30 mm/h and/or CRP ≥ 3.0 mg/dL (30 mg/L) · prolonged PR (if carditis not a major)[51]

A manifestation counts once — polyarthritis as a major cannot also be counted as a minor[51].

TREAT

Eradicate GAS (everyone, even if swab negative)

WHAT TO GIVE

Benzathine penicillin G IM once: ≤ 27 kg → 600,000 units; > 27 kg → 1,200,000 units. Alt: penicillin V PO ×10 d; if allergic, azithromycin 12 mg/kg/day (max 500 mg) ×5 d.[53]

Arthritis / mild carditis

WHAT TO GIVE

Until the diagnosis is confirmed: acetaminophen alone (15 mg/kg/dose every 4 h; max 60 mg/kg/day or 4 g/day) — NSAIDs mask evolving joint signs and fever. Then first-line **naproxen 10–20 mg/kg/day** PO in 2 divided doses (max 1,250 mg/day) or **ibuprofen 5–10 mg/kg/dose** PO every 8 h (max 2,400 mg/day). Second-line: **aspirin 50–60 mg/kg/day** PO in 4–5 divided doses (may be escalated to 80–100 mg/kg/day), continued until symptoms and inflammatory markers settle, then tapered; watch for tinnitus/hyperpnea (salicylate toxicity).[54]

Moderate–severe carditis / heart failure

WHAT TO GIVE

Consider **prednisone/prednisolone 1–2 mg/kg/day** (max 80 mg) in selected severe carditis, then taper, overlapping aspirin — overall benefit in meta-analyses is not evident. Diuretic + ACE inhibitor for heart failure; bed rest.[54]

Sydenham chorea

WHAT TO GIVE

Usually self-limited — quiet environment, protect from injury. If disabling: carbamazepine (first-line) or valproate (off-label); a corticosteroid may be added for very severe chorea. Salicylates do **not** treat the chorea itself.[54]

SECONDARY PROPHYLAXIS — BENZATHINE PENICILLIN G IM EVERY 3–4 WEEKS (≤ 27 KG 600,000 UNITS; > 27 KG 1,200,000 UNITS)[53]

ARF without carditis

DURATION

5 years or until age 21 (whichever longer)[53]

Carditis, no residual valve disease

DURATION

10 years or until age 21 (whichever longer)[53]

Carditis with residual valve disease

DURATION

10 years or until age 40 (whichever longer), sometimes lifelong[53]. WHO 2024: evidence on duration is limited — follow national/professional guidance; in children with mild isolated regurgitation and a normal echocardiogram, stopping after 1–2 years may be reasonable[814]

◈ **WHEN TO USE ORAL PENICILLIN INSTEAD** IM benzathine remains preferred for most patients[53]. **EXCEPTION — SEVERE VALVE DISEASE (SEVERE MITRAL STENOSIS, AORTIC STENOSIS OR AORTIC REGURGITATION), LVEF < 50%, OR NYHA III–**

IV HEART-FAILURE SYMPTOMS (INCLUDING SEVERE ACUTE CARDITIS WITH HEART FAILURE): sudden cardiovascular collapse has followed the injection, so prefer oral **PENICILLIN V**, decided with cardiology (AHA advisory 2022; WHO 2024[814]). WHO also accepts oral penicillin where IM delivery cannot be assured, or when recurrence risk is low (e.g., age ≥ 40), decided jointly with the patient[814]. Oral **PENICILLIN V 250 MG TWICE DAILY** is also the accepted alternative if the IM injection is declined (sulfadiazine if penicillin-allergic), although adherence is worse and it is less effective. For any IM dose: give lying down, fed and hydrated, and observe ≥ 30 min with epinephrine at hand.

✦ THE POINT OF THE CARD

- Treatment settles the attack; **prophylaxis prevents rheumatic heart disease**.[52]
- Recurrences are cumulative valve damage — document the injection schedule and hand it over so it is never missed.[52]

Pericarditis & Cardiac Tamponade

MINUTES ESC 2015 · ESC 2025

Tamponade is a clinical diagnosis — drain, don't wait for the scan.

PERICARDITIS — CHEST PAIN + ADDITIONAL CRITERIA (ESC 2025)

- Pleuritic chest pain **relieved by sitting forward**[55,56]
- pericardial **friction rub**[55,56]
- **widespread ST elevation / PR depression** on ECG (not one coronary territory)[55]
- new/worsening **pericardial effusion** on echo.[55,56]
- **raised CRP** — now a formal criterion[56]
- pericardial edema or late gadolinium enhancement on cardiac MRI[56]
- **ESC 2025:** pleuritic/positional chest pain plus the additional criteria above (rub · ECG changes · raised CRP · new/worsening effusion · CMR findings): **definite** = pain + more than 1 additional criterion; **possible** = pain + 1; unlikely = pain alone.[56] (ESC 2015: any 2 of 4 — chest pain, rub, ECG changes, effusion.[55])

- Causes — viral/idiopathic (commonest), purulent, post-pericardiotomy, autoimmune (SLE, JIA), uremic, TB, malignancy[55,56].

⚠ TAMPONADE — RECOGNIZE AND ACT

- **Beck's triad** (hypotension, muffled heart sounds, and raised JVP) + **tachycardia** and a **narrow pulse pressure**; **pulsus paradoxus > 10 mmHg** (inspiratory drop in systolic BP)[55].
- Children compensate then crash — tachycardia is the early sign. **A small effusion can tamponade if it accumulates fast** — volume on echo does not equal severity; the clinical picture does[55].
- Beck's triad and pulsus are often incomplete — their absence does not exclude it[55].

DECISION

Hemodynamic compromise (tamponade)?

YES

Emergency echo-guided pericardiocentesis — removing even a small volume rescues output[55]. **IV fluid 10–20 mL/kg is a bridge only**, never a substitute (expert consensus — not guideline-stated). **Maintain systemic vascular resistance** with a vasopressor — **norepinephrine** (± **vasopressin**) — as a temporizing bridge to support coronary and systemic perfusion; keep the circulation **full, fast, and tight** (preload, avoid bradycardia, support afterload; expert consensus — not guideline-stated). **Avoid intubation / positive-pressure ventilation** — it drops preload and can cause arrest[55]; if unavoidable, drain first, low tidal volume/PEEP, keep volume-loaded (expert consensus — not guideline-stated). Avoid diuretics/vasodilators.[57]

NO

Uncomplicated pericarditis: **high-dose NSAID (ibuprofen)** until symptoms resolve; **add colchicine** for recurrent pericarditis — it halved recurrences in children (in adults it is also given for a first episode)[55]. Treat the cause; restrict strenuous exercise until symptom-free with normal CRP/ECG/echo.[55] **No corticosteroids** in children unless there is a specific indication such as autoimmune disease (growth and other side effects; they also increase recurrence); **no aspirin** (Reye syndrome, hepatotoxicity). Anti-IL-1 therapy (anakinra) may be considered for recurrent, especially steroid-dependent, pericarditis[55].

Ibuprofen

PEDIATRIC DOSE

30–40 mg/kg/day divided every 6–8 h (max ~2.4 g/day)[55]

NOTES

First-line anti-inflammatory; give with gastroprotection, taper on CRP[55].

Colchicine

PEDIATRIC DOSE

< 5 yr: 0.5 mg/day · > 5 yr: 1–1.5 mg/day divided[55]

NOTES

Adjunct for recurrent pericarditis in children (ESC class IIa) — halves recurrence; reduce in renal impairment.[55,58]

Purulent pericarditis

PEDIATRIC DOSE

Urgent drainage + IV vancomycin + 3rd-gen cephalosporin, ~3–4 weeks (antibiotic choice and duration: expert consensus — not guideline-stated)[57]

NOTES

Surgical emergency — NSAIDs alone are inadequate; narrow to culture[55].

✦ THE TRAP

Don't reach for the ventilator in a crashing tamponade — positive-pressure ventilation can be the last straw. **Drain first.** And treat **purulent**

pericarditis as the surgical emergency it is.[55,57]

Infective Endocarditis (incl. Subacute)

HOURS | Duke-ISCVID 2023 / AHA

Fever + a new murmur + positive cultures — think endocarditis; diagnose by the Duke-ISCVID 2023 criteria.

SUSPECT IT — SUBACUTE CLUES

- Persistent/unexplained fever with a **new or changed regurgitant murmur** — the classic pairing.[59,60]
- Subacute course over weeks: malaise, weight loss, night sweats, anorexia.[59] **Viridans-group streptococci** are the commonest cause in children with underlying heart disease (typically subacute native-valve disease); **S. aureus** dominates in children without heart disease and in acute disease[61].
- Peripheral stigmata (late; immune-mediated or embolic): **splinter hemorrhages**, tender **Osler**

nodes, painless **Janeway lesions**, **Roth spots**[62], splenomegaly, embolic phenomena.[60,63]

- At-risk: **congenital heart disease**, prosthetic valve/material, previous IE, indwelling central lines, IV drug use.[59,64]

DUKE-ISCVID 2023 CRITERIA — HOW TO CLASSIFY

- **DEFINITE** (clinical) = **2 major**, or **1 major + 3 minor**, or **5 minor**.[62,64]
- **POSSIBLE** = **1 major + 1 minor**, or **3 minor**.[62,64]
- **REJECTED** = firm alternative diagnosis, or resolution with ≤ 4 days of antibiotics[62].

DECISION

The three MAJOR domains (Duke-ISCVID 2023)

MICROBIOLOGY

Typical organism in **≥ 2 separate blood-culture sets** (*S. aureus*, *S. lugdunensis*, *E. faecalis*, all streptococci except *S. pneumoniae*/*S. pyogenes*, *Granulicatella*, *Abiotrophia*, *Gemella*, HACEK; **with intracardiac prosthetic material** also coagulase-negative staphylococci, *Corynebacterium striatum*/*jeikeium*, *Serratia marcescens*, *Pseudomonas aeruginosa*, *Cutibacterium acnes*, non-tuberculous mycobacteria, *Candida*) **or a non-typical organism in ≥ 3 sets**; or *Coxiella burnetii* phase I IgG > 1:800 (or one positive culture), *Bartonella* IgG ≥ 1:800, or blood PCR positive for *Coxiella*, *Bartonella* or *T. whipplei*[64].

IMAGING · SURGICAL

Imaging: echocardiography, cardiac CT or [18F]FDG PET/CT evidence of **endocardial involvement** — on echo: **vegetation**, **abscess**, new partial dehiscence of a prosthetic valve, **or new valvular regurgitation** (worsening of an existing murmur is not enough)[62]. **Surgical:** endocarditis documented at operation. Definite / possible / rejected thresholds are unchanged[64].

THE FIVE MINOR CRITERIA

- **Predisposition** — predisposing heart condition or IV drug use.[62,64]
- **Fever** > 38°C.[62,64]
- **Vascular phenomena** — arterial emboli, septic pulmonary infarcts, mycotic aneurysm, intracranial or conjunctival hemorrhage, **Janeway lesions**.[62,64]
- **Immunologic phenomena** — glomerulonephritis, **Osler nodes**, **Roth spots**, rheumatoid factor.[62,64]
- **Microbiologic** evidence not meeting a major criterion[62]. (The 2023 Duke-ISCVID update adds imaging and surgical criteria and new predispositions[64].)

⚠ **WORKUP — GET IT RIGHT THE FIRST TIME**

- **Draw ≥ 3 sets of blood cultures** from separate venipunctures **before** starting antibiotics — the single most important step for diagnosis and tailoring therapy.[59,65]
- Echo: **TTE first**; proceed to **TEE** if TTE is non-diagnostic, a prosthetic valve is present, or suspicion stays high.[59,65]
- Add ESR/CRP, CBC, and urinalysis (microscopic hematuria supports it).[63] Do **not** delay antibiotics in a septic/unstable child once cultures are drawn.[12]

◈ Endocarditis prophylaxis (AHA / ESC 2023) — who

Prophylaxis needs **BOTH** a highest-risk cardiac condition **AND** a high-risk procedure.[65,66] The **HIGHEST-RISK CARDIAC CONDITIONS:**

1. **PROSTHETIC HEART VALVE** (surgical or transcatheter) or prosthetic material used for valve repair.[65,66]
2. **PREVIOUS INFECTIVE ENDOCARDITIS.**[65,66]
3. **UNREPAIRED CYANOTIC CHD** (including palliative shunts/conduits).[65,66]

4. Completely **REPAIRED CHD WITH PROSTHETIC MATERIAL/DEVICE** — during the **FIRST 6 MONTHS** after the procedure.[66]
5. **REPAIRED CHD WITH A RESIDUAL DEFECT** at or adjacent to the prosthetic patch/device.[66]
6. **CARDIAC TRANSPLANT** recipients who develop **VALVULOPATHY.**[66]
7. **LEFT VENTRICULAR ASSIST DEVICE (LVAD) OR IMPLANTABLE HEART** (AHA 2021; also ESC 2023).[65,66]
8. **SURGICAL OR TRANSCATHETER PULMONARY ARTERY VALVE OR CONDUIT** (e.g., Melody valve, Contegra conduit) — **NO 6-MONTH LIMIT**.[66]

◆ **ESC 2023 EMPHASIS:** for all **INTERMEDIATE- AND HIGH-RISK** patients, **GOOD ORAL HYGIENE AND REGULAR DENTAL REVIEW** prevent more endocarditis than any single antibiotic dose.[65,67]

◈ Endocarditis prophylaxis (AHA) — which procedures

- **DENTAL** — any procedure that manipulates **GINGIVAL TISSUE** or the **PERIAPICAL REGION** of teeth, or **PERFORATES THE ORAL MUCOSA** (extractions, scaling, periodontal work, implants). Anesthetic injections through non-infected tissue, radiographs, orthodontic appliance placement or adjustment,

and shedding of deciduous teeth do **NOT** count.[65,66]

- **RESPIRATORY TRACT** — procedures with **INCISION OR BIOPSY OF THE RESPIRATORY MUCOSA** (e.g., **TONSILLECTOMY, ADENOIDECTOMY**, bronchoscopy **WITH BIOPSY**).[67] If the airway procedure treats an established infection, add an anti-staphylococcal agent when *S. aureus* is suspected.[67]
- **INFECTED SKIN, SKIN STRUCTURES, OR MUSCULOSKELETAL TISSUE** — regimen should cover **STAPHYLOCOCCI AND B-HEMOLYTIC STREPTOCOCCI**.[67]
- **NOT RECOMMENDED** for **GI OR GU PROCEDURES**, or for bronchoscopy/endoscopy **WITHOUT** incision/biopsy, solely to prevent endocarditis.[67]
- ◆ **ESC 2023** is less restrictive for non-dental procedures — systemic prophylaxis **MAY BE CONSIDERED** (Class IIb) in high-risk patients undergoing an invasive diagnostic or therapeutic respiratory, GI, GU, skin, or musculoskeletal procedure.[65] Where the two guidelines differ, follow your local protocol.

PROPHYLAXIS REGIMEN — SINGLE DOSE 30–60 MIN BEFORE THE PROCEDURE[66]

Able to take oral

PEDIATRIC DOSE (SINGLE)

Amoxicillin 50 mg/kg PO[66]

MAX

2 g[66]

Unable to take oral

PEDIATRIC DOSE (SINGLE)

Ampicillin 50 mg/kg IM/IV, or cefazolin / ceftriaxone 50 mg/kg IM/IV[66]

MAX

Ampicillin 2 g · cefazolin/ceftriaxone 1 g[66]

Penicillin allergy — oral

PEDIATRIC DOSE (SINGLE)

Cephalexin 50 mg/kg, or azithromycin / clarithromycin 15 mg/kg, or doxycycline (< 45 kg 2.2 mg/kg; ≥ 45 kg 100 mg)[66]

MAX

Cephalexin 2 g · azithromycin/clarithromycin 500 mg · doxycycline 100 mg[66]

Penicillin allergy — no oral

PEDIATRIC DOSE (SINGLE)

Cefazolin or ceftriaxone 50 mg/kg IM/IV[66]

MAX

1 g[66]

✦ THE TRAP

Clindamycin is no longer recommended (dropped in the 2021

AHA update[66] — *C. difficile* risk and adverse effects). Prophylaxis is **not** indicated for most CHD, nor for routine GI/GU procedures.[66,67] Avoid cephalosporins if there is a history of anaphylaxis, angioedema, or urticaria to penicillin[66]. **Good oral hygiene and regular dental care prevent more endocarditis than any single antibiotic dose.**[66,67]

04 Common Acute Conditions

Everyday clinic & ED infections and presentations

Fever in a Well-Appearing Infant < 2 Months

HOURS ≤ 60 DAYS · CPS 2026 / AAP 2021

Most are viral — but ~8–13% have a serious bacterial infection[68]. Define fever as rectal ≥ 38.0°C; stratify risk and spare the low-risk from over-testing.

SCOPE & FIRST MOVE

- This pathway is for the **well-appearing, full-term (≥ 37 wk), previously healthy** infant with a documented **rectal temperature ≥ 38.0°C**. **Hypothermia < 36.0°C** also signals an elevated risk of infection — manage identically[69].
- **This pathway does not apply to the ill-appearing at any age.**
- **Exclusions — an infant with any of these risk factors is outside this pathway (manage individually and**

conservatively): prematurity < 37 wk, prior or prolonged hospitalization, a chronic / genetic / technology-dependent condition, immunodeficiency, recent antibiotics, or any focal bacterial infection (e.g., omphalitis, cellulitis).

⚠ KEEP A HIGH INDEX OF SUSPICION

- Even a well-appearing infant can deteriorate quickly.
- The youngest (**≤ 21–28 days**) have the highest risk of **invasive bacterial infection (IBI** — bacteremia or bacterial meningitis) and the **lowest threshold** for full work-up, LP, empiric antibiotics, and admission[68].

◣ EVERYONE GETS

- **All ages:** history + exam, **urinalysis + urine culture** (catheter or suprapubic; clean-catch acceptable), **blood culture**, **CBC + differential**, and an **inflammatory marker** — procalcitonin (PCT) or CRP.
- **Risk-stratify with a validated rule: PECARN** or **Step-by-Step** (both use PCT), or **Aronson** when PCT is

unavailable — keep a **lower threshold for LP** with Aronson[69].

- **CSF pleocytosis** = > 15 cells/mm³ (≤ 28 d) or > 9 cells/mm³ (> 28 d) → treat as bacterial meningitis. Don't delay the LP if there are neurological signs.[69]

RISK STRATIFICATION — VALIDATED LOW-RISK RULES

PECARN (uses PCT)

LOW RISK IF ALL CRITERIA ARE MET

1) Urinalysis negative (leukocyte esterase, nitrite, ≤ 5 WBC/hpf); 2) ANC ≤ 4000/µL; 3) PCT ≤ 0.5 ng/mL[69,70]

Step-by-Step (uses PCT)

LOW RISK IF ALL CRITERIA ARE MET

1) Well-appearing; 2) 22–90 days; 3) urinalysis negative for leukocytes; 4) PCT < 0.5 ng/mL; 5) CRP ≤ 20 mg/L and ANC ≤ 10,000/µL[69,71]

Aronson (no PCT — keep a lower LP threshold)

LOW RISK IF ALL CRITERIA ARE MET

Low risk if ≤ 1 point: age < 21 d (1) · ED temp 38.0–38.4°C (2) or ≥ 38.5°C (4) · ANC ≥ 5185/µL (2) · urinalysis positive (3)[69,72]

◈ APPLYING THE RULES — PCT TIMING & ALTERNATIVES

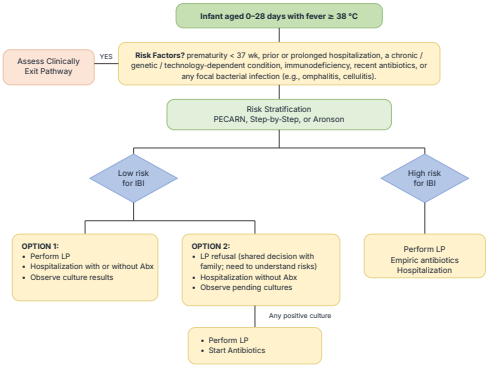
- Where **PROCALCITONIN IS NOT READILY AVAILABLE**, PECARN and

Step-by-Step (both require PCT) **CANNOT BE FULLY APPLIED**. Use an alternative: the **ARONSON** rule (no PCT needed) and keep a **LOWER THRESHOLD FOR LP**; **CRP ≤ 20 MG/L** with a normal ANC and urinalysis still support lower risk.

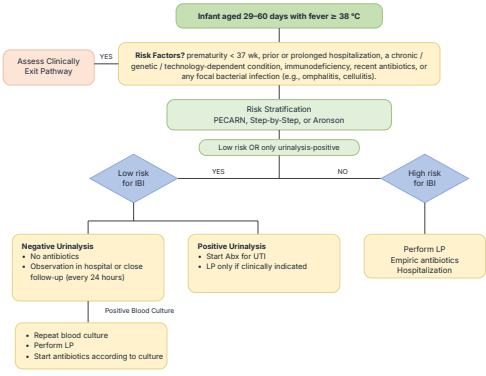
- When PCT **IS** obtained, draw it **≥ 2 H AFTER FEVER ONSET** — it rises ~3–4 h after a bacterial trigger, so very early samples can read falsely low[73]. It typically **STAYS LOW (< 0.5 NG/ML)** in isolated viral illness.
- Missed invasive infection with Step-by-Step clusters in the **22–28-DAY** group and in infants tested very early — keep a low threshold in these.[71]

FEVER PATHWAY ALGORITHMS (WELL-APPEARING, ≥ 37 WEEKS)

Algorithm 1 – infant 0–28 days with fever ≥ 38°C



Algorithm 2 – infant 29–60 days with fever ≥ 38°C



EMPIRIC ANTIBIOTICS — WELL-APPEARING, ≥ 37 WEEKS

0–7 days

FIRST-LINE IV

Ampicillin 50 mg/kg/dose q8h (meningitis 100 mg/kg/dose q8h) + gentamicin 4 mg/kg/dose q24h[42,69]

MODIFIERS

Meningitis: add — or replace the aminoglycoside with — cefotaxime 50 mg/kg/dose q8h. HSV risk: add acyclovir 20 mg/kg/dose q8h.

8–28 days

FIRST-LINE IV

Ampicillin 50 mg/kg/dose q6h (meningitis 75 mg/kg/dose q6h) + gentamicin 5 mg/kg/dose q24h[42,69]

MODIFIERS

Meningitis: add — or replace the aminoglycoside with — cefotaxime 50 mg/kg/dose q6h (200 mg/kg/day for meningitis at this age). HSV risk: add acyclovir 20 mg/kg/dose q8h.

29–60 days

FIRST-LINE IV

Ceftriaxone 100 mg/kg/dose q24h[69]

MODIFIERS

Meningitis: add vancomycin 15 mg/kg/dose q6h. HSV risk: add acyclovir 20 mg/kg/dose q8h. Low-risk UTI: cefixime 8 mg/kg/dose q24h PO.[68,69]

◈ **BEYOND 60 DAYS** The well-appearing infant **61–90 DAYS** falls outside this pathway: risk of invasive infection is lower and routine blood culture / full septic work-up is **NOT**

REQUIRED[69]. At minimum obtain a **URINALYSIS AND URINE CULTURE** in every febrile infant 61–90 days; blood culture, CBC and PCT/CRP with risk stratification as for 29–60 days are optional (clinician's clinician's choice). Infants who are low-risk, or have an isolated UTI and are clinically well, can go home with follow-up in 24–48 h; escalate the ill-appearing or those with abnormal results.

◈ **SEE ALSO** For the **ILL-APPEARING OR SEPTIC** neonate (≤ 28 days) use **Neonatal Sepsis — Early-Onset (rapid approach)**.

Ampicillin uses one regimen throughout this guide — 50 mg/kg/dose, q8h in the first week and q6h from day 8, with the term-neonate meningitis doses (100 mg/kg/dose q8h in the first week, then 75 mg/kg/dose q6h) from Lexicomp[42]; CPS gives 75 mg/kg/dose q6h[69]. Gentamicin and cefotaxime doses are the CPS regimen.

Gastroenteritis & Dehydration

HOURS

Assess hydration: alertness, eyes, mucosa, skin turgor, capillary refill, urine output.

CLINICAL SIGNS OF DEHYDRATION

- Altered mental status
- sunken eyes
- dry oral mucosa
- poor skin turgor
- delayed capillary refill
- decreased urine output
- tachycardia
- abnormal peripheral perfusion.
- The more signs present, the greater the fluid deficit; no single sign is reliable alone.[14]

DECISION

Degree of dehydration?

NONE–MODERATE

Oral rehydration with ORS; a single ondansetron dose can reduce vomiting and the need for IV.[14]

SEVERE / SHOCK

IV/IO crystalloid bolus, repeat to reverse shock; then deficit + maintenance. Check glucose & electrolytes.

Oral rehydration solution

DOSE

~50–100 mL/kg over 4 h

ROUTE & NOTES

Oral/NG + replace ongoing losses. First-line for minimal–moderate dehydration.[14]

0.9% sodium chloride (bolus)

DOSE

20 mL/kg

ROUTE & NOTES

IV/IO rapid bolus for hypovolemia/shock; reassess during & after each bolus and repeat until perfusion is restored. If shock seems out of proportion to the diarrhea/vomiting, consider sepsis, DKA, a surgical abdomen, or myocarditis. **Balanced crystalloid (e.g., Ringer's lactate) is an acceptable alternative.**[14]

0.9% sodium chloride (moderate)

DOSE

10 mL/kg over 30–60 min

ROUTE & NOTES

Moderate dehydration not tolerating oral — then reassess for a further bolus or transition back to ORT if tolerated.

Ondansetron

DOSE

0.15 mg/kg/dose — single dose, max 8 mg (either route). Weight-based: 2 mg (8–15 kg) · 4 mg (15–30 kg) · 8 mg (> 30 kg)

ROUTE & NOTES

PO preferred; **age ≥ 6 months only**. Reduces vomiting and the need for IV. **Restart ORT 15–30 min after the dose.** Ondansetron prolongs the QT interval dose-dependently — do not exceed **8 mg** in a single pediatric dose (the 16 mg cap is an adult chemotherapy figure, not for gastroenteritis)[74].

Zinc (adjunct to ORS)

DOSE

5 mg/day

ROUTE & NOTES

Oral, **10–14 days** (WHO 2024, conditional recommendation — replaces the former 20 mg/day [10 mg/day < 6 months], which caused more vomiting). A WHO/UNICEF measure for low- and middle-income settings where zinc deficiency is common — shortens diarrhea by ~½ day (~1 day if malnourished); the benefit is concentrated in children **≥ 6 months** who are zinc-deficient or malnourished. **Not routine in high-income, well-nourished populations including Kuwait**; reserve for malnutrition, documented zinc deficiency, or persistent / chronic diarrhea. Little benefit under 6 months. (ESPGHAN/ESPID acute-gastroenteritis guideline: zinc not recommended for well-nourished European children.)[75]

Racecadotril — optional adjunct

DOSE

1.5 mg/kg/dose PO TID with ORS sachets 10 mg (≤ ~12 kg) / 30 mg (> ~13 kg). Age > 3 months. Continue until diarrhea stops (2 normal stools), max 7 days.

ROUTE & NOTES

Antisecretory enkephalinase inhibitor — reduces stool water loss **without slowing gut motility** (unlike loperamide, which is contraindicated). **Adjunct to ORS, not a substitute.** Licensed and used in Kuwait/Europe/Asia; **not FDA/NICE/AAP/CPS/WHO-endorsed**. **ESPGHAN/ESPID 2014: "may be considered"** (II-B, weak recommendation, moderate-quality evidence; responder NNT ≈ 4). Cochrane 2019 found it safe with limited benefit (low-certainty)[76].

PEARLS

- Resume normal feeding (including breastfeeding) early. Antibiotics only for specific pathogens.[14]
- ***C. difficile*** **(CPS 2026)** — do **not** test healthy children **< 2 years** (colonization is common, disease rare); think of it with diarrhea after antibiotics, in IBD, immunocompromise or hospital stay. **Non-severe:** oral vancomycin 40 mg/kg/day in 4 doses (max 125 mg/dose) for 10 days (preferred), or metronidazole 30 mg/kg/day in 4 doses (max 500 mg/dose) for 10 days; stop the precipitating antibiotic. **Severe** (systemic toxicity): oral vancomycin as above. **Severe complicated** (hypotension/shock, ileus, megacolon,

peritonitis): vancomycin 40 mg/kg/day in 4 doses (max 125 mg/dose; 2 g/day) PO/NG — or rectally if ileus — **plus IV metronidazole** 30 mg/kg/day in 4 doses (max 500 mg/dose) for 10–14 days; surgical review. IV vancomycin does not treat *C. difficile*. Second or later recurrence: tapered/pulsed vancomycin, or fidaxomicin 200 mg PO twice daily for 10 days if ≥ 6 months and ≥ 12.5 kg — with infectious diseases.[841]

- Red flags: bilious or bloody vomit, severe pain/distension (think surgical), inability to tolerate ORS.
- Zinc dosing & evidence: [WHO guideline on management of pneumonia and diarrhoea in children up to 10 years of age (2024)]



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ADMIT · DISCHARGE · REFER

- **Admit** — shock or severe dehydration, failed oral/NG rehydration, intractable vomiting, dangerous electrolyte derangement, or diagnostic uncertainty.
- **Home from the emergency department** — minimal or mild dehydration tolerating oral rehydration, with carers confident on fluids and red-flag advice.

- **Refer — now** — surgical review if a surgical abdomen is suspected; PICU for refractory shock or severe electrolyte disturbance.

Acute Otitis Media ASSESS

INFANT–CHILD · CPS 2016 / AAP 2013

Diagnose by the drum, not the symptoms — then choose between watchful waiting and antibiotics.

◣ CLINICAL DIAGNOSIS — EFFUSION + ACUTE INFLAMMATION

- Acute onset (otalgia, ear-tugging, or non-specific signs in the non-verbal child) **plus** a middle-ear effusion **plus** signs of acute inflammation.
- **A bulging tympanic membrane is the key sign** — highest predictive value for bacterial AOM, especially if yellow, cloudy, or hemorrhagic.[77] Acute perforation with purulent otorrhea also confirms a bacterial cause — distinguish from otitis externa, chronic drainage, or tube discharge.

- **Not AOM:** a non-bulging drum, or erythema / air-fluid level alone without bulging. Effusion without inflammation is OME[77] — do not give antibiotics.
- **Scope:** the **watchful-waiting** option applies only to healthy children **≥ 6 months** (CPS 2016). **AAP 2013 is narrower:** observation only for unilateral non-severe AOM at 6–23 months and for non-severe AOM at ≥ 24 months — bilateral AOM at 6–23 months is treated at once, and moderate otalgia counts as severe[77,78]. **Infants < 6 months are excluded from observation**[77] — treat all with antibiotics. Excludes tympanostomy tubes, craniofacial anomalies, immunocompromise, or recurrent AOM.

DECISION BY AGE & SEVERITY

DECISION

How old is the child, and how severe?

< 6 MONTHS

Antibiotics for all — no watchful waiting (below the CPS/AAP observation range; the exam is less reliable and complications are more likely). In a **febrile infant ≤ 90 days**, do **not** attribute the fever to AOM alone — evaluate for invasive bacterial infection (see **Fever in the Well-Appearing Infant**).

≥ 6 MO — TREAT NOW

Bulging, erythematous TM **and** any of: highly febrile (≥ 39°C), moderately-to-severely ill, severe otalgia, symptoms ≥ 48 h, perforation with otorrhea, **bilateral AOM at 6–23 months (AAP)**, or complicated disease (mastoiditis, facial palsy).[77]

≥ 6 MO — WATCHFUL WAITING (24–48 H)

Otherwise-healthy child, mildly ill, alert, responding to antipyretics, low-grade fever (< 39°C), mild otalgia — or when the diagnosis is uncertain. Needs assured follow-up.

◈ **HOW TO WATCHFUL-WAIT (CHOOSE ONE)**

- Reassess within 24–48 h to document the course; **OR** have the caregiver return if no improvement or worsening by 48 h; **OR** give a "safety-net" prescription to fill only if not improved by 48 h.
- Always give analgesia advice; ensure ready access to care.

Amoxicillin (first choice)

DOSE

40–45 mg/kg/dose BID (max 4 g/day)

ROUTE & NOTES

PO. Drug of choice — covers *S. pneumoniae*; excellent middle-ear penetration.[77]

Amoxicillin- clavulanate

DOSE

40–45 mg/kg/dose BID (amoxicillin component; max 4 g/day amoxicillin)

ROUTE & NOTES

PO. If AOM + purulent conjunctivitis, amoxicillin in the last 30 days, or failure at 48–72 h. Specify the 14:1 suspension (for children up to 40 kg; above that use an adult formulation).[77]

Cefuroxime- axetil

DOSE

15 mg/kg/dose BID (30 mg/kg/day; max 1 g/day)

ROUTE & NOTES

PO, twice daily. Non-anaphylactic penicillin allergy (cefprozil is an alternative).

Ceftriaxone

DOSE

50 mg/kg IM/IV once daily × 3 days

ROUTE & NOTES

If oral not tolerated or amoxicillin-clavulanate failed. Reserve.

◈ DURATION — BY AGE

- < 2 years: 10 days. ≥ 2 years, uncomplicated: 5 days (CPS 2016; AAP 2013 gives 7 days for 2–5 years and 5–7 days for ≥ 6 years).[77,78]
- Also 10 days for a perforated TM or recurrent AOM.
- Symptoms should improve within 24 h and resolve in 2–3 days — reassess if they persist or worsen.

⚠ ANALGESIA IS PART OF EVERY PLAN

- Pain control (acetaminophen or ibuprofen) is essential whether or not antibiotics are given — it is often the child's main need.
- Persistent effusion after treatment does **not** warrant a change of antibiotic; a middle-ear effusion can linger for months.[77]

ADMIT · DISCHARGE · REFER

- **Admit** — a complication (mastoiditis, intracranial spread, facial palsy), a toxic child, or failure of second-line therapy.
- **Home from the emergency department** — uncomplicated disease — analgesia, with observation or antibiotics per age and severity, and safety-netting.
- **Refer — now** — ENT for suspected mastoiditis or complicated disease.
- **Refer — clinic** — ENT for recurrent disease or a non-resolving effusion.

GAS Pharyngitis ASSESS

≥ 3 YR · IDSA 2025

Most sore throats are viral. Score first to decide who needs a test — then treat the confirmed case.

WHEN TO TEST — SCORE FIRST

- Sore throat is usually viral, and clinician judgment alone is unreliable. GAS causes up to ~30%

of childhood (and ~15% of adult) pharyngitis.[79]

- IDSA 2025 suggests a **clinical scoring system to decide who to test**. A score is most useful for spotting **low-probability** patients in whom testing is unlikely to help — prefer a score that needs no lab (Centor / McIsaac).[79]
- **Does not apply under 3 years** — GAS in this age may not show the typical features; test only for an outbreak, scarlet fever, or a household case.[80]
- Score criteria point to GAS: fever, tonsillar swelling or exudate, tender anterior cervical nodes, and **absence of cough**. Cough, coryza, or hoarseness point to a virus.

Tonsillar exudate or swelling

POINT
+1

Tender / swollen anterior cervical nodes

POINT
+1

History of fever

POINT
+1

No cough

POINT

+1

Age 3–14 years (McIsaac)

POINT

+1

◈ **HOW TO TEST**

- Read the score as a probability of GAS (IDSA 2025, Centor / McIsaac): **0–1 LOW** (~7–13%) → testing can usually be deferred; **2–3 INTERMEDIATE** (~21–38%) → test; **≥4 HIGH** (~50–70%) → test, and still confirm before treating.[79]
- Test with a rapid antigen test (RADT), a molecular test (NAAT), or throat culture.
- In children, confirm a **NEGATIVE** rapid antigen test with culture, or use a molecular test.[80]
- The score selects *who to test* — never a treatment threshold.
- Do **NOT** use ASO titers to diagnose acute pharyngitis.[80]
- Start treatment within 9 days of onset.

⚠ TEST EVEN IF THE SCORE IS LOW

Test regardless of a low score when the patient is high-risk: a **household GAS case** (shared indoor living or sleeping space), prior **rheumatic fever**, or features of complicated or systemic GAS — peritonsillar or retropharyngeal abscess, scarlet fever, or toxic shock.[79]

First choice

DRUG & DOSE

Amoxicillin 50 mg/kg once daily (max 1 g) or 25 mg/kg/dose BID (max 500 mg/dose); or penicillin V 250 mg BID–TID (children), 250 mg QID or 500 mg BID (adolescents and adults)[80]

DURATION

10 days

Poor adherence expected

DRUG & DOSE

Benzathine penicillin G IM — < 27 kg: 600,000 units; ≥ 27 kg: 1,200,000 units (deep IM only — never IV)

DURATION

1 dose

Non-immediate (delayed / non-IgE) penicillin allergy

DRUG & DOSE

Cephalexin 20 mg/kg/dose BID (max 500 mg/dose) ◈ if unavailable: cefuroxime-axetil 20 mg/kg/day ÷ BID (max 500 mg/day) PO

DURATION

10 days

Documented penicillin anaphylaxis / IgE-mediated (immediate) reaction

DRUG & DOSE

Azithromycin 12 mg/kg on day 1 (max 500 mg) then 6 mg/kg (max 250 mg) once daily on days 2–5 (IDSA, as corrected 2014)[80] — the FDA-labeled 12 mg/kg once daily × 5 days (max 500 mg/day) is an accepted alternative[53]
or clarithromycin 7.5 mg/kg/dose BID (max 250 mg/dose) × 10 days
or clindamycin 7 mg/kg/dose TID (max 300 mg/dose) × 10 days

DURATION

5–10 days

⚠ WHY WE TREAT

- Antibiotics prevent suppurative complications and acute rheumatic fever (but not post-streptococcal glomerulonephritis). **All GAS is penicillin-susceptible**, but macrolide and clindamycin resistance is now common (about

one in three invasive US isolates per CDC surveillance; 5–8% and ~1% when IDSA 2012 was written) and varies locally — reserve those for true penicillin anaphylaxis and confirm local susceptibility.[80]

- Acetaminophen or ibuprofen for pain and fever; corticosteroids are not recommended as analgesic adjuncts.[80]

ADMIT · DISCHARGE · REFER

- **Admit** — rarely — complications (peritonsillar abscess, dehydration, systemic illness).
- **Home from the emergency department** — most, with antibiotics and safety-net advice.
- **Refer — now** — ENT for abscess.
- **Refer — clinic** — ENT for recurrent tonsillitis.

Urinary Tract Infection HOURS

> 2 MONTHS

A common occult source of fever in infants — get a reliable sample before antibiotics.

◁ WHEN TO SUSPECT & TEST

- **Preverbal child** with unexplained fever (> 39°C, no source) — especially **fever > 48 h** without another focus. A clear viral source (coryza, cough, diarrhea, rash) makes UTI unlikely.[81]
- **Verbal child (≥ 3 yr):** dysuria, frequency, hematuria, abdominal/back pain, or new daytime incontinence. Beware bubble-bath / hygiene vulvovaginitis — sterile cultures, often mis-treated as UTI.
- **Usual pathogens:** *E. coli* (most), then *Klebsiella*, *Enterobacter*, *Citrobacter*, *Serratia*; *S. saprophyticus* in adolescent girls.[81]
- Do not over-diagnose: low colony counts, mixed growth, or **no pyuria** usually mean contamination or asymptomatic bacteriuria.

SAMPLING — BEFORE ANTIBIOTICS

- **Toilet-trained:** clean-catch midstream. **Not toilet-trained:** catheter or suprapubic aspirate for culture.
- A bag specimen may screen the urinalysis but its culture is unreliable (contamination up to 63%) — never use it to diagnose.[81]
- A single antibiotic dose sterilizes urine; always collect first.[81]

◈ **INTERPRETING THE URINALYSIS** UTI is unlikely if the urinalysis is completely normal. **LEUKOCYTE ESTERASE OR NITRITE POSITIVE** ≈ 93% sensitive; **NITRITE ALONE** is highly specific (~98%) but often falsely negative (frequent voiding, Gram-positive / non-nitrate organisms)[81]. **PYURIA** (AAP 2026, unspun urine): under 2 months ≥ 5 WBC/HPF or ≥ trace leukocyte esterase; 2 months to 5 y ≥ 10 WBC/HPF or ≥ 2+ leukocyte esterase to start treatment (once the culture is positive, ≥ 5 WBC/HPF or ≥ 1+ is enough).[82] Nitrite does not show inflammation, so it cannot separate UTI from asymptomatic bacteriuria.

DIAGNOSTIC COLONY-COUNT THRESHOLDS

Clean catch / midstream

MINIMUM COUNT (CFU/ML)

≥ 10^5

NOTE

Mixed growth usually = contamination.

In-and-out catheter

MINIMUM COUNT (CFU/ML)

≥ 10^4

NOTE

Single uropathogen plus pyuria (AAP 2026; lowered from 5 × 10^4).[82] Indwelling-catheter specimens less reliable.

Suprapubic aspirate

MINIMUM COUNT (CFU/ML)

≥ 10^4

NOTE

Single uropathogen plus pyuria (AAP 2026). Most reliable method.[81]

ADMIT · DISCHARGE · REFER

- **Admit** — young infants, ill/septic, unable to tolerate oral, or complicated/obstructive UTI.
- **Home** — well child on oral antibiotics with follow-up.

- **Refer — clinic** — nephrology/urology for recurrent, atypical, or obstructive UTI, or abnormal imaging.

UTI — Treatment & Follow-up HOURS

LOCAL SUSCEPTIBILITY

Oral is fine for most non-toxic children — pick the empiric agent from your antibiogram; plan for ESBL.

DECISION

Cystitis or febrile UTI / pyelonephritis?

CYSTITIS · AFEBRILE LOWER TRACT

Dysuria/frequency, no fever (mainly post-pubertal girls). **3 days** (NICE NG109, to which NG224 refers) of an oral agent chosen by local *E. coli* susceptibility. No imaging needed.[83]

FEBRILE UTI / PYELONEPHRITIS

Treat **5–7 days** from 2 months of age (AAP 2026: a course of ≤ 7 days rather than longer).[82] Give a longer course (**> 7 days**) to infants under 2 months and to children with a urinary tract anomaly, bacteremia, or no clinical response to the initial course. **Oral is as effective as IV** in non-toxic children likely to tolerate every dose.[81] Use IV initially if toxic, aged ≤ 28 days, vomiting, or unable to tolerate oral — then step down early once improving (AAP 2026: oral from > 28 days of age if well and tolerating).[82]

◈ **ESBL RISK — PLAN FOR IT**

- ESBL-producing Enterobacterales are increasingly isolated even without prior antibiotics — often resistant to cephalosporins and many oral agents.
- Where local ESBL rates are high or the child is high-risk: **AMIKACIN (IV)** is the most reliable aminoglycoside — active against the large majority of pediatric ESBL isolates, whereas gentamicin is variable (roughly half)[84,85,86]. **TMP-SMX (PO)** is a useful oral step-down once susceptibility is confirmed, though ESBL isolates are often co-resistant.

- Fluoroquinolones are not routine in prepubertal children but may be used if the isolate is resistant to other oral options and oral therapy is a reasonable alternative to parenteral treatment[87].

ANTIMICROBIAL OPTIONS — IF THE ISOLATE IS SUSCEPTIBLE

Amikacin (IV)

DOSE

15 mg/kg once daily (max 1.5 g/day)

NOTES

ESBL-active empiric choice[84,85,86]; once-daily 15 mg/kg per the UK SmPC; monitor levels & renal function if > 48 h[88].

Gentamicin (IV/IM)

DOSE

5–7.5 mg/kg once daily

NOTES

ESBL activity variable (~half of isolates) — confirm susceptibility. Monitor levels / renal function > 48 h.

Ceftriaxone (IV/IM)

DOSE

50–75 mg/kg once daily (max 2 g)

NOTES

Less nephrotoxic but broader; **not** reliable if ESBL.

Ampicillin (IV)

DOSE

50 mg/kg/dose q6h (max 2 g/dose)

NOTES

± aminoglycoside; many *E. coli* now resistant. (Lexicomp)

TMP-SMX (PO)

DOSE

4–5 mg/kg/dose (TMP) BID (max 160 mg TMP/dose)

NOTES

Preferred oral step-down once susceptible — covers many ESBL isolates if tested S.[81]

Cefixime (PO)

DOSE

8 mg/kg/dose once daily (max 400 mg/day)

NOTES

Common first oral choice pending susceptibilities (if low ESBL).

Cefdinir (PO)

DOSE

7 mg/kg/dose BID or 14 mg/kg once daily (max 600 mg/day)

NOTES

Palatable oral step-down; **not always on the MOH formulary**. Like cefixime, **not reliable against ESBL**.

Cephalexin (PO)

DOSE

12.5 mg/kg/dose QID

NOTES

Oral cephalosporin option.

Amoxicillin- clavulanate (PO)

DOSE

13 mg/kg/dose (amoxicillin component; 7:1) TID

NOTES

If susceptible; amoxicillin alone often resisted.

Ciprofloxacin (PO) *

DOSE

15 mg/kg/dose BID (max 750 mg/dose)

NOTES

* Not routine in prepubertal children — reserve for resistant isolates.

◁ COMPLICATED UTI — ESCALATE & IMAGE EARLY

- Hemodynamic instability, **rising creatinine**, abdominal/bladder mass, poor urine flow, or **no improvement by 24 h / fever not settling by 48 h** on appropriate antibiotics.
- Use **IV until clearly improving**; start with a **renal & bladder ultrasound (RBUS)** to look for obstruction or abscess.[81]

⚠ IMAGING & FOLLOW-UP

- **RBUS** after a first febrile UTI in a child **< 5 yr** (AAP 2026).[82] It need not be done during the acute illness — arrange it before discharge; scan acutely if the illness is severe or atypical[81].
- **VCUG is not routine** — consider it after a first febrile UTI only if RBUS is abnormal (**hydronephrosis, scarring, or findings suggesting high-grade VUR or obstructive uropathy**), with an atypical pathogen or complex course, or after a **second febrile UTI**[81,89]. AAP 2026: offer VCUG for a clinically relevant RBUS abnormality, for every child under 2 years with a second febrile UTI, and from 2 years with a second febrile UTI that has no other explanation. After a first febrile UTI with a normal RBUS it is an option only in selected groups (age < 1 month, organism other than *E. coli*, circumcised boys, septic shock or ICU admission, or unreliable follow-up). No routine prophylaxis in low-risk VUR (grade I–II without bladder–bowel dysfunction).[82] A normal RBUS does not exclude

VUR (**VCUG** grades reflux; **DMSA** for scarring).

- Routine antibiotic **prophylaxis is not recommended** while awaiting RBUS.[81]
- Repeat urinalysis / culture to confirm cure is **not recommended** unless symptoms persist.
- Counsel families to test urine early in any future unexplained fever.
- Recurrent afebrile UTI is often driven by **bladder–bowel dysfunction** — assess and treat constipation (a major, modifiable risk factor).[81]

Skin & Soft Tissue Infections ASSESS

CPS 2026

Match the antibiotic to the layer and the pathogen — most are oral, short-course, and cephalexin-first.

TYPES — BY DEPTH & MORPHOLOGY

- **Impetigo** (epidermis): non-bullous (honey-crusted) or bullous; highly contagious. Mostly group A streptococcus (GAS) / *S. aureus*.

- **Erysipelas / cellulitis** (dermis → subcutis): spreading erythema, warmth, tenderness. Non-purulent cellulitis is more often **GAS**; purulent points to *S. aureus*.[90]
- **Folliculitis / furuncle / carbuncle / abscess**: discrete pus collections — *S. aureus* (methicillin-susceptible, MSSA, or methicillin-resistant, MRSA). Source control is the priority.
- **Necrotizing infection** (fascia/muscle): pain out of proportion, rapid spread, necrosis, crepitus[90] — surgical emergency. GAS ± polymicrobial.

DECISION

How severe, and is there pus?

MILD / NON-PURULENT

Impetigo or small localized lesion, systemically well — often resolves with skin/wound care alone. Limited: topical **mupirocin 2% TID × 5 days**. Widespread/multiple lesions or systemic features: oral **cephalexin**.

PURULENT — ABSCESS / FURUNCLE

Incision & drainage is the treatment. For a small, drained abscess in a healthy host without surrounding cellulitis, antibiotics are usually **not** needed; stop them once source control is achieved.[90]

SEVERE / DEEP / NECROTIZING

Extensive or rapidly progressive, systemic toxicity, necrosis or crepitus → **admit, urgent surgical debridement, and broad empiric IV therapy**: piperacillin-tazobactam (or ceftriaxone) + vancomycin + clindamycin (antitoxin); stop vancomycin once MRSA is excluded; consult infectious diseases.

Oral cephalexin is the antimicrobial of choice when antibiotics are warranted.

BY PATHOGEN / SETTING

MSSA / GAS — oral, first-line

DRUG & DOSE

Cephalexin 50–100 mg/kg/day PO ÷ TID–QID (e.g., 25 mg/kg/dose QID or 33 mg/kg/dose TID; max 1 g/dose, 4 g/day)
upper end, TID for adherence, for moderate cellulitis managed as an outpatient

NOTES

Drug of choice (CPS 2026). Covers MSSA **and** GAS. Upper-range dosing enables outpatient treatment of moderate cellulitis.[90,91]

MSSA / GAS — IV (admitted)

DRUG & DOSE

Cefazolin 33 mg/kg/dose IV q8h (max 2 g/dose)

NOTES

IV first-line for non-toxic inpatients. Step down to oral cephalexin on improvement.

GAS — streptococcal

DRUG & DOSE

Amoxicillin 25 mg/kg/dose PO BID (max 4 g/day); penicillin G IV if severe

NOTES

For confirmed/likely pure GAS (erysipelas, non-purulent cellulitis).

MRSA — oral, first-line

DRUG & DOSE

Trimethoprim-sulfamethoxazole 4–6 mg/kg/dose (trimethoprim component) PO BID (max 160 mg TMP/dose)

NOTES

Preferred oral MRSA agent — also covers GAS.[91] Use when colonized or MRSA strongly suspected.

MRSA — alternative

DRUG & DOSE

Clindamycin 10 mg/kg/dose PO/IV q8h (max 600 mg/dose PO [1.8 g/day], 900 mg/dose IV [2.7 g/day])

NOTES

Only where local clindamycin susceptibility is high. Anti-toxin role in severe disease.

MRSA — IV (severe)

DRUG & DOSE

Vancomycin 15 mg/kg/dose IV q6h (max 4 g/day before level-guided adjustment)

NOTES

Add when MRSA suspected in toxic/deep infection; stop once MRSA excluded. *K. kingae* (the leading bone/joint pathogen at 6–48 months) is generally susceptible to β-lactams, so cefazolin/cephalosporins — rather than vancomycin or clindamycin alone — are preferred empirically for bone/joint infection in under-4s.[92,93]

◈ **DURATION & STEP-DOWN**

- **5–7 DAYS IS USUALLY ENOUGH**, even for many severe SSTIs (rarely > 7 days).[90,91]

- Failure to improve → re-evaluate diagnosis and source control, not simply broaden.
- Avoid routine combination therapy (e.g., cephalexin + TMP-SMX) and broad outpatient IV (ceftriaxone).
- If a child improves on a non-MRSA agent but is later found MRSA-colonized/positive, **DO NOT SWITCH** — clinical response governs.

⚠ **PREVENTING RECURRENCE**

- Protect the skin barrier: optimize **eczema** control, diligent wound care, cover open lesions, treat scabies/lice, and encourage varicella vaccination.
- Reserve **decolonization** (5-day nasal mupirocin + chlorhexidine washes, or dilute bleach baths) for recurrent moderate–severe SSTIs or household clusters — success is variable and re-colonization common.[90]

ADMIT · DISCHARGE · REFER

- **Admit** — systemic illness, rapid spread, an abscess needing drainage, immunocompromise, or

failed oral therapy; suspected necrotizing infection → emergency.

- **Home** — localized, well child on oral antibiotics with review.
- **Refer — now** — surgery for drainage or necrotizing infection.

Cervical Lymphadenopathy ASSESS

COMMON

Very common and usually reactive — your job is to separate the benign node from the few that need antibiotics, imaging, or a malignancy work-up.

WHAT COUNTS AS ABNORMAL

- A small, mobile, palpable node is **normal** in most healthy children. Treat a **cervical node > 1 cm** as enlarged (inguinal > 1.5 cm; epitrochlear > 0.5 cm).[94,95]
- A **supraclavicular** node is **never normal** — it is the single highest-risk site for malignancy. Image and investigate every one.[94,96,97]
- Sort by **tempo & laterality** — it points to the cause.[94,96]

PATTERN → LIKELY CAUSE

Acute, bilateral, tender

THINK

Reactive viral URTI (commonest)
EBV / CMV if prolonged with splenomegaly

ACTION

Supportive, no antibiotics, safety-net. EBV serology if a glandular-fever picture.[94,96]

Acute, unilateral, tender, warm ± fluctuant

THINK

Bacterial lymphadenitis — S. aureus (incl. MRSA) & group A strep

ACTION

Empiric oral antibiotics 10 d; ultrasound if fluctuant → drain an abscess. Review at 48 h.[94,95,98]

Subacute (2–6 wks) / chronic (> 6 wks), often non-tender

THINK

Nontuberculous (atypical) mycobacteria (violaceous, "cold", young child), cat-scratch (Bartonella), TB, toxoplasma[94,99]

ACTION

Don't just re-course antibiotics — investigate. NTM → complete surgical excision; cat-scratch → usually self-limited (azithromycin if bulky/symptomatic).[94,98,100,101]

⚠ CAN'T-MISS — RED FLAGS FOR MALIGNANCY (LYMPHOMA / LEUKEMIA / METASTASIS)

- **Supraclavicular** node; **hard, matted, fixed**, or **painless / rubbery**; **> 2 cm and enlarging**; persisting or progressive **beyond 4–6 weeks**; **generalized** nodes (≥ 2 non-contiguous regions) or **hepatosplenomegaly**; **B symptoms** — unexplained fever > 38°C, drenching night sweats, weight loss > 10%; a **mediastinal mass** on chest X-ray.[94,95,96,102,103]
- Any one → urgent bloods + imaging and refer.[95,104] **Strongest predictors:** a **larger node** and **older age** — the risk rises with each — more nodal sites, a supraclavicular site, fixed nodes, and an **abnormal chest X-ray**; fever, weight loss, and organomegaly may also raise the odds.[97,102,105]

◣ WORK-UP (WHEN IT ISN'T SIMPLE REACTIVE)

- **Bloods:** CBC + differential + **blood film** (blasts, cytopenias), **ESR / CRP, LDH**; EBV / CMV serology; a **TB test**

(IGRA or tuberculin); Bartonella / toxoplasma serology if exposed.[94,95,102,106]

- **Imaging: ultrasound first-line** (size, abscess, architecture); chest X-ray if any red flag (mediastinal mass).[95,96,97,106]
- **Biopsy** (excisional preferred) for a red-flag or supraclavicular node, **failure to regress by 4–6 weeks**, or progression despite treatment.[94,95,107,108]

EMPIRIC ANTIBIOTICS — ACUTE BACTERIAL LYMPHADENITIS (10 DAYS)

Cover S. aureus + GAS

ORAL

Cephalexin 50–100 mg/kg/day ÷ 3–4 (max 4 g/day) OR amoxicillin-clavulanate[90,98]

NOTES

Review at 48 h; most settle within days. Add source control if an abscess forms.[94]

MRSA risk / penicillin allergy

ORAL

Clindamycin 20–40 mg/kg/day ÷ 3[90,98]

NOTES

Also covers GAS; use per local MRSA rates.[80,90]

Fluctuant / abscess

ORAL

`Incision & drainage + culture`

NOTES

Ultrasound-guided if deep; send pus for routine **and** mycobacterial culture.[94,95,98]

✦ DON'T FORGET

- A cervical node **≥ 1.5 cm** is a clinical criterion of **Kawasaki disease** — reassess if fever has lasted ≥ 5 days.[109]
- Tender anterior nodes with exudative pharyngitis suggest **GAS pharyngitis**.[80]
- A firm supraclavicular or matted node in a child with pallor or bruising → treat as possible malignancy and refer **same day**.[95,104,108]

✦ YOUR ROLE — THE GENERAL PEDIATRICIAN

- **Most nodes are yours to manage.** Do the first-line assessment and reassurance; classify by duration (**acute ≤ 2 wks · subacute 2–6 wks · chronic > 6 wks**) and actively look for a red flag.[94,96,107]

- Treat acute bacterial lymphadenitis empirically and **review at 48 h**. **Safety-net every child and set a definite review point** — a node that has not begun to shrink by ~**4 weeks**, or is growing, needs work-up.[94,95,106]
- You can start the first-line bloods and request the ultrasound yourself. **Refer early rather than re-course antibiotics** for a persistent or red-flag node: **same-day to hematology-oncology** for a hard/matted/supraclavicular node or systemic features; **surgery/ENT** for excision biopsy (persisting > 6 weeks or progressive); **infectious diseases** for suspected TB or atypical mycobacterial disease.[94,95,98,104,108]

ADMIT · DISCHARGE · REFER

- **Admit** — systemically unwell, a large / fluctuant node needing drainage, airway or deep-space concern, or a strong malignancy suspicion.[94,95,104,110]
- **Home from the emergency department** — the well child with a small, mobile, reactive node →

safety-net and review in 2–4 weeks.[95,96,98]

- **Refer — clinic** — surgery / ENT for excision (NTM, abscess, biopsy); hematology-oncology for a red-flag node; infectious diseases for TB or atypical infection.[94,100,104]

Fever – Assessment & Antipyretics

ASSESS NICE NG143

Fever ≥ 38°C. Treat the child's discomfort and risk — not the number.

RISK-ASSESS BY TRAFFIC LIGHT (AND BY AGE)

- Any infant **under 3 months** with fever is high-risk → use the **Fever in the Young Infant** pathway.
- **Red (high-risk):** pale/mottled/ashen/blue, no response to social cues, unrousable, weak/high-pitched cry, grunting, respiratory rate > 60, reduced skin turgor, bulging fontanelle, neck stiffness, non-blanching rash, focal seizures/neurology.[111]

- **Amber (intermediate):** pallor, decreased activity, poor feeding, dry mucous membranes, reduced urine, nasal flaring, tachycardia, fever ≥ 5 days, rigors, non-weight-bearing/limb swelling.[111]
- **Green (low-risk):** normal color, responsive, content, moist membranes — manage at home with safety-netting.

ANTIPYRETIC DOSING

Acetaminophen — PO

DOSE

10–15 mg/kg/dose every 4–6 h PRN

MAX · NOTES

≤ 1 g/dose, ≤ 5 doses/24 h; max 75 mg/kg/day (not > 4 g/day). Onset 30[112]–60 min.

Acetaminophen — IV

DOSE

≥ 2 y: 15 mg/kg/dose every 6 h
29 days–2 y: 15 mg/kg/dose every 6 h
Neonate (birth–28 days): 12.5 mg/kg/dose every 6 h

MAX · NOTES

≥ 2 y: max 750 mg/dose if < 50 kg, 1 g/dose if ≥ 50 kg; ≤ 75 mg/kg/day (not > 4 g/day). 29 days–2 y: max 60 mg/kg/day. Neonate: max 50 mg/kg/day. Daily maxima include acetaminophen by all routes.[113]

Ibuprofen — PO

DOSE

5–10 mg/kg/dose every 6–8 h

MAX · NOTES

Age ≥ 6 months. Max 400 mg/dose, 40 mg/kg/day. Give with food + ensure hydration.[112]

Ibuprofen — IV

DOSE

10 mg/kg/dose every 6–8 h

MAX · NOTES

Age ≥ 6 months. Max 400 mg/dose, 40 mg/kg/day.

◈ **AVOID**

- Acetaminophen — severe liver failure.
- Ibuprofen — dehydration / any poorly hydrated child, renal impairment, active GI bleeding / ulcer disease, and **CHICKENPOX (VARICELLA)** — associated with severe skin and soft-tissue infection; use acetaminophen (see **Must-Avoid Drugs**).

⚠ **USE ANTIPYRETICS FOR COMFORT, NOT THE THERMOMETER**

- Give only while the child is uncomfortable.[112]

- Giving both agents together (PITCH trial) gave more fever-free time over 24 h than either alone, but cleared fever no faster than ibuprofen alone and did **not** improve comfort — so for comfort one agent is usually enough.[114]
- Switch agents if discomfort is not relieved; alternate only if discomfort recurs before the next dose; counsel carefully to avoid dosing errors.
- Tepid sponging is not recommended; don't over- or under-wrap. **Antipyretics do not prevent febrile seizures.**[112] Encourage fluids; safety-net for red/amber signs.

The Rash — Approach & Red Flags

MINUTES

Two questions first: does the child look unwell, and does the rash blanch?

◣ STEP 1 — DOES THE CHILD LOOK UNWELL? (BEFORE FOCUSING ON THE RASH)

- Rapid ABCDE-style screen: work of breathing; color and perfusion (capillary refill > 2–3 s, mottled, cold peripheries); heart rate and respiratory rate for age; mental status (irritable, lethargic); fever; neck stiffness, photophobia, bulging fontanelle in infants.
- Any red flag → urgent assessment + empiric IV antibiotics (see **Septic Shock**), **in parallel** with the rash exam. Looks well → Step 2.
- **A blanching rash does not rule out sepsis** — meningococcal disease often begins as a blanching maculopapular rash before turning petechial or purpuric, and the classic non-blanching rash can be a late sign.[115] Escalate an unwell child whatever the rash looks like.

- **Darkly pigmented skin:** erythema, petechiae and purpura may appear dark brown or violaceous and be masked — check all over the body (including the nappy area), look for petechiae in the conjunctivae, and lower the threshold to escalate.[116]

STEP 2 — DOES THE RASH BLANCH? (PRESS A CLEAR GLASS AGAINST IT)

DECISION

Does the rash blanch under glass?

NON-BLANCHING

Petechiae (< 2 mm) or purpura (> 2 mm) — **purpura carries higher risk**.[115] Unwell or febrile → treat as invasive meningococcal disease / sepsis until excluded. A **well** child still needs a diagnosis and follow-up (see below) — do not dismiss just because they look well.

BLANCHING

Usually benign — viral exanthem, urticaria, or eczema. Treat symptomatically; safety-net with clear advice to "come back if the child becomes unwell, even if the rash looks the same or fades.[111]"

NON-BLANCHING — SORT THE CAUSE

Meningococcal / invasive bacterial

KEY FEATURES

Ill, febrile — emergency (identified at Step 1)

IgA vasculitis (Henoch–Schönlein)

KEY FEATURES

Palpable purpura on buttocks and legs in a *well* child; abdominal pain, arthralgia/arthritis; check urine for blood and protein (renal involvement)

Immune thrombocytopenia (ITP)

KEY FEATURES

Well child, isolated low platelets, bruising; often post-viral; watch for mucosal bleeding (epistaxis, gums)

Mechanical purpura

KEY FEATURES

Forceful cough, vomiting or breath-holding; classically above the nipple line (head and neck, SVC territory) — benign

Leukemia

KEY FEATURES

Pallor, hepatosplenomegaly, fatigue, bone pain, unexplained bruising

BLANCHING — SORT THE CAUSE

Viral exanthems

KEY FEATURES

Roseola, measles, rubella, slapped-cheek (parvovirus B19); hand-foot-and-mouth and varicella are vesicular, not purely maculopapular

Scarlet fever

KEY FEATURES

Sandpaper rash + strawberry tongue → penicillin

Urticaria

KEY FEATURES

Transient wheals → antihistamine; airway or systemic features → see **Anaphylaxis**

Kawasaki disease

KEY FEATURES

Fever ≥ 5 days + rash + non-purulent conjunctivitis + mucositis/strawberry tongue + extremity changes + cervical node — easily mistaken early for scarlet fever or a viral exanthem (see **Kawasaki Disease**)

⚠ ANY UNWELL CHILD IS THE EMERGENCY

- Escalate immediately — with or without a rash, and whatever the rash looks like.

- This alone is sufficient.

◣ ESCALATE URGENTLY — REGARDLESS OF BLANCHING — ALSO IF

- Non-blanching rash with fever, ill appearance, or rapid spread.
- **Retiform purpura** (branching, angulated, stellate) rather than round petechiae/purpura — suggests vascular occlusion (DIC, severe sepsis, vasculitis) and is higher-acuity than ordinary purpura.[117]
- **Mucosal involvement** (eyes, mouth, genitals) with blistering or skin peeling → Stevens–Johnson syndrome / TEN or toxic shock syndrome. Superficial peeling with **perioral crusting and radial fissures but mucous membranes spared**, especially in young children → **staphylococcal scalded skin syndrome (SSSS)** — mucosal sparing is the classic clue that separates SSSS from SJS/TEN. The **Nikolsky sign** (gentle shearing pressure separates the epidermis) is positive in SJS/TEN, SSSS, and pemphigus.

- **Vesicles in a neonate** → herpes simplex. Skin vesicles **never appear in roughly 30–40% of neonatal HSV with CNS or disseminated disease** (32% CNS, 39% disseminated) — keep the threshold low for a full sepsis + HSV workup (and empiric acyclovir) in any unwell neonate, even with no rash.[118]
- Fever ≥ 5 days with rash plus any Kawasaki features.[109]

◈ BEDSIDE TIPS

Faded or changed rash? Ask whether a parent photographed it — useful for evanescent eruptions like urticaria. **Stroke test:** a wheal along a tongue-blade stroke = dermographism (common, benign); a wheal raised specifically over a pigmented lesion = **Darier's sign** (mastocytosis — worth recognizing in recurrent unexplained wheals). **Herpes zoster** in a dermatomal band is usually benign and immunocompetent in children, especially after early-life varicella or vaccination; consider underlying immunodeficiency only if it is multidermatomal, sacral, recurrent,

prolonged or treatment-refractory, or has invasive features.

Preseptal & Orbital Cellulitis HOURS

CPS 2026

The orbital septum is the firewall — eye signs separate sight-threatening orbital disease from benign preseptal swelling.

THE DISTINCTION THAT DRIVES EVERYTHING

- The **orbital septum** is the anatomic firewall. **Preseptal (periorbital)** = infection anterior to it — usually from skin trauma or sinusitis; mostly benign. **Orbital** = posterior to it — a complication of **ethmoid sinusitis** eroding the lamina papyracea; threatens vision and brain.[119]
- The distinction drives etiology, imaging, antibiotics, and disposition.[119]

DIFFERENTIATE AT THE BEDSIDE

Eyelid swelling & erythema

PRESEPTAL
Present

ORBITAL
Present

Pain **with** eye movement

PRESEPTAL
Absent

ORBITAL
Present

Extraocular movements

PRESEPTAL
Normal

ORBITAL
Impaired / restricted

Proptosis

PRESEPTAL
Absent

ORBITAL
Often present

Chemosis / diplopia / ↓ acuity / RAPD

PRESEPTAL
Absent

ORBITAL
May be present

Fever / toxic appearance	
PRESEPTAL	May be present
ORBITAL	Usually present

◁ ETIOLOGY & MICROBIOLOGY

- **Preseptal — traumatic:** skin flora after a bite/scratch → *S. pyogenes*, *S. aureus*.
- **Preseptal — atraumatic:** a complication of bacterial rhinosinusitis.
- **Orbital:** mirrors acute sinusitis — *Streptococcus* (*anginosus*, *pyogenes*, *pneumoniae* groups); *S. aureus* and oral anaerobes in chronic sinusitis / older children; *H. influenzae* if under-immunized.[119]
- **MRSA:** generally low but rising — risk factors do not reliably predict it[119]; a **negative nasal MRSA swab reliably excludes** it and guides the oral step-down.

◈ IMAGING — CONTRAST CT ORBITS + SINUSES

- Well children with uncomplicated **PRESEPTAL** disease need **NO IMAGING**.[119]

- Contrast CT is first-line; MRI preferred if intracranial extension or cavernous sinus thrombosis is suspected.
- Its job: find who needs surgery or has a complication.
- Image **IF** toxic appearance, optic-nerve signs (abnormal vision, RAPD), intracranial signs (focal deficit, seizure), prominent forehead swelling, high-risk labs (CRP > 120 mg/L, WBC > 20,000/µL or ANC > 10,000/mm³), or to resolve diagnostic uncertainty[119].
- Blood count and CRP (± blood culture) for severe infection, uncertain preseptal vs orbital extent, or a limited examination (young child); conjunctival swabs are not recommended.[119]
- Otherwise reasonable to **DELAY CT 24–36 H** to judge response when ENT / ophthalmology are available.[119]

ADMIT · DISCHARGE · REFER

- **Admit** — orbital signs, systemic illness, age < 1, and all true orbital cellulitis → IV antibiotics.
- **Home from the emergency department** — mild preseptal in a well child on oral antibiotics with 24 h review.

- **Refer — now** — ophthalmology and ENT for orbital involvement; surgery for an abscess.

Preseptal & Orbital — Management

HOURS RISK-BASED

Preseptal is mostly oral outpatient; orbital is admitted, IV, and shared with ENT + ophthalmology.

DECISION

Preseptal or orbital?

PRESEPTAL — MOSTLY OUTPATIENT

Well, immunized child, eyelid erythema/edema with **normal painless eye movements, normal vision, no proptosis** → oral antibiotics + review. Admit the very young, severe, or not-improving.

ORBITAL — ADMIT, EMERGENCY

Pain/restriction on eye movement, **proptosis, chemosis, diplopia, reduced acuity, or RAPD** → admit: CBC/CRP, blood cultures, IV antibiotics, **same-day ENT + ophthalmology**, CT per criteria. Do not swab the conjunctiva (contamination).

WHAT TO SEND

- Uncomplicated preseptal, well child: no work-up.
- Severe / uncertain / young child: **CBC + CRP**. Severe disease: **blood cultures before antibiotics**. Drained pus / abscess → culture ± PCR. **MRSA nasal swab** where available — a negative result reliably excludes MRSA and guides the oral step-down.

Traumatic preseptal (bite / broken skin)

FIRST-LINE

PO cephalexin
IV cefazolin

DOSE (MAX) · MRSA / NOTES

Cephalexin 25 mg/kg/dose q6h (100 mg/kg/day, max 4 g/day); cefazolin 33 mg/kg/dose q8h (100 mg/kg/day). MRSA suspected → TMP-SMX 4–6 mg/kg/dose (TMP) q12h (max 160 mg TMP/dose) or clindamycin.[119]

Atraumatic preseptal (from sinusitis)

FIRST-LINE

PO cephalexin
IV cefazolin

DOSE (MAX) · MRSA / NOTES

Doses as above (local adaptation on infectious-disease review — CPS 2026 recommends amoxicillin PO / ampicillin IV here). **Escalate to / add amoxicillin-clavulanate** (co-amoxiclav 30 mg/kg [= amoxicillin 25 mg/kg + clavulanate 5 mg/kg] q8h) if no response by 24–48 h or the child is under-immunized.

Orbital cellulitis (admitted)

FIRST-LINE

IV ceftriaxone + vancomycin

DOSE (MAX) · MRSA / NOTES

Ceftriaxone 50 mg/kg q12h (max 4 g/day) + vancomycin 15 mg/kg q6h (target levels). Alternative: ceftriaxone + clindamycin (adds anaerobe/MSSA cover) or amoxicillin-clavulanate. PO step-down by culture + MRSA swab.[119]

Severe · toxic / intracranial / optic-nerve

FIRST-LINE

IV ceftriaxone (or cefotaxime) + vancomycin + metronidazole

DOSE (MAX) · MRSA / NOTES

Ceftriaxone 50 mg/kg q12h + vancomycin 15 mg/kg q6h + metronidazole 10 mg/kg q8h. CNS-penetrating triple cover; consult ID; assess for surgery.

◈ WHY THESE CHOICES — ADAPTED TO LOCAL EPIDEMIOLOGY (INFECTIOUS-DISEASE REVIEW)

- In Kuwait, near-universal Hib and pneumococcal conjugate vaccination reduces the *H. influenzae* / *S. pneumoniae* contribution, so a first-generation cephalosporin (cephalexin/cefazolin — strong streptococcal + MSSA cover) is a reasonable narrow empiric choice for skin- and sinus-origin preseptal disease; escalate to amoxicillin-clavulanate on non-response or under-immunization.
- For orbital disease, **VANCOMYCIN IS INCLUDED EMPIRICALLY** as a **LOCAL ADAPTATION** to the regional community-associated MRSA rate, which is much higher than in Canada (infectious-disease review — CPS 2026 adds vancomycin only when MRSA is suspected and notes

a negative MRSA swab reliably excludes it); ceftriaxone covers sinusitis streptococci with good tissue/CNS penetration; metronidazole is added for intracranial extension.[119]

- Always tailor to immunization status, prior antibiotics, and the **LOCAL ANTIBIOGRAM**.

Preseptal cellulitis

DURATION
7 days (infectious-disease review; CPS 2026 gives 5–7 days)[119]

Orbital cellulitis (uncomplicated)[119]

DURATION
10–14 days

Orbital + subperiosteal / orbital abscess (no intracranial)

DURATION
2–3 weeks

✦ **SURGERY, ADJUNCTS & STEP-DOWN**

- **Surgery:** subperiosteal or orbital abscess → prompt ENT + ophthalmology for possible drainage (most small subperiosteal collections settle medically)[119]; intracranial complications → neurosurgery.

- **IV → oral** once clearly improving, narrowed by cultures / MRSA swab.
- **Adjuncts:** intranasal saline/steroids only with subspecialty input; systemic corticosteroids are **not** routinely recommended.[120] Escalate to ID for systemic illness, non-response, large abscess, or intracranial extension.

⚠ SIGHT & BRAIN AT RISK — RED FLAGS

- Falling visual acuity, a relative afferent pupillary defect, severe or bilateral proptosis, ophthalmoplegia, cranial-nerve palsies, or altered consciousness → cavernous sinus thrombosis or intracranial spread.
- Image urgently and escalate immediately.
- Bilateral involvement or rapid progression despite IV therapy is an emergency.

◈ **DIFFICULT IV ACCESS?** Reassess for an early IV→oral switch at every line failure rather than re-sticking — see **IV → Oral Switch & the DIVA Patient** (Quick Reference).

BRUE (Brief Resolved Unexplained Event)

ASSESS · < 1 YR · AAP 2016

A frightening but now-resolved episode in a well-appearing infant — a diagnosis of exclusion.

DEFINE

- An infant < 1 year, when an observer reports a **sudden, brief, now-resolved** episode of one or more of: cyanosis or pallor; absent, decreased, or irregular breathing; a marked change in tone (hyper- or hypotonia); or altered responsiveness.[121]
- Diagnose a BRUE **only when no explanation is found** after appropriate history and examination.[121]

LOWER-RISK — ALL OF

- Age > 60 days; gestation ≥ 32 wk and corrected (postmenstrual) age[121] ≥ 45 wk.
- First event (no prior BRUE, not in clusters); duration < 1 min; no CPR by a trained provider; no concerning

history or examination findings.[121]

◣ LOWER-RISK — DO

- **Should** — educate caregivers about BRUEs and use shared decision-making to guide evaluation, disposition, and follow-up; offer resources for caregiver CPR training.
- **May** — obtain pertussis testing and a 12-lead ECG; briefly monitor with continuous pulse oximetry and serial observations.[121]

✕ LOWER-RISK — DO NOT / NEED NOT

Should not: blood counts or cultures, CSF, electrolytes/renal panel/calcium, ammonia, blood gases, or metabolic screen (urine organic acids, plasma amino acids, acylcarnitine); chest X-ray, echocardiogram, EEG, or studies for reflux; home cardiorespiratory monitoring; acid-suppression or antiepileptic drugs. **Need not:** viral respiratory testing, urinalysis, glucose, bicarbonate, lactate, anemia work-up, or neuroimaging; admission **solely** for cardiorespiratory monitoring.[121]

⚠ CONCERNING FEATURES → NOT LOWER-RISK,

EVALUATE

- Toxic appearance, lethargy, vomiting, or respiratory distress at assessment; significant compromise / CPR during the event; recurrent or prior events; family history of sudden cardiac death, long-QT syndrome, unexplained drowning or motor-vehicle death, SIDS, or sibling BRUE; history suggesting seizure; paroxysmal cough or pertussis exposure; any trauma or concern for maltreatment; unexplained sibling death or dysmorphic features.
- These mandate **targeted** evaluation — the testing restrictions above apply to lower-risk infants only.

✦ PEARL — "LOWER-RISK" IS NOT "NO-RISK"

- In the multicenter BRUE network, about **4%** of infants had a serious underlying condition (most often a seizure disorder or an airway abnormality) — nearly half diagnosed only after the index visit — and return visits occurred

after roughly **7%** of ED discharges and **11%** of hospital discharges.[122]

- The AAP criteria reliably identify low-risk infants but over-classify many as higher-risk.[122]
- Safety-net every family, offer CPR training, and consider asking carers to video any recurrence for diagnostic clarity.

ADMIT · DISCHARGE · REFER

- **Admit** — higher-risk BRUE (age < 2 months, prematurity, repeated events, or concerning features) for monitoring.
- **Home from the emergency department** — lower-risk BRUE with education, CPR resources, and follow-up.
- **Refer — clinic** — by cause (cardiology, neurology, safeguarding).

Adolescent Emergencies — Kuwait Context

HOURS ADOLESCENT

Mental-health crises and menstrual emergencies — within the Kuwait consent and confidentiality framework.

MENTAL HEALTH & SELF-HARM

- Screen the psychosocial context in a calm, private setting — Home, Education, Eating, Activities, Drugs, Sexuality, Suicide/safety (HEEADSSS).[7]
- **Acute self-harm, suicidal ideation, or intentional ingestion → manage per the Self-Harm / Intentional Ingestion card** (continuous one-to-one observation, remove the means, treat the ingestion, mental-health assessment before discharge). This card adds the **adolescent consent, confidentiality, and safeguarding** framework below.

MENSTRUAL EMERGENCIES

- **Heavy menstrual bleeding:** assess for hemodynamic compromise and anemia. Check CBC, ferritin,

coagulation screen and **von Willebrand studies** (especially at menarche)[123], thyroid function, and a pregnancy test — performed within the local legal/ethical and safeguarding framework, and discussed with a senior clinician where culturally sensitive.

- **Severe dysmenorrhea:** first-line is a scheduled NSAID; escalate to hormonal therapy for a menstrual indication if refractory, and reassess for secondary causes (endometriosis) if no improvement after 3–6 months.[124]
- **Amenorrhea:** investigate primary amenorrhea if no menarche by age 15 (or within 3 years of thelarche), or by 13 with no secondary sexual characteristics; in secondary amenorrhea, exclude pregnancy first.[125,126]

Tranexamic acid

DOSE

PO 1.3 g three times daily for up to 5 days (US label dose, post-menarchal; not studied < 18 y) or 15–25 mg/kg/dose (max 1.5 g) two to three times daily (SmPC) · IV 10 mg/kg/dose (max 1 g) every 8 h

ROUTE & NOTES

Acute heavy menstrual bleeding[123,127,128]. The weight-based PO dose and the IV maximum are the pediatric doses (4 weeks–18 years, Perth Children's Hospital monograph citing BNF for Children 2024)[815] and equal the Cyklokapron SmPC adult doses.[266,816]

Combined oral contraceptive / oral progestogen

DOSE

per gynecology protocol

ROUTE & NOTES

Hormonal control of acute bleeding or refractory dysmenorrhea

NSAID (ibuprofen / mefenamic acid)

DOSE

ibuprofen 10 mg/kg/dose every 6–8 h (max 400 mg/dose, 40 mg/kg/day); mefenamic acid per protocol

ROUTE & NOTES

Dysmenorrhea; also reduces menstrual blood loss

Iron

DOSE

3–6 mg/kg/day elemental iron

ROUTE & NOTES

Iron-deficiency anemia from chronic loss

⚠ SAFEGUARDING OVERRIDES CONFIDENTIALITY

- Confidentiality with an adolescent is real but **not absolute**.
- When there is imminent risk of serious harm — self-harm, suicide, abuse, or exploitation — override it: involve the guardian and escalate through the hospital safeguarding pathway.
- Treat life- or limb-threatening conditions immediately, with or without consent.

◈ KUWAIT LEGAL FRAMEWORK

- Under **LAW NO. 70/2020** (Medical Profession & Patients' Rights), informed consent is required before any intervention and, for a minor, is given by the **LEGAL GUARDIAN (WALI)**.[1]
- **CONFIDENTIALITY (ARTICLE 13):** the practitioner must not disclose a patient's secret — whether it came

to their knowledge, was discovered through practice, or was entrusted to them — except in defined circumstances: a written order from a court, the public prosecution, or a competent investigating authority; disclosure to prevent or report a crime; notification of a communicable disease to the authority designated by the Ministry; the patient's written consent; information exchange required between the care team for the patient's management; or reporting of child abuse (Law 21/2015) or elder abuse/neglect (Law 18/2016).

- Under the **MENTAL HEALTH LAW NO. 14/2019**, a physician may hold a patient for **UP TO 72 HOURS** for psychiatric assessment when there is danger to self or others or an inability to self-care/consent (Art. 11);[129] involuntary referral is also permitted by judicial order or at the request of a relative (to second kinship), the treating physician, or an investigator. Disclosing a patient's psychological information is a **CRIMINAL OFFENSE**.
- Confirm exact article wording against the official gazette text and current Kuwait MOH circulars.

The Child with Obesity ASSESS

AAP 2023

Obesity reshapes acute care — weight-based dosing, a harder airway, and comorbidities that present as emergencies.

DEFINE

- **Obesity** = BMI ≥ 95th percentile for age and sex; **severe obesity** ≥ 120% of the 95th percentile (or BMI ≥ 35). A chronic disease with genetic, physiologic, and environmental contributors — not a failure of willpower.[130]
- Focuses on how obesity **modifies acute care** — drug dosing, the airway, resuscitation, and the comorbidities that present as emergencies.

APPROACH & WORK-UP

- Confirm the **BMI percentile**; targeted history (diet, activity, sleep/snoring, family history, medications) and exam for comorbidity signs — acanthosis nigricans, hypertension (correct-size cuff), hepatomegaly, hip/knee findings, papilledema.

- **Screen ≥ 10 years**: fasting glucose/HbA1c (T2DM), ALT (fatty liver), and a lipid panel; blood pressure with an appropriately sized cuff.[130]

MANAGEMENT — DRUG DOSING IS THE KEY BEDSIDE TRAP

Resuscitation drugs · defibrillation

DOSE

Actual (total) body weight — but cap at the adult dose

ROUTE & NOTES

Length-based tapes (Broselow) estimate weight poorly — only about half of estimates fall within 10% of actual weight[817] — weigh the child.

General rule

DOSE

No universal scalar — dosing is drug-specific

ROUTE & NOTES

There is **no valid one-size default**; the correct weight basis depends on each drug's pharmacokinetics. Confirm with clinical pharmacy / the formulary. Never exceed the adult dose (PPAG: weight-based dosing from 40 kg only until the adult dose is reached); scaling a hydrophilic drug to total body weight can cause overdose.[131, 818]

Lipophilic drugs, large V_d

DOSE

Loading dose nearer total body weight

ROUTE & NOTES

Then maintain on lean/adjusted weight (e.g., some sedatives, induction agents).

Cefazolin

DOSE

Total body weight (TBW)

ROUTE & NOTES

Cap at the adult dose. TBW dosing is supported for cefazolin[131].

Antineoplastics

DOSE

Body surface area calculated from actual weight, per oncology protocol

ROUTE & NOTES

Chemotherapy is dosed by body surface area[131]; do not empirically cap or reduce without the oncologist/pharmacist.

Aminoglycosides · hydrophilic drugs

DOSE

Adjusted body weight

ROUTE & NOTES

Volume of distribution altered; gentamicin is dosed on adjusted body weight in obesity, level-guided.[819]

◈ **RULE OF THUMB** When total body weight exceeds ~120% of ideal body weight, choose the weight basis deliberately — **PER**

DRUG, NOT BY A BLANKET RULE. NEVER EXCEED THE RECOMMENDED ADULT DOSE for the indication, regardless of weight. For any drug not listed above, or with a narrow therapeutic index, **INVOLVE CLINICAL PHARMACY**.

⚠ AIRWAY & VENTILATION

- Anticipate **difficult bag-mask ventilation and intubation** and **rapid desaturation** (reduced functional residual capacity).
- Pre-oxygenate well, position **ramped/HELP** (ear-to-sternal-notch), and have adjuncts ready.
- Higher risk of OSA and obesity-hypoventilation.

◣ RED FLAGS — DON'T-MISS ACUTE COMORBIDITIES

- **T2DM → DKA or HHS** — hyperglycemic hyperosmolar state is increasingly reported in youth with T2DM (up to ~2% present with HHS at T2DM onset) and obesity makes dehydration hard to assess.[132]
- **SCFE** — hip, thigh, or knee pain with a limp in an adolescent[133] (see the SCFE card).

- **Idiopathic intracranial hypertension** — headache, papilledema, visual change.
- **Cholelithiasis / pancreatitis**, VTE in adolescents, worsening asthma control.

✦ PEARL — WEIGH THE CHOICE, NOT JUST THE CHILD

Document both actual weight and ideal body weight, pick the scalar per drug class, and avoid codeine (and tramadol) — the FDA recommends against their use in adolescents 12–18 with obesity, OSA or severe lung disease because of CYP2D6 ultra-rapid metabolism and respiratory depression.[134]

Pertussis (Whooping Cough)

MINUTES AAP Red Book 2024 · CDC

In the young infant, the danger is apnea and cyanosis — the “whoop” is often absent.

◣ RECOGNIZE

- Paroxysmal coughing fits ± inspiratory whoop or post-tussive vomiting, worse at night, with well

periods in between; often marked lymphocytosis.

- **Infants < 6 months / unimmunized:** may present with **apnea, cyanosis or bradycardia** and little cough — a low threshold to admit and monitor.[99]

⚠ SEVERE / MALIGNANT PERTUSSIS

Extreme leukocytosis (WBC > 50 $\times 10^9$/L), pneumonia, pulmonary hypertension and refractory hypoxemia carry high mortality in young infants — escalate early to critical care; exchange transfusion/leukoreduction is considered in specialist units.[99]

WORKUP

- **Nasopharyngeal PCR** — test of choice in the first 3–4 weeks of cough; culture (< 2 weeks) for confirmation/typing; serology in later/adolescent disease.[99]
- CBC — marked **lymphocytosis**; **extreme leukocytosis** predicts pulmonary hypertension and death in young infants.
- Chest X-ray if respiratory distress.

< 6 months

AZITHROMYCIN

10 mg/kg once daily for 5 days

NOTES

Macrolide of choice — lowest risk of infantile pyloric stenosis[99]

≥ 6 months

AZITHROMYCIN

10 mg/kg (max 500 mg) day 1, then 5 mg/kg (max 250 mg) days 2–5

NOTES

PO

◈ **PUBLIC-HEALTH & CONTACTS**

- Pertussis is **NOTIFIABLE** — inform public health.
- Droplet precautions until 5 days of macrolide.[99]
- Offer **POST-EXPOSURE PROPHYLAXIS** (same macrolide dosing) to close contacts, prioritizing households with infants < 12 months or pregnant women[99,135], and check the family's immunization status.
- Reinforce **MATERNAL TDAP** each pregnancy (27–36 weeks) as the main protection for young infants.[99]

ADMIT · REFER

- **Admit** — any infant < 6 months, apnea/cyanosis, feeding difficulty, pneumonia or extreme leukocytosis.
- **Refer — now** — call critical care for severe pertussis.

05

Complex & Technology-Dependent Care

Technology-dependent & medically complex children — tracheostomy, feeding tubes, ECMO, post-ICU, transport

The Child with Medical Complexity

ASSESS

When a Child with Medical Complexity presents unwell — start from their baseline, and treat the carer as the expert.

WHO — AND WHY THEY DECOMPENSATE FAST

- **Children with Medical Complexity (CMC)** have chronic conditions with **medical fragility**, multiple coexisting problems needing **multidisciplinary care**, and often **medical technology dependence** — a tracheostomy, long-term ventilation, enteral feeding tubes and pumps, a central venous catheter, a ventriculoperitoneal shunt, or an intrathecal baclofen pump. They usually have

polypharmacy, coordinated care needs, and frequent healthcare use.[136]

- They have little reserve, present **atypically**, and the **carer knows the baseline** — when they say "this is not normal for him," believe it and look hard.[137]

THE UNWELL CHILD — A STRUCTURED APPROACH

- **Start from baseline:** their usual saturations, tone, secretions, feeds, alertness, and seizure pattern. **Deviation from baseline is the alarm**, not the absolute number.
- **Read the emergency care plan first** — diagnosis, baseline, devices and sizes, drugs, allergies, and the agreed goals of care.
- **Think the common six:**
- infection
- **device malfunction**
- constipation
- pain / dystonia
- seizures
- medication problem (including **withdrawal**).

- These cause most acute presentations.[137]

TECHNOLOGY PROBLEM — WHERE TO LOOK

Tracheostomy / home ventilator

RED FLAG → ACTION

Desaturation, distress, or alarm → blocked or displaced tube, tracheitis → see Tracheostomy Emergencies. Ventilator alarm → think **DOPES** (displacement, obstruction, pneumothorax, equipment, stomach)[5,138]

Gastrostomy / jejunostomy

RED FLAG → ACTION

Dislodged or blocked tube, leak, or peritonism → see Gastrostomy (Feeding) Tube Problems

a fresh stoma can close within hours

Central venous catheter

RED FLAG → ACTION

Fever = line infection until proven otherwise — paired cultures (line + peripheral) before antibiotics

do not pull a tunneled line lightly.

Occlusion or breakage → specialist

VP shunt

RED FLAG → ACTION

Vomiting, headache, drowsiness, irritability, or a bulging fontanelle = **shunt malfunction / raised ICP until proven otherwise** → urgent imaging + neurosurgery

Baclofen pump

RED FLAG → ACTION

Itch, rigidity, fever, agitation, autonomic instability = acute withdrawal (can be life-threatening) → urgent specialist bridge with benzodiazepines ± oral baclofen

⚠ POLYPHARMACY & DO-NOT-STOP DRUGS

- Do **not** abruptly stop chronic medications — **most should be continued** — including anticonvulsants, baclofen, and long-term steroids, or long-term oxygen / ventilation.[137]
- If on long-term steroids and acutely unwell, give **stress-dose steroids** (see Adrenal Crisis).
- Reconcile every drug, check interactions, and bring the child's own equipment and ventilator settings with them.

◈ **PLAN BEFORE THE CRISIS** Agree and document the **BASELINE, THE EMERGENCY CARE PLAN, AND THE GOALS OF CARE** with the family and the medical home in advance — and make sure it travels with the child.[137]

Tracheostomy Emergencies MINUTES

The deteriorating child with a tracheostomy — oxygenate both ways, then work the algorithm: patent, obstructed, or displaced?

🖨 PRINTABLE TRACHEOSTOMY TOOLS

- **WARD CARDS** — elective tube change (2 sides), bedside emergency box, the 5 R's of routine care · **PRINT ON A5**

  Open / print ward cards (A5 PDF)

  kpc-guide.com/print/KPC-Tracheostomy-Ward-Cards-A5.pdf
- **BEDHEAD SIGNS** — tracheostomy (upper airway patent) and neck breather (laryngectomy) · **PRINT ON A4**

  Open / print bedhead signs (A4 PDF)

  kpc-guide.com/print/KPC-Tracheostomy-Bedhead-Signs-A4.pdf

◢ FIRST MOVES — CALL FOR HELP, OXYGENATE BOTH WAYS

- **Call for help.** Apply **high-flow oxygen to both the stoma and the face** as soon as it is available — use **two sources if you have them**; with a **single oxygen source, apply it to**

the airway the child is breathing through (face or stoma)[139]. Attach **pulse oximetry ± waveform capnography** (exhaled CO_2 = a patent or partly patent airway).[139] Bring the **tracheostomy emergency kit**: same-size and one-size-smaller tubes, a suction machine + catheters, water-based lubricant, a cuff syringe, and a bag-valve-mask.[139,140,141,142] Use the **bedside emergency card** (tube type and size, cuff status, **suction depth**); suction with a **premarked catheter to the pre-determined depth** on the card[139] — just past the tube tip, no deeper.[140] Routine **humidification** (HME / "Swedish nose") helps prevent the thickened secretions and mucus plugs that obstruct the tube.[140,142]

- **Rapid airway assessment:** look, listen, and feel at **BOTH the mouth and the stoma** — assess **chest rise, breath sounds (air entry), airflow, and exhaled CO_2** (if available).[139]

DECISION

① Is the tracheostomy tube in place?

NO

Accidental decannulation. If **trained, reinsert the tracheostomy tube**. If not trained or reinsertion fails, **ventilate via whichever route achieves chest rise** (upper airway or stoma). Continue ventilation and await expert airway support.[139]

YES

Tube is in place — proceed to the steps below.

② REMOVE WHAT MAY BE CAUSING THE PROBLEM

- Remove any **speaking valve or cap**, remove the **inner cannula** (if present), and **check the ventilator / circuit** (if ventilated) — this alone may relieve the obstruction.[139]
- (Some inner cannulas must be reinserted to connect a breathing circuit.)[139]

DECISION

③ Can you pass a suction catheter?

PASSES

Tube is **patent** — suction to clear secretions (a partially obstructed tube may still need replacing — if suction does not clear it, **change the tube**; do not persist)[139]. Ventilate via the tracheostomy if not breathing. Continue ABCDE.[139]

WON'T PASS

Tube is **obstructed or displaced**. **Deflate the cuff** (if present — adult NTSP algorithm step; most pediatric tubes are uncuffed) — if this improves things, air is moving around the tube[143] → **remove the tracheostomy tube**.[139]

after tube removal / still not ventilating

④ VENTILATE — VIA WHICHEVER ROUTE ACHIEVES CHEST RISE

- **Upper airway** (if patent): cover the stoma (gauze / finger) and bag-mask via the mouth/nose (± oral or nasal airway), or an LMA.[139]
- **Stoma** (if the upper airway is not patent or oral/nasal ventilation is ineffective — e.g., laryngectomy, subglottic stenosis): ventilate over the stoma with an appropriately sized pediatric face-mask, or an LMA.[139]

at once if trained — otherwise when trained help arrives

⑤ RE-ESTABLISH THE AIRWAY

- **Emergency tube change — maximum 3 attempts:** (1) the **same-size tube** on its obturator; (2) a tube **half a size (0.5 mm ID) smaller**, with shoulder roll/neck extension and stay sutures lifted if present; (3) a half-size smaller tube passed over a **soft suction catheter** as a guide. After each attempt confirm patency (suction catheter passes to the marked depth, capnography); **remove any replacement tube that is not patent — do not ventilate through it**. After three failed attempts **do not force — stop**: oxygenate/ventilate via the upper airway (stoma occluded) or over the stoma and await expert airway support; rescue intubation — **oral** (uncut ETT half a size smaller than the tracheostomy tube, advanced **beyond the stoma**) or via the stoma (tube half a size smaller)[139,140,141]
- Confirm with **capnography**. A **shoulder roll** (pillow or rolled towel under the shoulders) may improve airway patency and access to the stoma.[139]

DOPES – CAUSES OF DETERIORATION

- **D — Displacement** (accidental decannulation)[5,138]
- **O — Obstruction** (mucus plug, blood, granulation tissue)[5,138]
- **P — Pneumothorax**[5,138]
- **E — Equipment failure** (ventilator / circuit, speaking valve, cap, inner cannula, oxygen failure)[5,138,139]
- **S — Stomach** (distended stomach / abdominal compartment)[5,138]

KEEP THE OBTURATOR AT THE BEDSIDE

- Keep the tracheostomy **obturator at the bedside at all times**.[139,141]
- In an emergency it may be needed to **reinsert the child's existing tube** when a new tube is unavailable or there is no time to open one — a dedicated obturator **eases insertion, reduces trauma and protects the stoma**.[139]

NO UPPER AIRWAY? (LARYNGECTOMY / FIXED OBSTRUCTION)

- If the child **cannot be ventilated or intubated from above** (fixed

upper-airway obstruction such as severe subglottic stenosis or bilateral vocal-cord palsy; laryngectomy is rare in children), the **stoma is the only airway** — do not waste time on face-mask ventilation; oxygenate via the stoma (face mask or laryngeal mask over it) and re-cannulate, or intubate the stoma with a tube one half-size smaller than the tracheostomy tube.[139]

- Know this from the care plan **before** the emergency.[139,140]

⚠ BLEEDING – EXCLUDE TRACHEO-INNOMINATE FISTULA (TIF)

- **Massive bleeding — or a brief "sentinel" bleed — 3 days to 6 weeks after tracheostomy is TIF until proven otherwise** (adult-derived window)[139,144]; in children TIF also occurs late in long-term tracheostomies, and most reported pediatric cases had neurological comorbidity[145].
- This is an airway/ENT/surgical emergency — call expert help (ENT, surgery, anesthesia/ICU) immediately.[139]

- As an expert-performed bridge while help arrives: **overinflate the cuff** to tamponade (controls bleeding in > 80% in adult series); if it fails, **orally intubate past the stoma** (ETT cuff distal to the bleed) and apply the **Utley maneuver** — a finger through the stoma compressing the artery against the back of the sternum — then **activate massive transfusion, call ENT + surgery, and go to OR**.[139,144]
- Any tracheostomy bleeding needs ENT review before discharge.[140]

TRACHEITIS

- Increasingly **purulent / copious secretions, fever, plugging, rising work of breathing** — can obstruct.[140] Send a **tracheal aspirate** to guide antibiotics[146]; empiric cover usually includes *S. aureus* (including MRSA) and *Pseudomonas*, the organisms most often reported, guided by prior cultures and the local antibiogram[147]; step up humidification and suction.[140]

⚠ WHEN NOT TO CHANGE THE TUBE YOURSELF – CALL ENT / THE TRACHEOSTOMY TEAM

As a general pediatrician, **do not attempt an elective tube change** when: it is the **first change** (the surgical / ENT team performs or directly supervises the first change, usually at **day 3–7** post-formation, to confirm a patent tract)[148]; the stoma is **fresh / immature (< 7 days**, especially percutaneous) — high risk of a **false passage** or an unrecoverable airway[139,148]; you are **not trained in that specific tube**, or the correct-size tubes and suction are not at hand[139,141]; the child is **unstable, on high ventilator / oxygen support, or has a known difficult airway** — change only where **ENT / anesthesia and airway rescue are immediately available**[139]; or there is **active bleeding or suspected tracheo-innominate fistula** (an emergency, not a routine change)[139]; the tracheostomy was placed for **critical upper airway obstruction** — the upper airway is **not a reliable rescue route**, so a lost or displaced tube can mean a **lost airway** (treat the stoma as the only airway and change only with ENT / anesthesia and airway rescue at the bedside)[139,140]; or the child has had **major airway / tracheal reconstruction** (laryngotracheal reconstruction, slide

tracheoplasty, tracheal resection & anastomosis) — the tube may cross or protect a **fresh repair**, so changes are done by the **surgical team only** (risk of disrupting the anastomosis or a false passage; expert consensus). Otherwise **keep the current tube, oxygenate, and get expert help**.[139]

ELECTIVE TUBE CHANGE (ROUTINE)

- Two people.[140]
- Supine with a **shoulder roll, neck extended**; suction.[140]
- Load the obturator, lubricate, deflate the cuff.[140,142]
- Remove the old tube along its curve; insert the new one on the **obturator** in a downward, inward arc — **never force**. **Remove the obturator immediately**, insert the inner cannula, inflate the cuff, and confirm (chest rise, breath sounds, capnography, suction catheter passes)[139,140,142]
- Secure ties to a one-finger gap.[140]

⚠ CALL ENT / ANESTHESIA EARLY

- Any bleeding · suspected TIF (emergency) · failed or difficult reinsertion · obstructing granulation · **accidental**

decannulation with a fresh stoma (< 7 days) — lift the stay sutures 'up and out' to aid reinsertion; if it fails, intubate orally.[139,140]

- An established stoma can still narrow within hours of decannulation[140], so if the tube has been out for several hours and the child is stable, call ENT before repeated attempts (dilation may be needed) — expert consensus, not guideline-stated.

ADMIT · DISCHARGE · REFER

- **Admit** — any airway compromise → ED/PICU.[139]
- **Home** — after the tube is secure and patent and the caregiver is confident.[141,146]
- **Refer — now** — ENT and the home-ventilation/tracheostomy team.[139,146]

◎ LEARN MORE — OPEN-ACCESS PEDIATRIC RESOURCES (no login required)

- **CINCINNATI CHILDREN'S — TRACHEOTOMY CARE** — caregiver handbook (Arabic available) plus short videos

including an **EMERGENCY TUBE CHANGE**: cincinnatichildrens.org

- **ABOUTKIDSHEALTH (SICKKIDS) – TRACHEOSTOMY & VENTILATION** — home care, suctioning and **EMERGENCY MANAGEMENT**: aboutkidshealth.ca/trachvent

Tracheostomy Tubes & Cuff Types

REFERENCE

Know the exact tube before you change or ventilate — same stated size from different manufacturers is not interchangeable.

TUBE — WHAT IT IS AND WHEN

PVC tube

MATERIAL & FEATURES

PVC, firm, thermosensitive, radiopaque line
neonatal / pediatric / pediatric-long
cuffed (soft air cuff) or uncuffed.
Pediatric sizes are single-lumen (no inner cannula).[139]

NOTES

Single-patient, disposable. Sized by **inner diameter (ID, mm)**.[139]

Silicone tube

MATERIAL & FEATURES

Silicone, soft and flexible, reusable
cuff options tight-to-shaft (TTS), air, or foam
extended-proximal and adjustable-length (wire-reinforced) variants exist.

NOTES

Bivona silicone tubes, including wire-reinforced variants, are labeled **MR-conditional** (≤ 3 T) — check the specific tube's labeling before MRI. Sized by ID.[142]

CUFF TYPES — INFLATE WITH WHAT, WATCH WHAT

Uncuffed

INFLATE WITH

–

USE / CAUTION

Most children; airflow around the tube (speech), least mucosal injury.

Air cuff

INFLATE WITH

Air

USE / CAUTION

Positive-pressure ventilation or aspiration protection; keep **cuff pressure < 20–25 cmH_2O** (minimal-leak) — over-inflation causes mucosal ischemia.[148]

Tight-to-shaft (TTS)

INFLATE WITH

Sterile water (never air)

USE / CAUTION

Deflated, it sits flush like an uncuffed tube (speech / airflow); inflate only when needed. Air diffuses out of silicone[148] — **use water**.

Foam cuff

INFLATE WITH

Self-inflating (pilot open to air)

USE / CAUTION

For a difficult seal or tracheomalacia; actively **deflate and cap the pilot** to insert / remove, then release to self-inflate.

⚠ **CUFF SAFETY**

- Never use a **speaking valve or cap with the cuff inflated** — no route to exhale (can be fatal)[148]; deflate cuff first.
- Deflate cuff whenever a seal is not needed, to protect mucosa and allow speech.

◢ **BEFORE ANY TUBE CHANGE**

- Same-size tubes from **different manufacturers differ in outer diameter and length — not interchangeable**; if you must substitute in an emergency, be ready to **downsize**.[139]
- Keep a **same-size and one-size-smaller** spare at the bedside; know the exact tube from the **bedside emergency card**.
- After insertion, confirm airway — chest rise, **capnography**, suction catheter passes.

◎ **LEARN MORE — OPEN-ACCESS PEDIATRIC RESOURCES** (no login required)

- **CINCINNATI CHILDREN'S — TRACHEOTOMY CARE** — caregiver handbook (Arabic

available) plus short videos including an **EMERGENCY TUBE CHANGE**: cincinnatichildrens.org

- **ABOUTKIDSHEALTH (SICKKIDS) – TRACHEOSTOMY & VENTILATION** — home care, suctioning and **EMERGENCY MANAGEMENT**: aboutkidshealth.ca/trachvent

Gastrostomy (Feeding) Tube Problems

HOURS

A dislodged tube is time-critical — the stoma can close within hours. Tract age decides who replaces it.

◣ DISLODGED TUBE – THE CLOCK IS THE STOMA

- Empty tract narrows within hours — per **ESPGHAN the fistula can close spontaneously within 6 h**; if no replacement is at hand, the same tube or a Foley catheter can be inserted gently and taped to keep it

open.[149] By **24 h** it is usually lost (expert consensus). Keep it open **now**, then replace.

- **Tract age decides the route** — ask when the tube was first placed.

DECISION

How old is the stoma tract?

IMMATURE < 6 WEEKS

High risk of a **false tract / intraperitoneal placement → do NOT insert a tube into the stoma**. Cover stoma with gauze, keep nil-by-stoma, get to **hospital** for guided replacement by **pediatric surgery / gastroenterology / interventional radiology**.[149]

MATURE ≥ 6 WEEKS

Epithelialized tract → bedside replacement usually safe. Replace **promptly** with a **same-size balloon tube**; lubricate, advance gently, inflate the balloon with water. **Caveat:** ESPGHAN notes centres wait at least 6 weeks before the first change; maturation may be delayed with immunosuppression, corticosteroids, obesity or diabetes (and, by extension, malnutrition or chemotherapy) — if unsure, **treat as immature**.[149]

IF THE SAME SIZE WILL NOT PASS

- Place the largest **Foley catheter** that passes atraumatically to hold the stoma open, then **serially dilate in 2-Fr steps** to the target size.[150]
- **Do not inflate a Foley balloon inside the tract to dilate** (expert consensus — not guideline-stated).
- If > 24 h out, or any resistance / false-passage concern → stop and refer.

◈ **CONFIRM BEFORE FEEDING**

- Verify intragastric position before use: **ASPIRATE GASTRIC CONTENTS**[150] (**PH ≤ 5.5** — the nasogastric-tube

threshold, applied by extension[151]) — **BEWARE A FALSE PH ON PROTON-PUMP INHIBITORS** (expert consensus).

- After any **DIFFICULT OR UNCERTAIN** replacement, confirm with a **WATER-SOLUBLE CONTRAST STUDY** before first use (expert consensus — not stated in the ESPGHAN paper). **NEVER USE AIR INSUFFLATION** to confirm.
- Document tube type, French size, and balloon volume.

BLOCKED TUBE & STOMA ISSUES

- **Blocked:** flush gently with **warm water**; do not force. Hold feeds until patency is confirmed.
- **Buried bumper:** suspect if the tube **will not rotate or advance freely**, or pain, leakage, or resistance on feeding — prevented by avoiding traction and rotating + advancing the tube regularly. Buried bumper or **suspected peritonitis** (pain, feed intolerance, fever, rigidity) → stop feeds, urgent **surgical review**.[149]
- **Granulation, leak, redness, excoriation:** see **Enteral Feeding Tubes — Types & Complications**.

⚠ ADMIT / ESCALATE

- **Admit** — peritonitis or systemic infection; **buried bumper syndrome**; uncertain or **difficult placement**; concern of a **false passage**; any immature-tract dislodgement; **tube out > 24 h**.
- **Refer — now** — surgery / gastroenterology.

◣ ADMIT · DISCHARGE · REFER

- **Admit** — peritonitis, a dislodged tube with a lost tract, or inability to replace it.
- **Home** — a replaced, patent tube with feeds tolerated.
- **Refer — now** — surgery/gastroenterology for tract problems or any immature-tract dislodgement (< 6 weeks, or longer if healing is impaired).

◎ LEARN MORE — OPEN-ACCESS PEDIATRIC RESOURCES (no login required)

- **CINCINNATI CHILDREN'S — G-TUBE HOME CARE** — caregiver handbook +

procedure videos (Arabic available): cincinnatichildrens.org

- **TOGETHER BY ST. JUDE — TYPES OF TUBES & DEVICES** — illustrated visual guide to NG / ND / NJ and G / GJ / J tubes and low-profile buttons: together.stjude.org

Enteral Feeding Tubes — Types, Delivery & Complications

REFERENCE

Know the route before you feed or give a drug — the stomach tolerates boluses, the jejunum does not.

TUBE TYPES — ROUTE, HOW TO FEED, AND WHAT NOT TO GIVE

NGT / OGT

ROUTE & HOW TO FEED

Stomach short-term bolus or continuous. Nasogastric vs orogastric route is a unit / clinical choice — evidence favors neither (in preterm infants).[152] **Choose by expected duration, gag strength, and respiratory status:** prefer **OGT** when nasal airflow matters (preterm, CPAP, respiratory distress) or the gag is weak **NGT** is more secure for a stronger gag or longer use (preterm rationale: nasal tubes may compromise respiration, oral tubes displace more easily[152]; otherwise expert consensus). **Confirm gastric aspirate pH ≤ 5.5 before each use (x-ray if in doubt; local policy: confirm by x-ray).**[151]

DO NOT

Never feed with position unconfirmed. Use **OGT** (not NGT) in suspected base-of-skull injury.

NJT

ROUTE & HOW TO FEED

Nose → jejunum (post-pyloric) for gastroparesis or high aspiration risk. Continuous feeds only.

DO NOT

No bolus (dumping). pH is unreliable — confirm position by imaging (expert consensus — not guideline-stated).

Gastrostomy (PEG / high-profile / button)

ROUTE & HOW TO FEED

Abdominal wall → stomach; long-term. Bolus or continuous.

DO NOT

Force or over-rotate a PEG bumper (buried bumper). A low-profile button needs an **extension set** to feed.

Gastrojejunostomy (GJ)

ROUTE & HOW TO FEED

Through the gastric stoma, tip in jejunum gastric + jejunal ports. Jejunal port = continuous only
gastric port = venting / medicines.

DO NOT

Blind replacement — needs fluoroscopy. No bolus down the jejunal port.

Jejunostomy (J)

ROUTE & HOW TO FEED

Abdominal wall → jejunum. Continuous feeds only, small volumes.

DO NOT

Bolus feed. Attempt a bedside change — refer (surgical tract).

⚠ MEDICINES THROUGH A FEEDING TUBE

- Use **liquid formulations** where possible; **never crush enteric-coated or modified / sustained-release** tablets (blocks the tube, alters the drug).[153]
- Give each drug **separately** and **flush with water** before, between, and after. **The route matters:** down a **jejunal (post-pyloric)** tube avoid hypertonic or large-volume drugs (dumping, perforation), and **some medications cannot be given jejunally at all** — check with pharmacy.
- Some **parenteral (injectable) preparations** can be given enterally when no oral liquid exists (e.g., **clonidine, glycopyrrolate**) — confirm suitability and dose with pharmacy first.

◢ DIFFERENTIATE THE TUBE AT THE BEDSIDE

- **Where it enters** — nose / mouth (NGT/OGT) vs the abdomen (gastrostomy / GJ / J).
- **Profile** — an external bumper with a **balloon port** (water valve) = balloon gastrostomy; **flush to the skin**

needing an extension = low-profile **button**; a firm internal flange that resists gentle traction = **PEG**.

- **Ports — two labeled ports (GASTRIC + JEJUNAL)** = GJ; a single feed port plus a balloon port = gastrostomy.
- Read the **French size, length, and brand** off the tube and the care plan. Unsure of the route? Confirm with **contrast** — do not feed to find out.

MANAGE THE COMMON STOMA COMPLICATIONS

Granulation (granuloma)

WHAT & WHY

Red, moist, friable overgrowth from friction and moisture.

MANAGEMENT

Stop the movement (secure the tube, correct balloon volume); **saline soaks**; topical **silver nitrate** (protect surrounding skin with a barrier) or a short **topical steroid**; silver / foam / hydrocolloid dressing.[149]

Leak

WHAT & WHY

Gastric contents track around the tube.

MANAGEMENT

Do not just upsize the tube (enlarges the stoma). Correct balloon volume; treat **constipation, retching, delayed emptying** (vent, prokinetic, slow the feed); treat granulation / infection; barrier cream. Consider buried bumper.[149]

Redness

WHAT & WHY

`Irritation vs infection.`

MANAGEMENT

< 5 mm erythema is usually irritation — barrier protection. **Spreading redness, pain, swelling, or pus = infection** → swab, then topical or systemic antibiotics (cover skin flora).

Excoriation

WHAT & WHY

`Enzymatic burn from leaked feed and acid.`

MANAGEMENT

Stop the leak at source; **barrier products** (zinc or dimethicone cream, pectin barrier ring / powder); keep dry; involve the stoma nurse.

◈ **GOLDEN RULES**

- Confirm route before feeding or giving a drug; **GASTRIC TOLERATES BOLUSES, JEJUNAL IS CONTINUOUS ONLY**; flush to keep patent.
- A fresh gastrostomy stoma can close within hours if the tube falls out — see **Gastrostomy (Feeding) Tube Problems**.

◎ **LEARN MORE — OPEN-ACCESS PEDIATRIC RESOURCES** (no login required)

- **TOGETHER BY ST. JUDE — TYPES OF TUBES & DEVICES** — illustrated visual guide

to NG / ND / NJ and G / GJ / J tubes and low-profile buttons:

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cincinnatichildrens.org

ECMO — What the General Pediatrician Needs to Know

ASSESS | KNOW WHEN TO CALL · ELSO

Temporary heart–lung support for severe but **reversible** failure — your job is to recognize the candidate and call **early**.

WHAT IT IS

- Temporary machine support that **oxygenates the blood and removes CO_2** (± supports the circulation) to buy time for **potentially reversible** heart or lung failure. It is a **bridge** — to recovery, a decision, or transplant — **not a cure**, and is run only in a specialized PICU / ECMO center.[154,155]

- **VV (veno-venous)** = **lung support** (the heart still works); **VA (veno-arterial)** = **heart ± lung support**, and covers **ECPR** (ECMO during a refractory but reversible cardiac arrest).[154,156]

⚠ WHEN TO THINK ECMO — CALL EARLY

Severe **cardiac or respiratory failure not responding to maximal conventional therapy**, in a child with a **reversible cause** (e.g., fulminant myocarditis, ARDS / severe pneumonia, PPHN; neonatal MAS or CDH). **Call the PICU / ECMO center early** — before catastrophic deterioration or irreversible brain injury; timely referral improves outcomes, so do not wait for arrest. **The center decides candidacy, thresholds, and timing.**[154,155,156,157]

⚠ USUALLY NOT A CANDIDATE

- An **irreversible** condition with no exit strategy · **severe irreversible brain injury** · a **lethal chromosomal / congenital anomaly** (e.g., trisomy 13 or 18 — not 21) · **uncontrolled bleeding.**[154,155,157]

- Extreme prematurity, very low birth weight, and many days of prior ventilation lower the chance of benefit.[154,155,157]
- The final decision rests with the ECMO team.[156]

✦ YOUR ROLE — BEFORE AND AFTER

- You are **not** expected to run ECMO — you **recognize the failing-yet-reversible child and escalate**.[154,155]
- Resuscitate and support maximally, **protect the brain and other organs**, avoid irreversible injury, and **call the PICU / ECMO center early**.[154,155]
- Afterwards, **survivors need long-term multidisciplinary follow-up**: about **1 in 4** neonatal survivors has neuropsychological deficits (more after cardiac ECMO) and new problems can appear later — track development and arrange **hearing tests** (sensorineural loss can be progressive / late).[158]
- Support the family through a **high-risk, uncertain course** (major complications include

bleeding, clots, and stroke).[154,155,158]

ADMIT · DISCHARGE · REFER

- **Admit** — refractory cardiac or respiratory failure with a reversible cause → **PICU / ECMO center now**.[154,155]
- **Refer — now** — discuss early — call **before** the child is in extremis; deterioration is often rapid.[155]

Post-PICU Syndrome (PICS-p)

ASSESS · AFTER CRITICAL ILLNESS

Surviving the PICU is only the start — new physical, cognitive, emotional, and social problems can follow the child and family for years.

WHAT IT IS

- **Post-Intensive Care Syndrome — pediatric (PICS-p)**: new or worsening impairment across **four domains** after critical illness — **physical, cognitive, emotional, and social** — affecting the **child and the**

family. It emerges over the months after discharge and can persist for years.[159,160,161]

- You, the general pediatrician, are the one who **sees these children back** — so you screen for it, coordinate care, and reassure.[160,161,162]

THE FOUR DOMAINS — WHAT TO LOOK FOR

Physical

WATCH FOR

ICU-acquired weakness, fatigue, pain, poor feeding / growth, reduced exercise tolerance, poor sleep
residual respiratory or organ problems.[160,162]

Cognitive

WATCH FOR

Attention, memory, and executive difficulties
developmental regression in the young
declining school performance.[160,162]

Emotional

WATCH FOR

PTSD, anxiety, depression, nightmares / delusional memories, fear, irritability or aggression, behavioral change.[160,162,163]

Social

WATCH FOR

Trouble reintegrating at school, absenteeism, withdrawal from peers and activities, identity and participation problems.[160,162]

HIGHER RISK AFTER...

- **Longer PICU stay, mechanical ventilation, sedation and delirium**, renal replacement, **ECMO**, cardiac arrest, sepsis, ARDS, or major trauma; oncology / neurology diagnoses; an **unscheduled admission**; younger age and pre-existing conditions.[160,164]

⚠ DON'T FORGET THE FAMILY (PICS-F)

- Parents and siblings are affected too: screened before PICU discharge, **~60% of parents were at risk of PTSD and ~75% of depression** (single-center study)[165], alongside anxiety, financial strain, and impaired family functioning.[159,160,162]
- Ask how the **family** is coping, and support them.[160,162]

✦ YOUR ROLE

- At the first post-discharge visits and beyond: **screen every domain** (development, school, mood / sleep, physical function) and the family's wellbeing; **coordinate multidisciplinary follow-up** — physiotherapy / occupational therapy / speech-language therapy, psychology, neurodevelopmental assessment, and **school liaison**; reconcile medications; and treat the family as part of the patient.[160,162]
- Normalize and follow up rather than dismiss — recovery is a trajectory, not an event.[159,162,166]

◣ ADMIT · DISCHARGE · REFER

- **Screen** — every child at follow-up after a significant PICU admission.[160,162]
- **Refer — now** — escalate new severe mental-health symptoms (e.g., self-harm risk) or acute physical deterioration.[160,162]
- **Refer — clinic** — neurodevelopment / rehabilitation, psychology / psychiatry, and the relevant specialty

for persistent domain-specific problems; social work for family support.[160,162]

Aeromedical Transport — Neonatal & Pediatric

ASSESS

PRE-FLIGHT ASSESSMENT · MOH A-ADM-014

Match the transport tier to clinical risk — two predictable cabin stresses (hypoxia, gas expansion) drive the pre-flight assessment.

TWO CABIN STRESSES — ASSESS BEFORE EVERY FLIGHT

- **Hypobaric hypoxia** — cabins are pressurized to a maximum **8,000 ft** equivalent (≈ breathing **15% oxygen** at sea level); a healthy PaO_2 falls to ~**60–75 mmHg** (8–10 kPa; SpO_2 ~89–94%). Limited cardiopulmonary reserve desaturates further. **Resting SpO_2 alone is insensitive. If available**, a **HAST (hypoxia-altitude simulation test)** best predicts in-flight oxygen need in a child with chronic lung or cardiac disease.[167] **If HAST is not available**, use the

practical **alternative**: base the decision on **resting oximetry, the diagnosis and trajectory, and any prior flight tolerance**, and — when in doubt — **give empiric in-flight oxygen** (double an existing flow) or choose a **sea-level cabin / air ambulance** for higher-risk children.[167,168,169,170]

- **Trapped-gas expansion** — gas in a closed space expands ~**38%** from sea level to 8,000 ft. Pneumothorax, recent surgery with retained gas, and intracranial or intraocular gas need a **sea-level cabin (air ambulance)** when the gas cannot be excluded. A **current pneumothorax requires a chest drain before any urgent flight**[167] **— even if it is minimal.**

⚠ NEONATAL & INFANT AIR TRANSPORT — STABILITY, NOT AGE, GOVERNS

- **Term neonate (> 37 weeks):** defer non-urgent flying for the **first 7 days** after birth to confirm feeding, thermoregulation, and no undiagnosed cardiorespiratory problem or silent pneumothorax.[167,169]

- **Preterm (< 37 weeks) not yet at the expected date of delivery:** avoid non-essential flying; if travel is essential, **in-flight oxygen must be available** (low flow, e.g. 1 L/min; a hypoxic challenge test is not reliable at this age). **Infants < 1 year with chronic respiratory problems:** discuss with a respiratory pediatrician and consider HAST — SpO_2 < 85% on HAST = in-flight oxygen; 85–90% = pediatrician discretion.[169]
- **Preterm without chronic lung disease:** the "~3 months corrected age" figure is a **soft guide, not a fixed cutoff** — fitness depends on **gestational maturity + demonstrated cardiorespiratory stability + being apnea-free**, judged individually. Avoid flying during a respiratory infection until ~6 months corrected age (apnea risk). Former preterms with **BPD / neonatal chronic lung disease**: discuss with a respiratory pediatrician and, where available, a **HAST** before flying — advised if oxygen was needed within the last 6 months; sea-level SpO_2 does not predict in-flight desaturation, and SpO_2 < 85% on the test means in-flight oxygen at 1–2 L/min.

Preterm infants who have not yet reached their due date do not need the test (unreliable) but should have in-flight oxygen available.[167,168,169]

- **An incubator is not mandatory for a stable infant** — a physiologically stable infant may travel in an aircraft **bassinet / in-arms**. A **transport incubator** is needed for thermal instability, continuous monitoring, controlled oxygen/humidity, or mechanical ventilation.[168,169,170]
- **Respiratory support changes the route, not by age:** a ventilated or monitoring-dependent infant goes by **dedicated air ambulance** (incubator/transport platform, continuous SpO_2 + ECG, capnography if ventilated, altitude-appropriate settings, sea-level-cabin option). A **stable, monitored, ventilated infant can still be flown** for urgent surgery with a specialist team.[167,168,170]
- **Tier by stability:** stable, self-ventilating, thermally stable → **bassinet/in-arms commercial** (after the term deferral / individualized preterm assessment); oxygen-dependent

or apnea-risk → **commercial + medical clearance + in-flight O_2** (roughly double the flow at cruise); unstable/ventilated/monitoring-dependen → **dedicated air ambulance**.[168,169,170]

IN-FLIGHT OXYGEN — INFANTS & YOUNG CHILDREN

Already on oxygen

ACTION

Double the flow rate in flight as a starting point; confirm it is deliverable in the cabin.[167,168,169]

Needs > 4 L/min at baseline

ACTION

Commercial flight **not advised** → escalate to **air ambulance**.[167,168]

◎ OXYGEN LOGISTICS

- Carriers supply oxygen at fixed flows (often 2–4 L/min, set rates or none).[169,171]
- A need for precise or higher flow, or a corrected requirement > ~4 L/min, cannot be reliably managed on a scheduled flight.[168,169]
- Carry an airline-approved **PORTABLE OXYGEN CONCENTRATOR (POC)** with battery for ≥ 150% of journey time; the US prohibits passenger oxygen

cylinders (use a POC or carrier oxygen).[167,169,171]

TRANSPORT TIER — ASSIGN THE LOWEST TIER THAT SAFELY COVERS THE WHOLE JOURNEY

0

MODE & ESCORT
Commercial seat, no escort

TYPICAL PEDIATRIC PATIENT
Stable, self-caring; PEWS low.[170]

1

MODE & ESCORT
Commercial seat + non-medical attendant

TYPICAL PEDIATRIC PATIENT
Minor / vulnerable; needs help with mobility, not clinical care.[170]

2

MODE & ESCORT
Commercial seat + a competent trained caregiver
a nurse/RT is required only if oxygen- or ventilation-dependent, or other risk is expected

TYPICAL PEDIATRIC PATIENT
Stable **tracheostomy on room air** (with a trained caregiver competent in the device), stable oxygen, or pump feeding.[170]

3

MODE & ESCORT

Commercial seat or stretcher + physician + nurse (add RT for home-vent)

TYPICAL PEDIATRIC PATIENT

Stable established home ventilation, or a fragile child with deterioration potential.[170]

4

MODE & ESCORT

Dedicated air ambulance + critical-care team

TYPICAL PEDIATRIC PATIENT

Critically ill or unstable (meets air-ambulance criteria below).[170]

◎ SCORING & PERSONNEL (PER POLICY)

- The policy stratifies patients by **LEVEL OF CARE 0–4** and a **NEWS-BASED RISK LEVEL** (Low = 1–4 · Medium = 5–6 · High = ≥ 7, as printed in the policy; a score of 0 is also low risk).[170] In children, substitute an age-appropriate **PEWS** (NEWS2 is not for use under 16 yr).[172]
- If findings fall between tiers, choose the **HIGHER TIER**. A low score with **HIGH DETERIORATION POTENTIAL** (end-stage lung disease, potential airway/hemodynamic compromise) is classified up by the accompanying physician.[170]

- **AT LEAST TWO COMPETENT PERSONNEL** escort any patient; for a child, include a **PARENT/LEGAL GUARDIAN** where possible.[170]

◎ LOCAL AVAILABILITY (KUWAIT) A **DEDICATED PEDIATRIC / NEONATAL AEROMEDICAL TRANSPORT TEAM IS NOT YET ESTABLISHED** — transfers are currently staffed by the **ACCOMPANYING PEDIATRIC / TREATING TEAM**. Confirm current MOH capability early and coordinate through the A-ADM-014 pathway (Directorate of Treatment Abroad).[170]

⚠ DEDICATED AIR AMBULANCE (SEA-LEVEL CABIN) — WHEN COMMERCIAL CARRIAGE WILL NOT DO

Any one absolute criterion mandates it: **acute / unstable ventilation** or a credible need to intubate or escalate in transit; **hemodynamic instability** needing vasoactive / inotropic infusion; a **trapped-gas condition** needing sea-level cabin (unresolved pneumothorax, recent intracranial / intraocular gas, significant bowel obstruction); need for **invasive monitoring or mechanical support** (arterial-line titration, ICP monitoring, IABP, **ECMO**, VAD, external pacing); **refractory hypoxemia** or oxygen need beyond carrier capability; **status epilepticus** / uncontrolled seizures; or a

communicable disease needing **isolation**. Under the policy, **Medevac (air ambulance)** also applies to **priority 1–2 cases**, expedited transfer of an unstable patient, brain-death repatriation, or when the commercial route/port is not cleared. **Absolute contraindications to flight until treated:** untreated pneumothorax, hemothorax or a compromising effusion, cardiac tamponade, recent abdominal surgery / immediate post-op, or a penetrated eye injury.[170]

✦ AIRWAY & CUFFS AT ALTITUDE

- The cabin is a poor place to rescue a failing airway — **secure a difficult or unstable airway definitively before departure**, not aloft; do not defer a foreseeable intubation to the aircraft.[170,173]
- Air in an endotracheal / tracheostomy **cuff** expands as cabin pressure falls — cuff pressure rises on ascent and falls (with a leak) on descent; **measure cuff pressure with a manometer and adjust the cuff volume as needed** during ascent and descent, or consider filling the cuff with saline/water.[173]

- Confirm the ventilator and oxygen are airline-approved with battery for ≥ 150% of journey time.[168,169]

TEAM, CLEARANCE & HANDOVER

- **Escort competence:** current **pediatric / neonatal resuscitation** (PALS / NRP) and competence with the child's devices; the accompanying physician is the **MRP** en route.[170]
- **Clearance:** pre-flight medical report + **risk assessment** reviewed and approved by the **MRP** (senior registrar or above) **7–14 days and again 48–72 h** before departure; airline **MEDIF** for commercial carriage. A **return/repatriation reassessment is mandatory** before flying home.[170]
- **Handover:** document status before, during and on arrival, and give a structured handover to the receiving team using the policy's **handover tools**.[170]

ADMIT · DISCHARGE · REFER

- **Escalate** — any air-ambulance criterion, or a deteriorating trajectory → critical-care transport team + treatment-abroad / transport committee.[170]
- **Proceed commercial** — stable child at Tier 0–3 with a completed pre-flight clinical assessment (HAST where available) and confirmed oxygen/device support.[168,169,170]
- **Refer — now** — the MOH Directorate of Treatment Abroad (DTA) decides transport type; involve the relevant clinical council for team and equipment.[170]

06 Endocrine & Metabolic

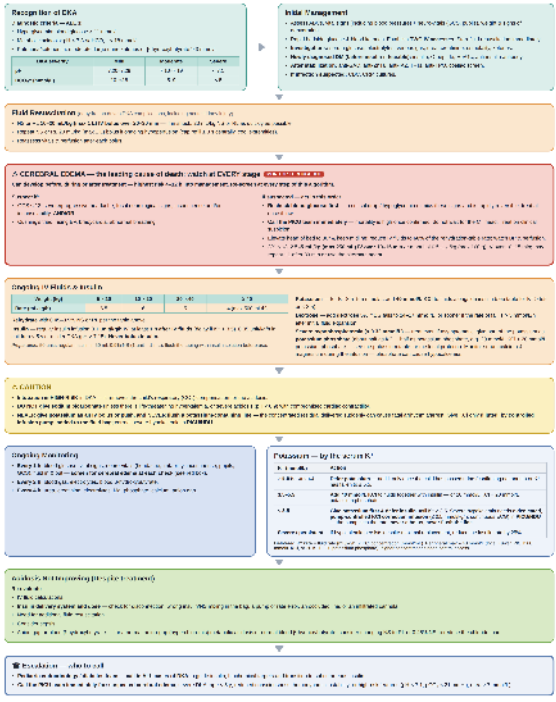
Diabetic Ketoacidosis HOURS

ISPAD 2022 · TREKK 2023

Glucose > 11 mmol/L (200 mg/dL) + pH < 7.3 or bicarbonate < 18 + ketonemia (β-hydroxybutyrate ≥ 3 mmol/L).

Diabetic Ketoacidosis — bedside algorithm

Adapted from TREKK[174]; aligned with the Kuwait PICU Task Force · ISPAD 2022.



◈ FLUIDS — THE ISPAD 2022 METHOD

- After the bolus, replace the estimated deficit (**5%** mild · **7%** moderate · **10%** severe, minus the bolus) **plus maintenance** evenly over **24–48 h**; the weight-band rates in the algorithm equal a 7% deficit (minus a 10 mL/kg bolus) plus maintenance over 24 h. Rapid versus slow rehydration and 0.45% versus 0.9% saline did not change neurological outcomes in the 1,389-episode PECARN FLUID trial.[132,175]

◈ SEVERITY & PICU

- **For DKA managed in the PICU, follow the latest Kuwait PICU Task Force DKA guideline** — the local task-force protocol governs fluid, insulin and electrolyte targets in the unit.[176]
- Consider PICU for severe DKA, young children (age < 5 y), reduced consciousness, long symptom duration, compromised circulation, or high-risk features

(pH < 7.1, pCO_2 < 21 mmHg, urea > 7 mmol/L).[132]

⚠ CEREBRAL INJURY — FURTHER DETAIL

- If focal neurological deficits develop, obtain an urgent CT to exclude cerebral venous thrombosis or intracranial hemorrhage. **Do not postpone treatment to obtain a CT.** Perform hourly GCS so cerebral injury is caught early — it is the leading cause of death in pediatric DKA.[132]

◈ AVOID WHERE POSSIBLE

Intubation (ventilation removes the child's respiratory compensation for the acidosis), central venous catheters (thrombosis risk; a large dead space can make insulin delivery erratic if insulin runs through the CVC), and routine urinary catheterization.[132]

✦ PEARL — THE MASQUERADES OF NEW-ONSET DKA

- First-presentation diabetes is missed when DKA wears a disguise: **abdominal pain and**

vomiting taken for gastroenteritis or appendicitis, **Kussmaul breathing** taken for pneumonia or an asthma attack, and **polyuria** taken for a urinary tract infection or, in a younger child, secondary enuresis.

- A bedside glucose and ketones settle it in seconds.

ADMIT · DISCHARGE · REFER

- **Admit** — all children with DKA; **level of care follows severity**: **mild DKA** → general pediatric ward with hourly monitoring; **moderate/severe**, young age (< 5 y), reduced consciousness, or high-risk features → high-dependency/PICU.[132]
- **Home from the ward** — not from DKA; after transition to subcutaneous insulin with diabetes-team education.
- **Refer — now** — pediatric endocrinology/diabetes team for all; PICU for cerebral-injury risk.

Hyperglycemic Hyperosmolar State (HHS)

MINUTES ISPAD 2022

Not “severe DKA” — very high glucose, very high osmolality, little ketosis, and higher mortality.

DEFINE (DIFFERS FROM DKA)

- Glucose **> 33 mmol/L (600 mg/dL)**, serum osmolality **> 320 mOsm/kg**, **venous pH > 7.25 (arterial > 7.30) and bicarbonate > 15 mmol/L**, only mild ketosis, with altered consciousness/profound dehydration. Increasingly seen in adolescents with obesity/type-2 diabetes.[132]

⚠ MANAGE IT DIFFERENTLY FROM DKA

- Fluid deficits are larger (~12–15%) and **fluid — not insulin — is the priority first**.[132]
- Start insulin **later and lower** (only once glucose stops falling with fluids alone[132], ~0.025–0.05 unit/kg/h).
- Watch for **rhabdomyolysis, malignant-hyperthermia-like**

fever, thrombosis and arrhythmia from potassium/phosphate shifts. Fever with a rising creatine kinase may be treated with **dantrolene** (mortality is high even with treatment).[132]

- Mortality is higher than DKA.[132]

✦ MIXED PICTURES EXIST

- Some children have features of both HHS and DKA.
- When ketoacidosis coexists, follow DKA fluid/insulin caution but expect a **bigger fluid requirement** and monitor osmolality and creatine kinase closely.

◣ WORKUP

- Glucose, **venous blood gas**, beta-hydroxybutyrate/ketones.
- Electrolytes with **corrected sodium**, potassium, **phosphate, magnesium, calcium**; BUN/creatinine.
- **Calculated effective osmolality**; ECG + continuous cardiac monitoring.

- **Creatine kinase** — screen for rhabdomyolysis.

Fluids first

APPROACH

0.9% saline bolus ≥ 20 mL/kg, repeated until perfusion is restored; then 0.45–0.75% saline to replace the deficit (assume 12–15%) over 24–48 h, and replace urinary losses

NOTES

Aim to lower glucose gradually with fluid alone initially

Insulin (delayed)

APPROACH

0.025–0.05 unit/kg/h once glucose plateaus on fluids

NOTES

No bolus; avoid rapid osmolar shifts

Monitor

APPROACH

Osmolality, K^+, PO_4, Ca^{2+}, creatine kinase, neuro obs

NOTES

Anticipate rhabdomyolysis and hyperthermia

ADMIT · REFER

- **Admit** to high-dependency/PICU.

- **Call** pediatric endocrinology and critical care.

Adrenal Crisis / Salt-Wasting CAH

MINUTES BSPED 2023

Shock + low sodium + high potassium + low glucose; collapse with illness.

RECOGNIZE

- Known adrenal insufficiency/CAH under stress, or a neonate (1–4 weeks) with vomiting, poor feeding, weight loss, hyperpigmentation, ambiguous genitalia (in females).[177]
- Labs: low sodium, high potassium, metabolic acidosis, low glucose.

① STEROID — DON'T WAIT

Hydrocortisone immediately (draw 17-OHP/cortisol first only if no delay).[178]

② FLUIDS + GLUCOSE

Saline 10 mL/kg bolus, repeat as needed; treat low glucose; maintenance with dextrose-saline.

③ ELECTROLYTES & CAUSE

High potassium usually corrects with fluids + steroid (ECG for peaked T waves). Treat the trigger (often infection); cover empirically for sepsis if suspected. Endocrine + PICU.

Hydrocortisone

DOSE

< 1 yr 25 mg
1–5 yr 50 mg
> 5 yr 100 mg

ROUTE & NOTES

IV/IM[179], then 50–100 mg/m²/day divided every 6 h[178]

Sodium chloride 0.9%

DOSE

10 mL/kg

ROUTE & NOTES

IV bolus over 5–10 min; reassess and repeat as needed (BSPED 2023)[179]

Dextrose 10%

DOSE

2 mL/kg

ROUTE & NOTES

IV, for low glucose; recheck glucose at 15 min, repeat if needed

Fludrocortisone

DOSE

0.1 mg once daily

ROUTE & NOTES

Oral — maintenance only, not for the acute crisis

⚠ DO NOT USE DEXAMETHASONE FOR SALT-WASTING CRISIS

- It has **no mineralocorticoid effect.**[177]
- Give hydrocortisone immediately — do not delay it for lab results.
- High-dose hydrocortisone (> 50 mg) covers the mineralocorticoid need acutely; fludrocortisone is added later for maintenance.[177]

ADMIT · DISCHARGE · REFER

- **Admit** — all → monitored bed; hydrocortisone before labs, treat hypoglycemia/hyponatremia.

- **Home from the ward** — only after stabilization, endocrine review, and stress-dosing/emergency-injection education.
- **Refer — now** — pediatric endocrinology (the "endocrine review" required before discharge).

Hypoglycemia (Beyond the Newborn)

MINUTES PES 2015

Plasma glucose < 3.3 mmol/L (60 mg/dL), or symptomatic (Whipple triad) — treat now; in a child with a known hypoglycemia disorder keep glucose > 3.9 mmol/L (70 mg/dL); draw the critical sample first only when it will not delay treatment.[180]

RECOGNIZE

- **Autonomic:** sweating, tremor, tachycardia, hunger, pallor, anxiety. **Neuroglycopenic:** lethargy, irritability, poor feeding, behavior change, confusion, seizures, coma.
- **Whipple triad** confirms it: low plasma glucose + consistent symptoms + resolution with glucose.

Confirm any bedside reading with a **laboratory plasma glucose** (glucometers are unreliable when low).[180]

- Red-flag context: hepatomegaly (glycogen storage / fatty-acid oxidation defect), midline defects or micropenis (hypopituitarism), hyperpigmentation (adrenal insufficiency), fasting- or illness-triggered episodes, or a high glucose-infusion requirement.

⚠ DRAW THE CRITICAL SAMPLE — BUT NEVER DELAY TREATING SEVERE OR SYMPTOMATIC HYPOGLYCEMIA

Obtain the sample before glucose **whenever it can be drawn immediately**. If the child is **symptomatic or severely hypoglycemic, treat first** and take the sample as soon as access allows — do not delay treatment for the sample. At the moment of hypoglycemia (ideally glucose < 2.8 mmol/L): **lab glucose, venous gas/bicarbonate, insulin + C-peptide, β-hydroxybutyrate + free fatty acids** (the pivotal branch point), **lactate, ammonia, cortisol + growth hormone, acylcarnitine profile + carnitine, plasma amino acids**; and the **first-void urine** for ketones, organic

acids ± toxin/sulfonylurea screen. One missed sample can cost the diagnosis.[180]

① CORRECT NOW

IV **D10 2 mL/kg** (200 mg/kg) slow push — avoid large hyperosmolar boluses. If alert with a safe airway: oral rapid carbohydrate ~0.3 g/kg.[180]

② MAINTAIN

- Continue **D10 at maintenance** and titrate the **glucose-infusion rate** to keep glucose > 3.9 mmol/L (central line for > D12.5)
- A requirement **> 8–10 mg/kg/min strongly suggests hyperinsulinism** (a hallmark[180] — confirm on the critical sample); maintain euglycemia with escalating dextrose as an initial measure until the endocrinology team advises.

Glucagon 0.5–1 mg IM/SC (fixed dose, independent of weight) when there is no IV access or hyperinsulinism is suspected; 0.03 mg/kg (max 1 mg) only if given IV — a rise > 1.7 mmol/L (30 mg/dL) suggests hyperinsulinism. It fails in glycogen-depleted states (ketotic hypoglycemia, fatty-acid oxidation defects).[180]

READ THE KETONES/FREE-FATTY-ACIDS BRANCH

- **Low ketones + low free fatty acids** (non-ketotic) with detectable insulin → **hyperinsulinism** (congenital K_{ATP}, Beckwith-Wiedemann, exogenous insulin/sulfonylurea, dumping).[180]
- **Low ketones + high free fatty acids** (hypoketotic) → **fatty-acid oxidation defect** (e.g. VLCADD or LCHADD) — abnormal acylcarnitines ± hyperammonemia/cardiomyopathy.
- **High ketones + high free fatty acids** (appropriate) → **ketotic hypoglycemia of childhood** (commonest, 1–5 yr, illness-triggered, diagnosis of exclusion), **GH/cortisol**

deficiency, or **glycogen storage disease** (hepatomegaly, high lactate).[180]

ADMIT · DISCHARGE · REFER

- **Admit** — unexplained symptomatic or persistent hypoglycemia → until fasting safety is documented and a cause established.
- **Home** — only after a documented safe fast and a sick-day/emergency plan (home glucagon where indicated).
- **Refer — now** — pediatric endocrinology/metabolic; hyperinsulinism or a glucose infusion rate > 8–10 mg/kg/min → **consult endocrinology with congenital hyperinsulinism (CHI) expertise**.

Acute Electrolyte Emergencies

MINUTES

Stabilize the heart, stop the seizures, then correct at a safe rate.

HYPERKALEMIA — GET AN ECG FIRST

- **Hyperkalemia** = serum K^+ **> 5.5 mmol/L** (ERC 2021 bands: mild 5.5–5.9 · moderate 6.0–6.4 · severe **≥ 6.5** or ECG changes[820]; Lehnhardt 2011 uses 5.5–6.5 · 6.5–7.5 · > 7.5[181]); **hypokalemia** = K^+ **< 3.5 mmol/L** (severe < 2.5).
- ECG progression: peaked T waves → flattened P / prolonged PR → widened QRS → sine wave → arrest. Treat urgently if there are **ECG changes or potassium > 6.5 mmol/L**.[181]
- If the child is well with a normal ECG, repeat a **free-flowing venous sample** first — hemolysis causes pseudohyperkalemia.[181] **Stop all potassium intake** and potassium-raising drugs.

HYPERKALEMIA — STABILIZE, SHIFT, REMOVE

STABILIZE · Calcium gluconate 10%

DOSE

0.5 mL/kg (max 20 mL) IV over 5–10 min

ROUTE & NOTES

Cardiac monitor; protects the heart, does **not** lower potassium. Repeat after 15 min if ECG still abnormal. **Not in the same line as bicarbonate** (precipitates); caution in digoxin toxicity[181]

SHIFT · Insulin (soluble) + glucose

DOSE

0.1 unit/kg (max 10 units) + glucose 0.5 g/kg IV (= 5 mL/kg of dextrose 10%)

ROUTE & NOTES

Onset 10–20 min; **monitor glucose** closely — early and late hypoglycemia[181]

SHIFT · Salbutamol (nebulized)

DOSE

2.5 mg if < 25 kg; 5 mg if ≥ 25 kg

ROUTE & NOTES

Additive to insulin; may cause tachycardia[181]

SHIFT · Sodium bicarbonate

DOSE

1 mmol/kg IV

ROUTE & NOTES

Only if acidotic; modest, adjunctive effect

REMOVE · Potassium binder

DOSE

0.5–1 g/kg (max 30 g) oral / rectal

ROUTE & NOTES

Sodium/calcium polystyrene sulfonate; slow onset — not for immediately life-threatening hyperkalemia; avoid with ileus, bowel obstruction, or NEC risk[181]

REMOVE · Furosemide

DOSE

1 mg/kg IV

ROUTE & NOTES

If making urine

REMOVE · Dialysis

DOSE

–

ROUTE & NOTES

Refractory or severe; involve renal / PICU early

◈ THE LOGIC

- Calcium and the shifters (insulin, salbutamol, bicarbonate) only **BUY TIME**; only binders, loop diuretics, and dialysis actually remove potassium from the body.[181]
- Recheck potassium and glucose after treating.

SODIUM — CORRECT AT A SAFE RATE

◎ **DEFINITIONS** Hyponatremia = Na^+ **< 135 MMOL/L** (severe < 125); hypernatremia = Na^+ **> 145 MMOL/L**[182] (> 150 is often used for hypernatremic dehydration — expert consensus, not guideline-stated).

Hyponatremia with seizures / encephalopathy

TREATMENT

3% saline 2 mL/kg (max 100 mL) IV over 10 min
repeat once or twice until symptoms improve

NOTES

Each bolus raises sodium by about 2 mmol/L[182]; stop boluses once symptoms improve and keep the rise ≤ 12 mmol/L in 24 h[183]; many experts aim for a **5–6 mmol/L** rise in the first 1–2 h and no more than 10 mmol/L in the first 5 h and 15–20 mmol/L in 48 h (expert consensus — not guideline-stated).

Hyponatremia (no severe symptoms)

TREATMENT

Treat the cause; correct slowly

NOTES

Do **not** exceed **8 mmol/L per 24 h** (a conservative expert limit[182]; NICE pediatric ceiling 12 mmol/L per 24 h) — osmotic demyelination. Volume depletion → 0.9% saline; SIADH → fluid restriction[183]

Hypernatremic dehydration

TREATMENT

Resuscitate shock with isotonic fluid first, then rehydrate over ~48 h

NOTES

Lower sodium **≤ 0.5 mmol/L per hour (≤ 10–12 per 24 h)** — faster risks cerebral edema[183,184]

CALCIUM & MAGNESIUM

◎ **DEFINITIONS** Hypocalcemia = total calcium **< 2.1 MMOL/L** or ionized **< 1.1 MMOL/L** (neonate < 2.0 mmol/L; correct total calcium for albumin). Hypomagnesemia = Mg^{2+} **< 0.7 MMOL/L** (blocks correction of low K^{+} and Ca^{2+}).

Symptomatic hypocalcemia

TREATMENT

Calcium gluconate 10% 0.5 mL/kg (max 20 mL) IV over 5–10 min, diluted 1:5–1:10 in 0.9% saline or 5% dextrose unless via central access; may repeat once if symptoms persist (local practice — the UK label gives age-banded doses of 0.1–0.9 mL/kg, up to 2 mL/kg in severe neonatal hypocalcemia[185]), cardiac monitor then infusion

NOTES

Tetany, seizures, prolonged QT, Chvostek / Trousseau signs. Monitor heart rate / ECG during injection; avoid extravasation (tissue necrosis)[185]

Refractory hypocalcemia or hypokalemia

TREATMENT

Check and replace magnesium

NOTES

Low magnesium blocks correction of both — replace it first (it makes hypokalemia refractory to potassium and impairs parathyroid hormone secretion)[186,187]

⚠ THE SAFE-RATE RULE

Move fast to **stabilize the heart** (calcium) and **stop seizures** (3% saline), but correct chronic sodium **slowly**: overcorrecting low sodium causes osmotic demyelination, and dropping high sodium too fast causes cerebral edema.[188]

ADMIT · DISCHARGE · REFER

- **Admit** — symptomatic or severe derangements, or those needing infusions/monitoring → high-dependency/PICU.
- **Home from the emergency department** — mild, asymptomatic, correctable causes, with a follow-up recheck.
- **Refer — now** — nephrology/endocrinology by cause; PICU for arrhythmia risk or rapid shifts.

Hypercalcemia HOURS

Corrected calcium > 2.6 mmol/L (10.5 mg/dL); > 3.5 mmol/L (14 mg/dL) is a crisis.[189]

RECOGNIZE

- **Stones, bones, groans & psychiatric moans:** nephrocalcinosis/stones; bone pain; constipation, nausea, anorexia, pancreatitis; lethargy, confusion, weakness, hypotonia, coma. Infants: poor feeding, failure to thrive, irritability.[189]

- **Polyuria → dehydration** (nephrogenic diabetes insipidus) — vicious cycle worsening the calcium. Cardiac: **short QT**, bradyarrhythmia; monitor ECG when severe/symptomatic.[189]
- **Correct for albumin:** add 0.8 mg/dL per 1 g/dL albumin below 4.0; confirm with **ionized calcium**.[189]
- Mild 2.6–3.0
- moderate 3.0–3.5
- severe > 3.5 mmol/L.

◣ FIND THE CAUSE — PTH IS THE BRANCH POINT

- **High or inappropriately normal PTH** → primary hyperparathyroidism (think MEN) or **familial hypocalciuric hypercalcemia** (low urine Ca/Cr — benign, do **not** operate).[189]
- **Suppressed PTH** → malignancy (PTHrP/osteolysis), vitamin D intoxication, granulomatous disease, immobilization, thiazides, milk-alkali. Send PTHrP, 25-OH & 1,25-$(OH)_2$ vitamin D[189], phosphate, magnesium, urine Ca/Cr.
- **Infants:** subcutaneous fat necrosis, Williams syndrome, idiopathic infantile hypercalcemia, neonatal

severe hyperparathyroidism.

LOWER THE CALCIUM — HYDRATE, THEN REMOVE

Stop intake

DOSE

—

ROUTE & NOTES

Stop all calcium & vitamin D (diet, fluids, supplements); stop thiazides, lithium, vitamin A/D

0.9% saline (cornerstone)

DOSE

10–20 mL/kg bolus, then ~2–3× maintenance (~3000 mL/m²/day)

ROUTE & NOTES

IV; restores volume then drives calciuresis; target brisk urine output[189]

Furosemide

DOSE

1 mg/kg IV

ROUTE & NOTES

Only after volume repletion; for fluid overload; monitor K^+/Mg^{2+}

Calcitonin (salmon)

DOSE

4 IU/kg SC/IM every 6–12 h (up to 8 IU/kg q6h)

ROUTE & NOTES

Rapid onset (2–6 h), modest; **tachyphylaxis by 48 h**[189] — a bridge. *Salmon* is the potent form used clinically (≈40× human calcitonin).

Zoledronic acid (preferred)

DOSE

0.025–0.05 mg/kg as a single IV dose (max 4 mg; pediatric dose: local practice) — do not repeat within 7 days; check creatinine, calcium and vitamin D first
4 mg/5 mL vial, dilute 1:20 in 0.9% saline, infuse over 15 min

ROUTE & NOTES

Preferred bisphosphonate for high bone turnover (malignancy, immobilization) — higher response rate (complete response ~88% vs ~70%) and a much shorter infusion (5 min vs 2 h in the trial) than pamidronate in adult hypercalcemia of malignancy (Major, *J Clin Oncol* 2001).[190] Onset 24–48 h; ensure volume replete; watch for hypocalcemia; reduce/withhold in renal impairment

Pamidronate (alternative)

DOSE

0.5–1 mg/kg IV over 2–4 h (pediatric dose: local practice)

ROUTE & NOTES

Alternative where zoledronic acid is unavailable; same indications (adult comparative trial)[190]; onset 24–48 h; ensure volume replete; watch for hypocalcemia

Glucocorticoid

DOSE

Prednisone 1–2 mg/kg/day

ROUTE & NOTES

For vitamin D–mediated, granulomatous disease, or lymphoma/leukemia[189]

Dialysis

DOSE

–

ROUTE & NOTES

Severe/refractory, renal failure, or cannot tolerate a saline load

ADMIT · DISCHARGE · REFER

- **Admit** — moderate–severe, symptomatic, or > 3.5 mmol/L → monitored bed/PICU with ECG.
- **Home from the emergency department** — mild & asymptomatic with an outpatient workup and offending agents stopped.
- **Refer — now** — pediatric endocrinology ± oncology/nephrology.
- **Refer — clinic** — parathyroidectomy for primary hyperparathyroidism (not for FHH).

Thyroid Storm (Thyrotoxic Crisis)

MINUTES ATA 2016 · BWPS

Decompensated hyperthyroidism: fever, tachyarrhythmia and agitation, often with a trigger.

RECOGNIZE

- Known/undiagnosed Graves' disease with **hyperthermia**, marked **tachycardia or tachyarrhythmia** (atrial fibrillation/heart failure), agitation or reduced consciousness, and GI upset — usually with a trigger (infection, surgery, DKA, medication non-adherence).

⚠ TREAT ON CLINICAL SUSPICION

- Do not wait for thyroid function results.
- Provide supportive care (cooling, fluids, treat the trigger) and block the thyroid axis in the right **order** — β-blockade and a thionamide first, and give **iodine only after** the thionamide to avoid fueling hormone synthesis.[191]

WORKUP

- **TSH (suppressed), free T4, free T3**, TRAb/TSI.
- CBC, LFTs, glucose, electrolytes, calcium; **ECG**.
- Diagnosis is **clinical** (Burch-Wartofsky[191] ≥ 45 highly suggestive) — do not delay treatment for labs.

1 · Propranolol (β-block)

DOSE

`0.25–0.5 mg/kg/dose PO/NG q6h`

ROUTE & NOTES

Controls heart rate, tremor and agitation; slows peripheral T4→T3. Caution in heart failure — treat failure alongside. **Avoid propranolol in asthma/bronchospasm** (seek senior advice on a cardioselective alternative)[191,192]

2 · Methimazole (thionamide)

DOSE

`0.5–1 mg/kg/day PO/NG/PR divided q8h (max 30 mg/day — local practice)`

ROUTE & NOTES

Blocks new hormone synthesis; give the thionamide **before** iodine. Carbimazole is its prodrug — **not mg-for-mg**: 1 mg carbimazole ≈ 0.6 mg methimazole (carbimazole 0.75–1.3 mg/kg/day)[191,192]

2 · PTU (thionamide — alternative)

DOSE

Dose per endocrinology

ROUTE & NOTES

Also blocks peripheral T4→T3. **Either thionamide is acceptable** — no difference in mortality (Lee, *JAMA Netw Open* 2023; adult ICU data); ATA 2016 has historically listed PTU first in storm[193]. Pediatric guidance avoids PTU because of the risk of hepatic failure.[192]

3 · Potassium iodide (saturated solution, SSKI)

DOSE

1–5 drops PO/NG q8h (local practice; pediatric pre-operative SSKI regimen 1–4 drops three times daily); if only Lugol's (strong iodine) solution is available, 5–10 drops q8h

ROUTE & NOTES

Blocks hormone **release**[191,192]; give ≥ 1 h **after** the thionamide

4 · Hydrocortisone

DOSE

Stress dose — per endocrinology

ROUTE & NOTES

Reduces peripheral T4→T3 conversion and covers relative adrenal insufficiency[191,192]

ADMIT · REFER

- **Admit** to PICU/HDU.

- **Call** pediatric endocrinology and critical care.

Metabolic Crisis (Inborn Error)

MINUTES ANY AGE

Suspected inborn error of metabolism — "sepsis that doesn't fit."

RECOGNIZE (THINK INBORN ERROR)

- Encephalopathy, vomiting, seizures, or apnea after a symptom-free interval or a catabolic trigger (fasting, intercurrent illness, surgery); poor feeding; tachypnea. Family history or parental consanguinity.[194]
- Mimics sepsis — “sepsis that doesn’t fit.” Presents at **any age**, not only the newborn. Not every metabolic crisis is hyperammonemic — the pattern points to the group:[194]

Urea-cycle (hyperammonemia)

ACID–BASE · AMMONIA

Respiratory alkalosis; very high ammonia; low urea[194]

POINTERS

Little or no acidosis; encephalopathy ± seizures

Organic acidemia (MMA / PA / IVA)

ACID–BASE · AMMONIA

High-anion-gap metabolic acidosis + ketosis; ammonia high (secondary)

POINTERS

Hypoglycemia; offending acid on urine organic acids[195]

MSUD

ACID–BASE · AMMONIA

Ketosis with normal / near-normal ammonia; acidosis variable (expert consensus)

POINTERS

Maple-syrup odor (urine/cerumen); high plasma leucine (alloisoleucine diagnostic)[196]

Fatty-acid oxidation disorder (MCAD, LC-FAOD)

ACID-BASE · AMMONIA

Hypoketotic hypoglycemia after fasting or illness; ammonia normal or mildly raised; acidosis variable

POINTERS

Lethargy/encephalopathy, hepatopathy, cardiomyopathy or arrhythmia, rhabdomyolysis (check CK) — abnormal acylcarnitines. Reverse catabolism with high-dextrose fluids (GIR as below); long-chain fat restriction and medium-chain fat sources only on metabolic advice.[842]

① STOP CATABOLISM

Stop all protein — a **temporary** emergency measure (first ~24–48 h) **until the metabolic team advises**; prolonged protein restriction itself worsens catabolism, so protein is reintroduced on their guidance. Run high-dextrose fluids; avoid hypotonic fluids[194] (add enough sodium chloride; hyperammonemia causes brain edema) and, by common practice, lactated Ringer's. Treat low glucose. **This card is initial stabilization pending specialist consultation.**

② IMMEDIATE LABS + CALL METABOLIC TEAM

- Ammonia (free-flowing sample, **on ice, run STAT and process immediately**)[194], blood gas, glucose, lactate, ketones, electrolytes/anion gap.
- Send as **confirmatory** (not routine/STAT): plasma amino acids, urine organic acids, acylcarnitines.

high ammonia

③ NITROGEN SCAVENGERS + COFACTORS

See drug table — coordinate with the metabolic service.

0 µmol/L with encephalopathy, onset on day 1–2 of life,

Urgent hemodialysis or CRRT. Transfer to a metabolic center.[194]

Dextrose 10%

DOSE

Dextrose 10% with electrolytes; glucose infusion rate: neonate 10 · infant 8 · older child 6 mg/kg/min. Higher rates only on metabolic advice

ROUTE & NOTES

IV — reverses catabolism. Hyperglycemia is dangerous: add insulin, or reduce the rate if lactate is > 3 mmol/L.[194]

Sodium benzoate + sodium phenylacetate

DOSE

≤ 20 kg: 250 mg/kg load over 90–120 min, then 250 mg/kg/day
> 20 kg: 5.5 g/m² load over 90–120 min, then 5.5 g/m²/day
Max 12 g/day of each scavenger

ROUTE & NOTES

IV; **must be diluted** in dextrose 10% (≥ 25 mL/kg) — never undiluted; central line where possible (the product label specifies central access), **peripheral only when life-saving** — ask pharmacy for an appropriately diluted preparation.[194] In **MMA / PA**, phenylacetate/phenylbutyrate is **not** the primary scavenger (depletes glutamine) — benzoate ± carglumic acid per the metabolic team.[195]

L-arginine hydrochloride

DOSE

250 mg/kg (up to 400 mg/kg) over 90–120 min, then 250 mg/kg per 24 h. Argininosuccinic aciduria: 200–400 mg/kg load, then 200–400 mg/kg per 24 h; max 12 g/day

ROUTE & NOTES

IV; omit in arginase deficiency[194]

Carglumic acid

DOSE

Acute 100–250 mg/kg/day (2–4 divided doses) then maintenance ~50 mg/kg/day (range 10–100) in 2 divided doses — titrate to plasma ammonia

ROUTE & NOTES

Oral/NG; for NAGS deficiency & some organic acidemias[194,195]

L-carnitine

DOSE

100 mg/kg

ROUTE & NOTES

IV / oral; for suspected organic acidemia

◈ **AVAILABILITY**

- Nitrogen scavengers, carglumic acid and L-carnitine are **SPECIALIST STOCK** held in tertiary metabolic / PICU units, not general wards.
- Phone the metabolic on-call **EARLY** — high-dextrose fluids, protein cessation and dialysis access can

start anywhere while drugs are sourced. **AVOID VALPROATE.** [194]

ADMIT · DISCHARGE · REFER

- **Admit** — all suspected → PICU; stop protein, high-dose dextrose, treat hyperammonemia.
- **Home from the ward** — not acutely; under the metabolic team with an emergency regimen.
- **Refer — now** — metabolic/genetics urgently and a center capable of ammonia scavengers/hemofiltration.

07 Focused Specialty Emergencies

Focused eye, dental, dermatologic, ENT & neurosurgical emergencies

Pediatric Eye Emergencies

MINUTES

SIGHT-THREAT

Chemical burn — irrigate before anything else. Leukocoria, orbital cellulitis, and a ruptured globe are the sight- and life-threats not to miss.

⚠ CHEMICAL INJURY — IRRIGATE FIRST

- Immediate, continuous irrigation with **normal saline or Ringer's lactate (preferred) or tap water BEFORE** examination, imaging or even registration; a topical anesthetic helps. Evert the lids and sweep out particles. Irrigate **until the pH is neutral (7.0)** on litmus/pH paper — up to 10–15 L may be needed — or for **at least 30 min** if pH cannot be measured. **Alkali** (drain/oven cleaner, cement, wet button batteries) penetrates deeper than acid.[197]

- Then urgent ophthalmology.

THE CAN'T-MISS DIAGNOSES

- **Orbital (post-septal) cellulitis — proptosis, pain on or limited eye movement, reduced acuity or color vision, a relative afferent pupillary defect**, chemosis → emergency. **CT orbits + sinuses, IV antibiotics, ophthalmology + ENT.** Distinguish from **preseptal** (lid swelling only, with **normal** movement, vision, and pupil)[197] (see **Preseptal & Orbital Cellulitis**).
- **Ruptured / penetrating globe** — after trauma with a **distorted (teardrop) pupil**, prolapsed dark uveal tissue, or marked subconjunctival hemorrhage → cover with a **rigid shield (never a pad or any pressure)**, keep **NPO**, give analgesia + antiemetic, update tetanus, and refer urgently. **No drops, no ointment.**[197]
- **Leukocoria (white pupil reflex)**, a new squint, or an **absent red reflex → retinoblastoma** until proven otherwise → urgent ophthalmology (a life-threatening tumor).[198]

- **Ophthalmia neonatorum** — hyperacute purulent conjunctivitis in the **first days of life** → gonococcal risk (corneal perforation) → emergency: **systemic ceftriaxone or cefotaxime is the main treatment** (adequate systemic therapy makes topical antibiotics unnecessary; prefer cefotaxime in the jaundiced neonate or with calcium-containing IV fluids), frequent saline irrigation of discharge, admit and swab; **test for both *N. gonorrhoeae* and *C. trachomatis***.[99] Doses (CDC 2021): **gonococcal** — ceftriaxone 25–50 mg/kg IV/IM once (max 250 mg), or cefotaxime 100 mg/kg IV/IM once if ceftriaxone cannot be given (calcium-containing IV fluids; caution in hyperbilirubinemia, especially preterm); evaluate for disseminated infection. **Chlamydial** — oral erythromycin 12.5 mg/kg/dose every 6 h for 14 days (watch for pyloric stenosis).
- **Acute red painful eye** with photophobia/reduced vision, or **hyphema** (blood layering in the anterior chamber after trauma) → same-day ophthalmology.

- **Corneal ulcer (microbial keratitis)** — red, painful, photophobic eye with a **white/opaque corneal infiltrate or haze** ± discharge; high risk in **contact-lens** wearers and after trauma → sight-threatening, same-day ophthalmology. **Do not patch**; stop contact-lens wear (expert consensus — not covered by the cited review).
- **Congenital / infantile glaucoma** — the infant triad of **watering (epiphora), photophobia, and blepharospasm** with an **enlarged or cloudy cornea (buphthalmos)** → urgent ophthalmology (needs surgery); do not dismiss as a blocked tear duct.[199]
- **New anisocoria (unequal pupils)** — may signal a **third-nerve palsy, Horner syndrome, or raised ICP / herniation** (see **Raised ICP**); with reduced consciousness, ptosis, or trauma it is a red flag → urgent assessment. Check pupils in **both light and dark** to localize (expert consensus — not covered by the cited review).

⚠ SAFEGUARDING — RETINAL HEMORRHAGES

Multilayered retinal hemorrhages extending to the periphery in an infant with encephalopathy suggest **abusive head trauma** — involve safeguarding and ophthalmology[200] (see **Fractures — Non-Accidental Red Flags**).

✦ PEARL — CHECK THE RED REFLEX IN EVERY CHILD

A symmetrical red reflex helps exclude retinoblastoma, cataract, and vitreous pathology; any **white, asymmetric, or absent** reflex needs urgent ophthalmology.[198]

✦ YOUR ROLE — THE GENERAL PEDIATRICIAN

- You are the first responder, not the eye surgeon.
- Three time-critical moves are yours: **(1) irrigate immediately** for any chemical splash — don't wait for ophthalmology; **(2) shield** (never pad or press) a suspected ruptured globe, keep **NPO**, give analgesia + antiemetic; **(3) check the red reflex in every child** and treat leukocoria / an absent reflex as retinoblastoma.

- Document **visual acuity, pupils, and eye movements** before referral. **Avoid drops, ointment, or any pressure** on a possibly open globe, and never patch a suspected corneal ulcer.
- Then refer to ophthalmology (add ENT for orbital cellulitis) within the timeframe the diagnosis demands.

REFER

- **Refer — now** — ophthalmology urgently — chemical injury, suspected globe rupture, leukocoria/absent red reflex, orbital cellulitis (add ENT), acute vision loss, or hyphema.

Dental & Oral Emergencies MINUTES

TIME-CRITICAL

An avulsed permanent tooth is a true emergency — reimplant within minutes. Never reimplant a primary tooth. Watch the swelling that threatens the airway.

DENTAL TRAUMA

- **Luxation** (displaced or mobile tooth) — **do not attempt to reposition it**; analgesia and same-day dental referral.[821]
- **Crown fracture** — preserve any fragment and keep it moist (milk or saline); analgesia; prompt dental review — pulp exposure needs same-day care.[821]
- **Primary tooth avulsion — do NOT reimplant** (risks of damaging the permanent successor); reassure and arrange dental review.[822]
- **Post-extraction bleeding** — firm gauze pressure 15–20 min ± tranexamic acid; if it persists, consider an undiagnosed **bleeding disorder**.

⚠ AVULSED PERMANENT TOOTH – MINUTES MATTER

- **Reimplant as soon as possible.** Hold the tooth by the **crown — never touch or scrub the root** (protect the periodontal ligament).
- If dirty, rinse gently in **milk, saline or the child's saliva**, reinsert, have the child bite on gauze.
- If reimplantation isn't possible, transport the tooth at once in (in order of preference) **milk, Hank's balanced salt solution, saliva (spat into a cup) or saline**. Water is a poor medium but still better than letting the tooth dry.[201]
- Then urgent dental care for splinting; **assess tetanus prophylaxis** — indicated for a contaminated avulsion and guided by both the child's immunization status and the nature of the wound; consider antibiotics.
- Prognosis falls sharply once **extra-oral dry time exceeds ~60 min**, and periodontal-ligament cells are then considered non-viable — **reimplant anyway**.[201]

✦ **PEARL — MILK BEATS WATER**

If Hank's solution isn't to hand, **cold milk** is the best readily-available storage medium; tap water is hypotonic and kills periodontal-ligament cells, worsening the outcome.[201] **Time is tooth.**

◣ PRIMARY HERPETIC GINGIVOSTOMATITIS (HSV-1)

- The commonest cause of a painful mouth with fever in the **1–5-year-old**: **fever** (usually **3–5 days**, occasionally up to a week), **swollen, friable, bleeding gingiva**, and crops of **painful vesicles → ulcers** on the gingiva, tongue, lips, and buccal mucosa (often with perioral spread), drooling, and **refusal to eat or drink**. Tender **cervical lymphadenopathy** is usual and, being reactive, resolves as the illness settles. Self-limited — the illness runs **~10–14 days**.[202]
- **Management is supportive** — the priority is **hydration and analgesia** (acetaminophen ± ibuprofen); offer cold, bland fluids. **Dehydration from poor intake is the main reason to admit.** Avoid topical lidocaine/anesthetic gels in young children (toxicity).[203]

- **Oral acyclovir — 20 mg/kg/dose 4×/day for 5–7 days** (max single dose 800 mg); immunocompromised children **20 mg/kg/dose 4×/day for 7–10 days**; immunocompromised adolescents 400 mg 3×/day for 5–10 days or until resolution.[203] **Significant or disseminated disease in an immunocompromised child needs IV acyclovir** (5–10 mg/kg/dose q8h) rather than a prolonged oral course. Shortens fever, oral lesions, and viral shedding **only if started within 72 h of symptom onset**; not routine for the well child presenting late.
- Distinguish from **herpangina** (coxsackievirus — ulcers on the soft palate/tonsillar pillars, **gingiva spared**) and hand-foot-and-mouth disease.[202] **Admit/refer** the dehydrated, the immunocompromised, or suspected **eczema herpeticum** / disseminated HSV.

ORAL SOFT-TISSUE INJURIES

- **Tongue lacerations** — most heal without sutures (rich blood supply). **Repair** if the wound gapes at rest, is large (> ~1–2 cm), bleeds

persistently, is through-and-through, or splits the free edge/tip (a bisecting flap) — these risk a notched tongue.

- **Lip lacerations** — a wound that **crosses the vermilion border** needs precise realignment of the border first (a 1 mm step is visible); through-and-through wounds need layered closure. Palpate and image for an **embedded tooth fragment** or foreign body after a fall onto the teeth.
- **Buccal & gingival mucosa** — most intraoral tears heal spontaneously; suture only large, gaping, or food-trapping wounds. A deep cheek wound can injure the **parotid duct or facial nerve** — refer.
- **Embedded foreign bodies** — account for **every tooth fragment**: a missing piece may be buried in the lip/tongue (soft-tissue radiograph or ultrasound) or aspirated (**chest X-ray if unaccounted for**). Remove grit/glass, irrigate, and assess tetanus status.
- **Intruded tooth** (driven into the socket) — **refer to a pediatric dentist**. A **primary** intruded tooth is usually left to **re-erupt**

spontaneously (do not reposition — protect the permanent tooth bud); a **permanent** intruded tooth needs dental assessment for repositioning.[821,822]

- Repair intraoral and lip wounds within ~24 h with analgesia; give antibiotics for through-and-through lip wounds, bites, or grossly contaminated wounds.

DENTOALVEOLAR ABSCESS / FACIAL SWELLING

- Analgesia and **dental source control — incision and drainage, root canal (pulp) treatment, or extraction of the causative tooth** — with a **mandatory dental referral**. For a **localized** abscess without systemic involvement or spreading, definitive dental treatment is the primary management and **systemic antibiotics are generally not required**; **reserve antibiotics for facial cellulitis, systemic signs, significant spreading, or suspected deep-space infection** (per clinical judgment and MOH protocols). These commonly present **directly to dental clinics**, where the dentist identifies the source and delivers

timely definitive treatment.[203] **Watch for spread to the deep neck, floor of mouth, or orbit** — a spreading facial-space infection can progress to Ludwig's angina (next).

⚠ AIRWAY — LUDWIG'S ANGINA

Firm submandibular swelling — in children often **unilateral at onset** before becoming bilateral — with a **raised (elevated) tongue**, drooling, or trismus is a deep-space infection that can obstruct the airway. **Call for airway help early — anesthesia, oral & maxillofacial surgery, ENT, or pediatric surgery** (all are equipped to manage these cases), give IV antibiotics, and do **not** lay the child flat.[204] **Time-critical — urgently call or refer.**

✦ YOUR ROLE — THE GENERAL PEDIATRICIAN

- Most of what reaches you is yours to start.
- For an **avulsed permanent tooth**, reimplant or store it in **cold milk** and send urgently — minutes decide the tooth; **never reimplant a primary tooth**.
- Give analgesia, control post-extraction bleeding with

pressure ± tranexamic acid, **assess tetanus** for contaminated wounds, and suture only the soft-tissue lacerations that need it — account for **every tooth fragment**.

- Treat herpetic gingivostomatitis supportively, watching hydration.
- Escalate the two true emergencies fast: a spreading facial-space infection or **Ludwig's angina** (airway — call/refer anesthesia, oral & maxillofacial surgery, ENT, or pediatric surgery), and refer to dental / maxillofacial for avulsion, pulp exposure, or abscess.

REFER

- **Refer — now** — dental / maxillofacial urgently — avulsion, fractures with pulp exposure, facial fractures, or a facial-space infection; for any airway threat call **anesthesia, oral & maxillofacial surgery, ENT, or pediatric surgery** — all are equipped to manage these cases.

- **Refer — clinic** — an intruded tooth → pediatric dentist.

Dermatologic Emergencies HOURS

CAN'T-MISS

Fever + rash — find the killers: meningococcemia / purpura fulminans, SJS/TEN, staph scalded skin, and eczema herpeticum.

⚠ NON-BLANCHING RASH + FEVER

- Petechiae or purpura that **do not blanch** in an unwell/febrile child = **invasive meningococcal disease / sepsis / purpura fulminans** until proven otherwise — take blood cultures, give **empiric IV antibiotics immediately**, follow the **Septic Shock** pathway.[115]
- Do not wait for investigations.

◣ THE CAN'T-MISS RASHES

- **SJS / TEN** — dusky/targetoid macules with skin detachment and **erosions of ≥ 2 mucosal sites** (eyes, mouth, genitals), 1–3 weeks after a

drug (antibiotics, anticonvulsants).[205] **Stop the culprit**; fluids, skin + eye care, urgent dermatology + ophthalmology, transfer to a **burns/PICU** unit. **Avoid the culprit drug and relevant cross-reacting agents** — broad beta-lactam avoidance applies mainly when a beta-lactam is the suspected culprit (see **Antibiotic Allergy**).

- **Staphylococcal scalded skin syndrome (SSSS)** — young child, fever, **tender diffuse erythema with superficial peeling (Nikolsky +)** and perioral crusting; **mucosae spared**. Toxin-mediated: IV anti-staphylococcal antibiotic (**cefazolin** first-line in Kuwait, as flucloxacillin is not available locally) + analgesia + fluids.[206]
- **Eczema herpeticum** — clusters of **monomorphic punched-out vesicles/erosions on eczematous skin** in an unwell child → start **acyclovir** urgently; ophthalmology if periocular. (HSV superinfection.)[207]
- **DRESS** — fever, widespread morbilliform rash, **facial edema**, lymphadenopathy, **eosinophilia**, and

organ (liver) involvement 2–8 weeks after a drug → stop the drug, supportive care ± steroids.[208]

- **Necrotizing fasciitis — pain out of proportion**, rapidly spreading dusky/edematous skin, systemic toxicity → surgical emergency + broad-spectrum antibiotics.[90]

◆ SJS / TEN — FOCUSED WORKUP & MANAGEMENT

- **Confirm the signs** — dusky/targetoid macules with **skin detachment** and **erosions of ≥ 2 mucosal sites**; **Nikolsky +** (lateral shearing pressure detaches epidermis on non-blistered skin), **Asboe–Hansen +** (a blister extends sideways with slight tangential pressure), and **widespread skin tenderness** — typically 1–3 weeks after a culprit drug.[205]
- **Prognosis** — calculate **SCORTEN** (best at day 1 and day 3). **In children it over-estimates mortality** (pediatric death rates are far lower), so use it for guidance, not as a ceiling.[205]
- **Investigations** — CBC with differential, urea & electrolytes, LFTs, glucose, bicarbonate, coagulation profile, CRP/ESR, magnesium, phosphate, lactate, urinalysis. **Sepsis is the leading cause of death** — infective screen (blood cultures; skin swabs for **HSV/VZV and bacteria**) and treat superadded infection. **Chest X-ray**;

***Mycoplasma* testing guided by the clinical picture** (in children, **reactive infectious mucocutaneous eruption [RIME]** — the current term, which subsumes the former *Mycoplasma*-induced rash and mucositis [MIRM] — is a distinct, milder mimic with **prominent mucositis and little skin loss**; RIME can also follow other respiratory pathogens, so test by presentation rather than routinely).[209] **Skin biopsy** if the diagnosis is unclear.

- **Act now — stop the culprit drug immediately** (earlier withdrawal improves survival); **transfer to a burns unit or PICU** — in children, transfer is **required at ≥ 10%** body surface detachment (burn center if > 30%) and may be considered below 10%; organ dysfunction needing intensive care is an indication at any extent.[210]
- **Supportive care is the mainstay** — IV fluids & electrolytes, **thermoregulation**, nutrition, **analgesia**; **gentle handling, minimize friction/shear**;

non-adherent dressings (petrolatum-impregnated gauze or silicone/advanced dressings); avoid **prophylactic** systemic antibiotics — treat proven infection. Early multidisciplinary team: **dermatology, ophthalmology** (prevent ocular scarring; amniotic-membrane grafting in severe eye disease), **urology/gynecology** (prevent genital adhesions), wound care, pain, psychology.[210]

- **Systemic immunomodulation — specialist decision, low-certainty evidence.** Drug withdrawal + supportive care remain the priority. If an agent is used, **ciclosporin** and **corticosteroids** showed the most promising (low-certainty) mortality signals; **IVIG** showed no benefit as monotherapy. **Etanercept** (off-label) may be considered (S3 2024); if IVIG is used at all, give it **combined with corticosteroids** — the only regimen with a survival signal in network meta-analysis (SMR 0.53, low certainty). Individualized by the specialist team.[210,211,823]

- **After recovery** — screen for **ocular, cutaneous, urogenital and psychological** sequelae; document the culprit, give a clear **allergy alert** (avoid re-exposure and cross-reacting agents), and consider **HLA-guided avoidance** where relevant (e.g. HLA-B*15:02 & carbamazepine, HLA-B*58:01 & allopurinol).[205]

Evidence: BAD children & young people SJS/TEN guideline 2018; German (AWMF/DDG) S3 guideline 2024; RIME term introduced by Ramien et al. (2021)[212], RIME/MIRM terminology per Damari et al., *J Hosp Med* 2025. Culprit-drug withdrawal + supportive care have the clearest benefit; all systemic immunomodulators remain low-certainty.

◆ SSSS (STAPHYLOCOCCAL SCALDED SKIN) — FOCUSED WORKUP & MANAGEMENT

- **Recognize** — young child, fever, tender diffuse erythema with **superficial peeling (Nikolsky +)**; **desquamation of the flexures** and **radial fissuring/crusting around the eyes, mouth and nose**; **mucosae are spared**. Toxin-mediated (exfoliative toxin from a distant staphylococcal focus).[206]
- **Cultures — swab the focus, not the blisters.** Nasopharynx/nares, conjunctivae, throat, umbilicus, urine, blood, and any suspected primary site; in a **neonate** include the **umbilical stump and circumcision site**. **Bulla fluid is sterile** (unlike bullous impetigo) — do not culture it. **Skin biopsy is usually unnecessary** — reserve it (or a frozen section) for when SJS/TEN cannot be excluded (SSSS splits high in the granular layer; TEN is full-thickness).[206]
- **Antibiotics** — start an **IV anti-staphylococcal** agent: **cefazolin** is first-line in Kuwait

(the penicillinase-resistant penicillins — flucloxacillin, nafcillin, oxacillin — are the international first-line but are not available locally), switching **IV → oral** once improving; **clindamycin** only as an **anti-toxin** adjunct where susceptible (added benefit uncertain in children, resistance rising); **vancomycin** if MRSA is suspected/prevalent or first-line fails. Doses below — de-escalate once afebrile and per sensitivities.[206]

- **Supportive care** — treat like a **superficial burn**: fluid & electrolyte balance, thermoregulation, nutrition, **analgesia**, and **minimal handling**. **Wound care** with **petrolatum/Vaseline-impregnated gauze** (apply to the dressing — do not smear emollient directly onto raw skin); **warm compresses** to facial crusting. Watch for fluid loss and secondary sepsis.
- **Prognosis** — good in children with prompt treatment (low mortality); higher risk in

neonates and with extensive involvement.[206]

Cefazolin (first-line IV)

DOSE (PEDIATRIC)
25–33 mg/kg/dose q8h (max 2 g/dose)

ROUTE & NOTES
IV; first-generation cephalosporin — anti-staphylococcal first-line **in Kuwait (flucloxacillin not available locally)**

Flucloxacillin / nafcillin / oxacillin (where available)

DOSE (PEDIATRIC)
25–50 mg/kg/dose q6h (max 2 g/dose)

ROUTE & NOTES
IV; penicillinase-resistant anti-staphylococcal — the international first-line, **not currently available in Kuwait**

Clindamycin (anti-toxin adjunct)

DOSE (PEDIATRIC)
10 mg/kg/dose q8h (max 900 mg/dose)

ROUTE & NOTES
IV/PO; optional — suppresses toxin, only where susceptible; benefit uncertain in children

Vancomycin (if MRSA)

DOSE (PEDIATRIC)
15 mg/kg/dose q6h (max 1 g/dose)

ROUTE & NOTES
IV; if MRSA suspected/prevalent or first-line fails

Oral step-down

DOSE (PEDIATRIC)

Cephalexin 25 mg/kg/dose q6–8h (max 1 g/dose)

ROUTE & NOTES

PO once afebrile & improving; complete ~7-day course (dicloxacillin/flucloxacillin where available)

Evidence: pediatric SSSS systematic review (Pediatr Dermatol 2025); Merck Manual (professional). Bullae are sterile — culture the primary focus; anti-staphylococcal therapy + supportive care is the mainstay.

◆ ECZEMA HERPETICUM — FOCUSED WORKUP & MANAGEMENT

- **Recognize** — clusters of **monomorphic punched-out vesicles/erosions** on eczematous skin in an unwell child; **honey-colored crusting** means the lesions are **impetiginized** (secondary *S. aureus*).[207]
- **Isolate** — contact precautions: **gloves and gown** until lesions are dry and crusted.
- **Confirm (don't delay treatment) — deroof an intact vesicle** with a sterile needle and swab the clear fluid for **HSV-1/2 & VZV PCR** (± Tzanck smear as a rapid bedside adjunct); take a **bacterial swab (C&S)** for secondary infection. Diagnosis is clinical — start antivirals empirically.[207]
- **Baseline labs** — CBC and a metabolic/renal panel, and check hydration, **before IV acyclovir** (renal safety).
- **Antivirals early — they save lives — IV acyclovir 10 mg/kg/dose q8h under 12 years**

(5–10 mg/kg/dose from 12 years; under 3 months 20 mg/kg/dose q8h as for neonatal HSV), each dose over 1 h (dose by ideal body weight in obesity; ensure hydration) if **systemically unwell, severe/disseminated, periocular, or poor oral intake**; **oral acyclovir per local protocol** for milder disease. Continue ~10–14 days / until lesions crust; step IV → oral on improvement.[207]

- **Cover secondary infection** — if impetiginized, add an **oral anti-staphylococcal antibiotic** for *S. aureus*.
- **Eyes** — facial/periocular involvement warrants **urgent ophthalmology** to exclude **corneal disease (herpetic keratitis)**; start topical ophthalmic antiviral if corneal lesions are suspected.
- **Skin / eczema care** — once antivirals are started (many **pause topical steroids for ~48 h, then restart the appropriate-potency topical corticosteroid** as the child improves — steroids must never

delay antivirals).[207] **Bland ointment emollients** (avoid creams — they sting); **non-soap cleansers**; lukewarm **5-min baths, pat (never rub) dry, no soap**; warm compresses to crusted areas; loose cotton clothing; avoid friction.

- **Supportive & referral** — fluids/electrolytes, analgesia, nutrition; admit if extensive/systemic/dehydrated. **Neurology** if CNS involvement is suspected; **dermatology at discharge** for ongoing eczema management.

Evidence: StatPearls (Eczema Herpeticum); pediatric emergency guidance. Early antivirals are the priority; topical steroids treat the underlying eczema but must not delay antivirals.

◆ DRESS / DIHS — FOCUSED WORKUP & MANAGEMENT

- **Recognize** — **morbilliform rash with facial edema** starting on the **face → upper trunk → extremities** (can **worsen even after the drug is stopped**), plus fever, lymphadenopathy, **eosinophilia** and atypical lymphocytes. Onset is **late: 2–8 weeks** after starting the culprit — but within **~24 h on re-challenge**. Commonest culprits: **anticonvulsants** (carbamazepine, phenytoin, lamotrigine, phenobarbital), **allopurinol**, and **antibiotics** (sulfonamides, vancomycin, minocycline). First-degree relatives carry up to **~25% risk** with the same drug (HLA-linked).[208]
- **Organ involvement** — **liver first** (hepatitis), then lung, kidney, **heart (myocarditis)**, spleen, GI and neurologic; **HHV-6/7, EBV, CMV reactivation** is characteristic. **Late endocrine autoimmunity** (hypothyroidism, type 1 diabetes) can appear months afterwards.[208]

- **Diagnose** — clinical, scored with the **RegiSCAR** or **J-SCAR** criteria. **Labs:** CBC + differential (eosinophilia, atypical lymphocytes), **LFTs** (may stay abnormal for months), renal panel + urinalysis (proteinuria/hematuria), CK, lipase, CRP/ESR/**ferritin**, baseline **TFTs + glucose**, viral PCR (HHV-6/7, EBV, CMV), **ECG + troponin + baseline echo**, and CXR if respiratory symptoms; extend the work-up by clinical suspicion. **Skin biopsy** to exclude mimics.[208]
- **Manage** — **stop the culprit immediately** and **label the patient hypersensitive**; supportive care; **high-potency topical corticosteroids**. For organ involvement, **systemic corticosteroids** — prednisolone **1–2 mg/kg/day** (moderate organ involvement 1–1.5 mg/kg/day; severe / danger signs: IV methylprednisolone 2 mg/kg/day for 3–5 days then oral 2 mg/kg/day, specialist-led) until resolution, then a **slow taper (~10–15% per week) over 6 weeks–3 months** (up to 6

months in severe disease) to avoid relapse; adjuncts/alternatives (specialist): **ciclosporin**, IVIG (limited evidence), JAK inhibitors (anecdotal).[208]

- **Monitor & avoid** — screen for **autoimmune sequelae** (thyroiditis, type 1 diabetes): **TSH, free T4 and glucose (with CBC, LFTs, renal function) at regular intervals for at least 6 months and up to 3 years or longer**.[208] **Strict lifelong avoidance** of the culprit and cross-reacting drugs; document the allergy clearly.

Evidence: EAACI position paper on DRESS in children 2025; RegiSCAR / J-SCAR criteria. Prompt drug withdrawal + staged (skin-only vs organ) therapy; steroids taper slowly to prevent relapse.

◆ NECROTIZING FASCIITIS — FOCUSED WORKUP & MANAGEMENT

- **Recognize** — **pain out of proportion** and **edema extending beyond the visible erythema**; rapidly spreading dusky skin, fever, **crepitus**, bullae, necrosis or ecchymosis, and a **hard "wooden" feel** of the subcutaneous tissue; **cutaneous anesthesia is a late sign**. Lower > upper extremities. Special forms: **perineum (Fournier gangrene)**, head & neck, and neonatal infection (e.g. from omphalitis).[90]
- **It is a surgical emergency — call the surgeon now.** Early aggressive debridement is the single biggest determinant of survival; **do not let the LRINEC score or imaging delay surgery**.[90]
- **Scoring / labs** — the **LRINEC** score can help distinguish necrotizing fasciitis from other soft-tissue infection, **but a low score does not exclude it** (poor sensitivity in children).[90] Send CBC + differential, basic metabolic panel, glucose, CRP,

serum lactate, coagulation profile, and **blood cultures (2 sets)** — then start antibiotics without waiting.

- **Imaging** — CT (or MRI) may support the diagnosis but **must never delay surgical exploration**.
- **Empiric antibiotics** (after cultures) — broad-spectrum covering **gram-positive incl. MRSA + gram-negative + anaerobes**, plus **clindamycin for its antitoxin effect**: e.g. **vancomycin 15 mg/kg/dose q6h (max 1 g/dose)** + **piperacillin-tazobactam 100 mg/kg/dose (piperacillin component) q6–8h (max 4 g piperacillin/dose)** (or meropenem 20 mg/kg/dose q8h, max 1 g/dose) + **clindamycin 10–13 mg/kg/dose q8h (max 900 mg/dose)**; de-escalate on sensitivities.[90]
- **Surgery = the gold standard** — surgical exploration is both the **definitive diagnosis and the treatment** (expect repeat looks/debridement); send intra-operative specimens for

Gram stain, culture, and histology — alert microbiology in advance: processing is **time-critical once tissue reaches the lab** (expedite the Gram stain and keep direct communication).

- **Who leads — shared surgical responsibility.** The operative lead follows the **anatomical site**: **orthopedics** (limbs), **ENT or maxillofacial** (head & neck), **plastics** (soft-tissue coverage), **urology** (perineum / Fournier), **general/pediatric surgery** (trunk / abdomen). In complex or multi-region cases, **several surgical subspecialties may need to collaborate together in the ED**.
- **Support & referral** — aggressive hemodynamic resuscitation / PICU; **IVIG** may be considered by the specialist team as an adjuvant in streptococcal toxic shock (evidence inconclusive — IDSA 2014 makes no recommendation for it).[90] Refer to **infectious diseases and plastic/reconstructive surgery** (with pediatric/general surgery).

Evidence: IDSA skin & soft-tissue infection guidelines 2014. Surgery is time-critical — neither the LRINEC score nor imaging should delay operative exploration.

⚠ NEONATE

Vesicles, or an unwell neonate with a rash, may be **neonatal HSV** — start **high-dose IV acyclovir 20 mg/kg/dose every 8 h** and a full sepsis work-up without delay. Treat for **14 days** (skin-eye-mouth disease) or **21 days** (CNS or disseminated disease); for **CNS disease**, repeat CSF HSV PCR near the end of therapy and continue until it is negative, then give **oral acyclovir suppression — 300 mg/m²/dose 3×/day for 6 months**.[99]

✦ PEARL — READ THE PATTERN

Non-blanching + unwell = sepsis; **monomorphic vesicles on eczema** = eczema herpeticum; widespread peeling with **mucosal erosions** = SJS/TEN, versus **mucosa spared / superficial** = SSSS.

◣ REFER

- **Refer — now** — dermatology + the relevant team urgently; **PICU/burns** for extensive TEN; **ophthalmology**

for any mucosal/ocular involvement; **urology/gynecology** for genital involvement.

Pediatric ENT Emergencies MINUTES

AIRWAY / ENT

The airway threats, bleeds, and batteries that can't wait — stabilize first, then call ENT.

⚠ BUTTON BATTERY IN THE NOSE OR EAR — HOURS MATTER

- A disc battery lodged in the nose or ear causes **liquefactive necrosis and septal/ostial perforation within hours**; **unilateral foul or bloody discharge** is the clue.
- ENT emergency — **urgent removal**[213]; do **not irrigate** a nasal battery. (Swallowed batteries → **Button Battery Ingestion**.)

◣ RECOGNIZE & ACT

- **Acute upper-airway obstruction** — stridor, drooling, tripod posture → epiglottitis / bacterial tracheitis /

severe croup: keep the child **calm and upright, minimal handling**, call **anesthesia + ENT**, and **do not examine the throat**[3] (see **Croup**, **Difficult Airway**, **Retropharyngeal Abscess**).

- **Post-tonsillectomy bleeding** — any bleed (classically **day 5–10**) is an emergency: sit up, suction, **IV access + fluids/blood**, tranexamic acid, call ENT + anesthesia, prepare for the operating room. Swallowed blood **hides the true loss**.
- **Deep-neck / peritonsillar / retropharyngeal abscess** — trismus, muffled "hot-potato" voice, neck stiffness or torticollis → IV antibiotics, imaging, ENT; watch the airway.[214]
- **Acute mastoiditis** — post-auricular swelling/erythema with a **protruding pinna** after otitis media → IV antibiotics + ENT (risk of intracranial spread / venous sinus thrombosis).[99]
- **Severe epistaxis** — sit forward, **pinch the soft part 10–15 min**, topical vasoconstrictor; if uncontrolled or recurrent, ENT — consider a **bleeding disorder**, or juvenile angiofibroma in an adolescent boy.

- **Ear/nose foreign body** — refer for removal; for a live insect, instill lidocaine or oil first.

⚠ AIRWAY

Do **not** try to visualize the airway or lay the child flat when epiglottitis or a deep-neck abscess is suspected — summon **anesthesia/ENT**, keep the child calm and upright.

✦ PEARL — UNILATERAL DISCHARGE = FOREIGN BODY / BATTERY

Unilateral foul or bloody nasal discharge in a toddler is a **foreign body — and a battery until excluded**; examine, image if needed, and remove urgently.

✦ YOUR ROLE — THE GENERAL PEDIATRICIAN

- Secure the child first, not the diagnosis.
- In suspected epiglottitis or a deep-neck abscess, keep the child **calm and upright**, give oxygen, do **not** examine the throat or lay them flat, and summon **anesthesia + ENT**.
- For post-tonsillectomy bleeding, get **IV access, fluids/blood, and tranexamic acid** while ENT is

called — assume swallowed blood hides the true loss.

- Recognize the emergencies that can't wait: a **nasal/aural button battery** and **unilateral bloody discharge** need same-hour ENT.
- Control epistaxis with **10–15 min of firm pressure** before escalating.
- Your job is early recognition, first stabilization, and a timely ENT / anesthesia call.

REFER

- **Refer — now — ENT urgently —** nasal/aural battery, post-tonsillectomy bleed, deep-neck abscess, mastoiditis, or uncontrolled epistaxis; **anesthesia** for any airway threat.

Pediatric Neurosurgical Emergencies

MINUTES TIME-CRITICAL

Shunt failure, rising ICP, and cord compression — recognize early, control the pressure, and call neurosurgery.

⚠ VP SHUNT MALFUNCTION — TREAT AS RAISED ICP

- In a child with a shunt, **headache, vomiting, drowsiness, irritability, a bulging fontanelle, or any change from baseline = a blocked shunt until proven otherwise**.[215]
- Assess, image (**CT or rapid-sequence MRI + shunt series**), call **neurosurgery urgently**.
- Shunt **infection** (fever, redness/swelling along the tract, or a new malfunction) carries the same urgency — manage on a defined pathway: **sample CSF from the shunt/reservoir plus blood cultures**; start empiric antimicrobials covering **staphylococci (including MRSA) and Gram-negative organisms** — e.g. **vancomycin + an**

anti-pseudomonal beta-lactam (cefepime, ceftazidime, or meropenem); plan **removal or externalization of the infected hardware**; and involve **neurosurgery and infectious diseases early**.[216]

- Controlling raised ICP is the priority while awaiting neurosurgery.

RECOGNIZE & ACT

- **Raised ICP / impending herniation** — falling GCS, an unequal or fixed pupil, **Cushing's triad** (hypertension, bradycardia, irregular breathing), or abnormal posturing → **head up 30°, midline neck, normocapnia, treat seizures, hyperosmolar therapy** (hypertonic saline or mannitol), urgent neurosurgery (see[217] **Raised ICP**).
- **Non-traumatic intracranial hemorrhage** — sudden severe headache, focal deficit, or coma (AVM, aneurysm, tumor) → urgent CT + neurosurgery.
- **Depressed / open skull fracture or penetrating head injury** → neurosurgery + antibiotics + tetanus

(see Traumatic Brain Injury).

- **Acute spinal cord compression** — **neck or back pain** with **arm or leg weakness**, a sensory level, or bladder/bowel dysfunction (tumor, abscess, trauma) → **urgent MRI**, dexamethasone if tumor, and **urgent spine-surgical referral — neurosurgery or pediatric orthopedic spine surgery** (either may be consulted for extradural pathology: epidural abscess, vertebral/extradural tumor, or bony trauma) ± oncology — time-critical for recovery. In **traumatic spinal cord injury**, also involve **PICU for hemodynamic (MAP) support** — maintain mean arterial pressure and avoid hypotension to preserve cord perfusion; watch for **neurogenic shock** (hypotension with bradycardia).
- **CSF leak** — clear rhinorrhea/otorrhea or a tense pseudomeningocele after surgery/trauma → neurosurgery (meningitis risk).

⚠ DON'T DELAY IMAGING

A shunted child who is drowsy or vomiting needs **urgent imaging and a**

neurosurgical call — deterioration can be rapid; do not attribute it to a viral illness.

✦ **PEARL — ASK THE PARENTS**

Parents of a shunted or hydrocephalic child usually recognize their own child's **"shunt-failure pattern"** — take that history seriously and image.

✦ **PEARL — PROTECT THE PUPIL EXAM**

Have **ophthalmology look for papilledema**, but **avoid dilating the pupils in a drowsy or deteriorating child** — mydriatic drops abolish the pupillary response, a key sign of herniation.

✦ **YOUR ROLE — THE GENERAL PEDIATRICIAN**

- Recognize, control the pressure, and call — you are not expected to operate.
- In any shunted child, treat headache / vomiting / drowsiness / any change from baseline as a **blocked shunt until proven otherwise**: image (CT or rapid-sequence MRI + shunt series) and call neurosurgery.
- While waiting, deliver the **ICP first-aid that is yours** — head up

30°, midline neck, normocapnia, treat seizures and fever, and give hyperosmolar therapy for impending herniation.

- Take a parent's **“this is his shunt-failure pattern”** seriously.
- Don't anchor on a viral illness, and refer **time-critically** for cord compression (urgent MRI) and open / depressed skull fractures.

REFER

- **Refer — now** — neurosurgery urgently — shunt malfunction/infection, raised ICP, intracranial hemorrhage, or a depressed/open skull fracture; acute spinal cord compression — neurosurgery or pediatric orthopedic spine surgery (either for extradural pathology); add **PICU** for traumatic cord injury (MAP support).

08 Gastroenterology & Hepatology

GI bleeding · liver failure · pancreatitis · hepatitis · neonatal cholestasis · ingestion (foreign body / battery) · feeding-tube problems → **Common Acute Conditions**

Upper Gastrointestinal Bleeding

MINUTES

Hematemesis or melena — resuscitate first, then find and treat the source.

RECOGNIZE & STRATIFY

- Bleeding proximal to the ligament of Treitz: **hematemesis** (fresh or coffee-ground) or **melena**. Confirm true blood — swallowed maternal or epistaxis blood and red foods mislead.[218]
- **Clinically significant** = hemodynamic instability, a hemoglobin fall ≥ 2 g/dL, or a transfusion requirement — most need PICU.[218]
- **Age-based causes:** neonate — swallowed maternal blood, vitamin K deficiency bleeding, stress gastritis;

infant/child — reflux esophagitis, gastritis, peptic ulcer, Mallory-Weiss tear; any age with liver disease — **varices**. Consider an **ingested button battery** (urgent chest X-ray; see **Button Battery Ingestion**).[219]

◯ Investigate — order → look for → what it means

CBC + serial hemoglobin

LOOK FOR
Hb fall ≥ 2 g/dL; thrombocytopenia

WHAT IT TELLS YOU
Severity & transfusion need[218]

Blood group + crossmatch

LOOK FOR
—

WHAT IT TELLS YOU
Prepare blood early in any significant bleed

Coagulation — PT/INR, aPTT, fibrinogen

LOOK FOR
Coagulopathy

WHAT IT TELLS YOU
Non-variceal bleed: correct a true coagulopathy before/with endoscopy. **Suspected variceal bleed with chronic liver disease: do NOT give FFP just to correct the INR** (no hemostatic benefit; the volume load raises portal pressure) — plasma/platelets/cryoprecipitate only

case-by-case (failure to control bleeding, sepsis/DIC, another bleeding source). A prolonged INR also flags underlying liver disease[219]

LFTs + albumin

LOOK FOR

High bilirubin, low albumin

WHAT IT TELLS YOU

Chronic liver disease → suspect a **variceal** source[219]

Urea & creatinine

LOOK FOR

Urea raised out of proportion to creatinine

WHAT IT TELLS YOU

Supports an **upper** (vs lower) GI source — absorbed blood-protein load[219]

Venous blood gas + lactate

LOOK FOR

Metabolic acidosis, rising lactate

WHAT IT TELLS YOU

Hypoperfusion → the bleed is severe; escalate[219]

① RESUSCITATE FIRST

ABC, two large-bore IVs, crystalloid; send crossmatch; correct coagulopathy/thrombocytopenia (no routine FFP for the INR in variceal bleeding). Protect the airway in brisk hematemesis.

DECISION

Hemodynamically unstable?

UNSTABLE / MASSIVE

Resuscitate to **hemodynamics** and activate the **massive transfusion protocol** (empiric RBC:plasma:platelet ratios) — **not** a fixed Hb target.[220] PICU; urgent endoscopy once stabilized.[219,221]

STABLE

Restrictive transfusion — transfuse at **Hb < 7 g/dL**, target 7–9 g/dL (extrapolated from adult data). Over-transfusion raises portal pressure and can worsen variceal bleeding.[220,221,222]

DECISION

Variceal suspected?
(known/suspected liver disease, splenomegaly, umbilical-catheter history)

VARICEAL

Octreotide infusion (start early, after senior/GI discussion). In **cirrhotic** portal hypertension, add **broad-spectrum IV antibiotic prophylaxis** (per local susceptibility) for 5–7 days (e.g., ceftriaxone); role in non-cirrhotic PH unclear.[221] Endoscopy within 24 h — band ligation preferred (sclerotherapy if ligation is not feasible).[221]

NON-VARICEAL

High-dose IV **proton pump inhibitor**.[223] Endoscopy for hemostasis — injection + cautery/clips[219] (± hemostatic powder for refractory bleeding — adult guidance) — **early (≤ 24 h)** once resuscitated[219]; emergent/urgent (≤ 6–12 h) endoscopy only if still unstable despite resuscitation (adult guidance).[224]



Uncontrolled bleeding → balloon tamponade (Sengstaken-Blakemore) as a bridge in massive variceal bleeding; interventional radiology (TIPS) or surgery — keep the massive transfusion protocol running.[221]

Octreotide

DOSE

bolus 1–2 mcg/kg (max 50 mcg) then 1–2 mcg/kg/h infusion (max 50 mcg/h); if bleeding continues titrate up to ~5 mcg/kg/h, still not exceeding 50 mcg/h

ROUTE & NOTES

IV; variceal bleeding. Continue 2–5 days after endoscopy, then wean gradually (rebound risk); monitor glucose[225]

Pantoprazole / omeprazole

DOSE

1–2 mg/kg (max 40 mg — intentional pediatric maximum, gastroenterology review) IV bolus then 0.1–0.2 mg/kg/h infusion (max 8 mg/h) for severe bleeding

ROUTE & NOTES

Non-variceal bleeding. Bolus + infusion is an **adult-derived** regimen (80 mg then 8 mg/h for up to 72 h); pediatric evidence is limited and shows no advantage over intermittent dosing. Stress-ulcer prophylaxis uses standard once-daily dosing, not this regimen[223]

Ceftriaxone

DOSE

50 mg/kg/dose once daily (max 2 g)

ROUTE & NOTES

Broad-spectrum IV prophylaxis **per local susceptibility, 5–7 days**, in **cirrhotic** portal hypertension with acute variceal bleeding; benefit in non-cirrhotic portal hypertension unclear[221]

PRBC transfusion

DOSE

restrictive: transfuse at Hb < 7 g/dL, target 7–9 g/dL

ROUTE & NOTES

Especially variceal/cirrhosis (threshold extrapolated from adult data); transfuse promptly for hemodynamic instability or ongoing massive bleeding regardless of Hb[220,221,222]

⚠ AT THE BEDSIDE

Do not routinely place a nasogastric tube — in adults it does not improve outcomes, is complicated in about a third of patients, and endoscopy is the diagnostic and therapeutic tool (adult data).[226,227] **If varices are suspected** (known chronic liver disease or portal hypertension, splenomegaly, prior varices), **avoid blind nasogastric tube insertion** — it can traumatize varices and provoke bleeding, and gains nothing before endoscopy; leave gastric access to the endoscopy/anesthesia team

(expert consensus — not guideline-stated). **Protect the airway** in brisk hematemesis; do not over-transfuse a stable variceal bleed.[219,221]

ADMIT · DISCHARGE · REFER

- **Admit** — all significant bleeds → resuscitation and endoscopy.
- **Home from the emergency department** — a minor self-limited bleed after observation, with follow-up.
- **Refer — now** — gastroenterology (endoscopy); surgery/interventional radiology for uncontrolled bleeding.

Lower Gastrointestinal Bleeding

HOURS AGE-STRATIFIED

Hematochezia — most are benign, but resuscitate first and never miss the surgical causes.

RECOGNIZE & STRATIFY

- Bleeding distal to the ligament of Treitz: **hematochezia** (fresh or maroon blood/clots per rectum), or

melena from a brisk right-colonic/small-bowel source. Confirm it is blood — red foods, drugs, and bismuth mislead.[219]

- **Separate the sick from the well first:** a pale, tachycardic child, or blood with bilious vomiting or severe pain, points to a **surgical emergency** (intussusception, malrotation with volvulus, or NEC in a neonate) — see the red lines below.[219]
- **Age-based commonest causes:**
  - **Neonate** — swallowed maternal blood, anal fissure, cow's-milk protein allergy, **NEC**, vitamin K deficiency bleeding, malrotation/volvulus.
  - **Infant / toddler** — anal fissure, cow's-milk protein colitis, **intussusception**, **Meckel diverticulum** (painless, brisk), infectious colitis.
  - **Child / adolescent** — infectious colitis, **juvenile polyp** (painless), anal fissure, inflammatory bowel disease, Henoch-Schönlein purpura, hemorrhoids.

[219]

◯ Investigate — order → look for → what it means

CBC + serial hemoglobin

LOOK FOR

Anemia, Hb fall, thrombocytopenia; microcytosis

WHAT IT TELLS YOU

Severity & chronicity (microcytic = chronic loss)[219]

Coagulation — PT/INR, aPTT

LOOK FOR

Coagulopathy

WHAT IT TELLS YOU

Bleeding diathesis; vitamin K deficiency bleeding in a neonate[219]

Blood group + crossmatch

LOOK FOR

—

WHAT IT TELLS YOU

Prepare blood for any significant bleed

Urea & creatinine

LOOK FOR

A **raised** urea:creatinine ratio

WHAT IT TELLS YOU

Suggests an **upper** source instead — reconsider[219]

Stool — culture, *C. difficile*, ova/parasites; fecal calprotectin

LOOK FOR

Pathogen; raised calprotectin

WHAT IT TELLS YOU

Infectious colitis vs inflammatory bowel disease[219]

Abdominal ± Doppler ultrasound

LOOK FOR

Target / pseudo-kidney sign

WHAT IT TELLS YOU

Intussusception (bowel ultrasound is an adjunct in NEC)[219]

Abdominal X-ray (supine + left-lateral decubitus)

LOOK FOR

Pneumatosis, portal venous gas, free air; obstruction

WHAT IT TELLS YOU

NEC / perforation / obstruction — neonate with bloody stools, or any distension/peritonism

^{99m}Tc-pertechnetate (Meckel) scan

LOOK FOR

Ectopic gastric mucosa

WHAT IT TELLS YOU

Meckel diverticulum in painless brisk bleeding[219]

① RESUSCITATE FIRST

ABC, IV access, crystalloid, crossmatch; transfuse by the **restrictive** strategy (Hb < 7 g/dL) unless unstable or massively bleeding.[220]

DECISION

Sick child, or surgical features?

SURGICAL / UNSTABLE

Bilious vomiting, peritonism, a palpable mass or **currant-jelly** stool, or a distended tender neonatal abdomen → **urgent surgical review + imaging** (ultrasound for intussusception; contrast study for malrotation). Do not delay.[219]

WELL / STABLE

Treat by the likely cause — fissure care and address constipation; trial a cow's-milk-protein-free diet in a well infant with colitis; supportive care for infectious colitis.[219]

Persistent, significant, or unexplained bleeding → endoscopy (colonoscopy ± upper endoscopy) by pediatric gastroenterology; a Meckel scan for painless brisk bleeding.[219]

⚠ **RED LINES — DO NOT MISS**

- **Intussusception** — colicky pain, drawing up the legs, currant-jelly stool, a sausage-shaped mass — ultrasound first, then air/contrast enema reduction.
- **Malrotation with volvulus** — bilious vomiting with rectal bleeding is a surgical emergency until excluded.
- **Meckel diverticulum** — massive **painless** rectal bleeding in a young child.
- **NEC** in a preterm/neonate — distension, bloody stools, systemic upset (see **Necrotizing Enterocolitis**).

[219]

ADMIT · DISCHARGE · REFER

- **Admit** — any significant bleed, hemodynamic compromise, or a suspected surgical cause.

- **Home from the emergency department** — a well child with a minor self-limited cause (fissure, small polyp bleed) and follow-up.
- **Refer — now** — pediatric surgery for intussusception/volvulus/Meckel/NEC; gastroenterology for endoscopy.
- **Refer — clinic** — gastroenterology for suspected IBD or recurrent/unexplained bleeding.

Acute Liver Failure HOURS

Coagulopathy not corrected by vitamin K — transfer to a transplant center early.

DEFINE (PALF)

- Biochemical liver injury with a **coagulopathy not corrected by vitamin K**: INR ≥ 1.5 **with** hepatic encephalopathy, or INR ≥ 2.0 **without** it — and no known chronic liver disease.[228]
- Encephalopathy is hard to read in infants (irritability, poor feeding, reversed sleep). Look for hypoglycemia, jaundice, hyperammonemia.

- Seek a treatable cause: acetaminophen, herpes simplex virus, autoimmune hepatitis, Wilson disease, metabolic (galactosemia, tyrosinemia), gestational alloimmune liver disease.[228]

◯ Investigate — order → look for → what it means (NASPGHAN)

PT / INR

LOOK FOR

INR ≥ 1.5 with encephalopathy, or ≥ 2.0 without it — not corrected by vitamin K

WHAT IT TELLS YOU

Meets the PALF diagnostic criterion; the trend is the key prognostic marker[228]

Ammonia, glucose, venous gas/bicarbonate, lactate (± pyruvate)

LOOK FOR

Hyperammonemia, hypoglycemia, metabolic acidosis, high lactate

WHAT IT TELLS YOU

Complications & severity — drive PICU/transplant escalation[229]

Bilirubin, albumin/total protein, AST/ALT/GGT

LOOK FOR

Rising bilirubin, low albumin

WHAT IT TELLS YOU

Degree of hepatocellular injury & synthetic failure[229]

CBC, electrolytes, Ca/Mg/phosphate

LOOK FOR

Cytopenias, electrolyte derangement

WHAT IT TELLS YOU

Supportive-care targets; bleeding risk[229]

Etiology panel: acetaminophen level, HSV PCR + viral serology, autoimmune markers, ceruloplasmin/Wilson studies, metabolic screen (galactosemia, tyrosinemia), gestational alloimmune liver disease workup

LOOK FOR

A **treatable** cause

WHAT IT TELLS YOU

Directs specific therapy — NAC, acyclovir, immunosuppression, chelation, exchange/IVIG[229]

Suspect it → contact a pediatric liver transplant center / PICU immediately

SUPPORT

- Treat hypoglycemia (continuous dextrose, glucose infusion rate 6–8 mg/kg/min, titrated — concentrate the dextrose rather than raising the fluid rate; total IV fluids about 90% of maintenance unless resuscitating)
- Give one dose of parenteral vitamin K. **Do not routinely correct the INR without bleeding or a pre-invasive procedure** — it is the prognostic marker the transplant team needs.[228]
- Manage hyperammonemia/encephalopathy with transplant-hepatology/PICU guidance (lactulose/ammonia-lowering, nurse head-up, avoid sedatives, transfer early); cover empirically for sepsis if unwell.
- **Every neonate/young infant (≤ 90 days) with acute liver failure:** send HSV PCR (blood; surface swabs/CSF as feasible) and **start IV acyclovir 20 mg/kg/dose every 8 h empirically** — do not wait for vesicles or a maternal history; stop only when HSV is excluded. **Start N-acetylcysteine without delay**

when acetaminophen toxicity is confirmed or suspected (regimen: Poisoning card).

Dextrose infusion (10%; concentrate to 12.5–20% or more via a central line as needed)

DOSE

start at glucose infusion rate 6–8 mg/kg/min and titrate to glucose 90–120 mg/dL (5–6.7 mmol/L) — up to 10–15 mg/kg/min may be required; keep total IV fluids at about 90% of maintenance unless resuscitating

ROUTE & NOTES

Raise the dextrose concentration, not the fluid rate; check glucose frequently

Vitamin K

DOSE

1 mg in infants, scaled by age/weight up to 10 mg in older adolescents — one parenteral dose (subcutaneous or slow IV; not oral)

ROUTE & NOTES

To exclude vitamin K–responsive coagulopathy; recheck the INR

N-acetylcysteine

DOSE

per acetaminophen protocol

ROUTE & NOTES

Acetaminophen toxicity (confirmed or highly suspected) only. **Not for non-acetaminophen acute liver failure** — the pediatric RCT showed no survival benefit and significantly lower 1-year transplant-free survival with N-acetylcysteine (35% vs 53%), especially under 2 years; any use outside acetaminophen toxicity is a transplant-center decision[230]

Acyclovir

DOSE

20 mg/kg/dose every 8 h

ROUTE & NOTES

IV; empiric in every neonate/young infant (≤ 90 days) with acute liver failure until HSV PCR is negative — HSV is a treatable cause[99]

⚠ AVOID HARM

- Avoid sedatives/benzodiazepines (not cleared by a failing liver; they mask encephalopathy) and hepatotoxic drugs. **Do not chase a normal INR with plasma** in a non-bleeding child — it erases the key trend.
- Watch for cerebral edema (rising intracranial pressure) as encephalopathy advances.

ADMIT · DISCHARGE · REFER

- **Admit** — all → PICU/transplant center.
- **Home from the ward** — not acutely.
- **Refer — now** — hepatology/transplant urgently; PICU for encephalopathy/cerebral edema.

Acute Pancreatitis HOURS

NASPGHAN 2018

Diagnose on two of three — then fluids, analgesia, and early feeding.

DIAGNOSE (≥ 2 OF 3)

- Abdominal pain compatible with acute pancreatitis (epigastric, may radiate to the back).
- Amylase and/or **lipase ≥ 3× the upper limit of normal** (lipase is more specific).[231]
- Imaging consistent with acute pancreatitis (ultrasound first; CT/MRI if needed).
- Look for a cause in every case: structural/biliary, trauma (including inflicted injury), drugs, infection,

metabolic, systemic illness, genetic.

◯ Investigate — order → look for → what it means

Lipase (± amylase)

LOOK FOR

≥ 3× the upper limit of normal

WHAT IT TELLS YOU

Diagnostic criterion (lipase more specific than amylase)[231]

CBC, CRP, hematocrit

LOOK FOR

Leukocytosis, rising CRP, hemoconcentration

WHAT IT TELLS YOU

Inflammatory burden & early severity[231]

BUN, creatinine

LOOK FOR

Rising BUN, acute kidney injury

WHAT IT TELLS YOU

Key severity predictor — escalate fluids/PICU[231]

Glucose, calcium

LOOK FOR

Hyperglycemia, hypocalcemia

WHAT IT TELLS YOU

Severity markers[231]

ALT, AST, GGT, ALP, bilirubin + triglycerides + calcium (every first attack)

LOOK FOR

Raised ALT/bilirubin; high triglycerides or calcium

WHAT IT TELLS YOU

Biliary (gallstone) vs metabolic cause — suspected obstruction: **MRCP first**, then ERCP only when a therapeutic procedure is needed[231]

Abdominal ultrasound first-line; MRCP for suspected biliary or pancreatic-duct obstruction/anomaly; CT for suspected complications

LOOK FOR

Gallstones, necrosis, ductal anomaly, choledocholithiasis

WHAT IT TELLS YOU

Etiology & complications[231]

① **FLUIDS**

Crystalloid **1.5–2× maintenance** first 24–48 h (10–20 mL/kg bolus for hypovolemia). Target urine output > 0.5–1 mL/kg/h; monitor cardiac, pulmonary, and renal status closely for 48 h.[231]

② ANALGESIA & FEEDING

- Adequate analgesia, including opioids when needed. **Start enteral nutrition early** (within 48–72 h, as tolerated — oral/gastric/jejunal); enteral is preferred over parenteral.
- Prolonged gut rest is no longer recommended.[231]

No routine prophylactic antibiotics — reserve them for proven infection (e.g., infected necrosis).[231]

Crystalloid (balanced, or saline + 5% dextrose)

DOSE / SETTING

`1.5–2× maintenance, first 24–48 h`
`avoid overly aggressive fluids — reassess for pulmonary edema, AKI, and shock, especially in severe disease`

NOTES

Most important early intervention

Morphine

DOSE / SETTING

`0.05–0.1 mg/kg IV, titrate`

NOTES

Opioid analgesia when needed

Early enteral nutrition

DOSE / SETTING

`within 48–72 h`

NOTES

Oral/gastric/jejunal; enteral preferred over parenteral

⚠ WATCH FOR SEVERE DISEASE

- Most complications declare within 48 h.
- Persistent organ dysfunction (respiratory, cardiovascular, renal) defines severe acute pancreatitis — escalate to PICU.
- Gallstone pancreatitis: **cholangitis or persistent obstructive jaundice → urgent therapeutic ERCP** (within 48 h; adult data) — do not delay for MRCP. Obstruction only suspected/unclear → **MRCP** (or endoscopic ultrasound) first, then **ERCP** only if a stone/obstruction is confirmed. Involve surgery and GI; cholecystectomy before discharge after mild biliary pancreatitis.

ADMIT · DISCHARGE · REFER

- **Admit** — essentially all confirmed cases — for IV fluids, analgesia, and monitoring; ICU for organ

dysfunction or predicted severe disease.

- **Home from the ward** — mild disease once pain is controlled, feeding is re-established, and the cause is being addressed.
- **Refer — now** — surgical or gastroenterology review for biliary/structural causes, necrosis, or complications.

Acute Hepatitis HOURS

Most recover — the job is to catch the few progressing to liver failure.

ASSESS

- Raised transaminases ± jaundice, nausea, anorexia, right-upper-quadrant pain, dark urine, pale stools.
- Causes: viral (hepatitis A/B/C/E, EBV, CMV, adenovirus, enterovirus, herpes simplex virus, SARS-CoV-2), drug-induced (including acetaminophen), autoimmune hepatitis, Wilson disease, metabolic, ischemic.[99]

- **Check synthetic function and a coagulation profile (INR) at presentation** — it separates uncomplicated hepatitis from evolving liver failure. In a sick or deteriorating child, also send **ammonia, lactate, glucose,** and a **toxicology (acetaminophen) screen.**[228]

◯ Investigate — order → look for → what it means

AST/ALT, bilirubin

LOOK FOR
Markedly raised transaminases ± jaundice

WHAT IT TELLS YOU
Confirms hepatocellular injury

PT/INR, albumin

LOOK FOR
Prolonged INR, low albumin

WHAT IT TELLS YOU
Synthetic failure → evolving acute liver failure — separates it from uncomplicated hepatitis[228]

Ammonia, glucose, lactate, venous gas

LOOK FOR
Hyperammonemia, hypoglycemia, acidosis

WHAT IT TELLS YOU

Complications & severity in a sick/deteriorating child[228]

Acetaminophen level; viral panel — hepatitis A/B/C/E, EBV, CMV, HSV PCR

LOOK FOR

A treatable/infectious cause

WHAT IT TELLS YOU

Directs specific therapy (NAC, acyclovir) and public-health notification[99]

Autoimmune markers, ceruloplasmin, ferritin

LOOK FOR

Autoimmune hepatitis, Wilson disease, HLH

WHAT IT TELLS YOU

Specific etiologies not to miss[228]

MANAGE

- Mostly supportive: hydration, antiemetics, avoid hepatotoxins, review every drug.
- Test for **viral hepatitis** as indicated; send autoimmune markers, ceruloplasmin, and **ferritin**. Notify per public-health requirements for notifiable viral hepatitis.

Red flags → treat as acute liver failure: a rising INR not corrected by vitamin K, hypoglycemia, or any encephalopathy. Refer urgently.

⚠ **DON'T MISS THE TURN**

- A child with hepatitis who develops coagulopathy (INR ≥ 1.5–2.0), hypoglycemia, or altered behavior is no longer "just hepatitis" — escalate to the Acute Liver Failure pathway (see **Acute Liver Failure**) and contact a transplant center.
- Consider acetaminophen toxicity and Wilson disease in any severe presentation.[228]

◣ **ADMIT · DISCHARGE · REFER**

- **Admit** — any coagulopathy, hypoglycemia, encephalopathy, severe vomiting or dehydration, or diagnostic uncertainty.
- **Home** — well child with stable or improving enzymes, normal INR, tolerating oral intake, with follow-up.
- **Refer — now** — urgent transplant-center/hepatology referral if it evolves to acute liver failure

(rising INR, encephalopathy).

Neonatal Cholestasis ASSESS

NASPGHAN/ESPGHAN 2017 · FISPGHAN 2025

Conjugated jaundice is never physiological — the biliary-atresia clock is ticking.

THE RULE

- **Any infant still jaundiced at 2 weeks**, whatever the feeding, needs a **fractionated (total and direct) bilirubin** — so does any infant with pale or acholic stools or an enlarged liver or spleen at any age; do not assume breast-milk or physiological jaundice.[232]
- **Cholestasis** = conjugated/direct bilirubin **> 1.0 mg/dL (> 17 µmol/L), regardless of the total bilirubin** — always pathological (NASPGHAN/ESPGHAN 2017; the older "> 20% of total" rule is no longer used).[232,233]
- Pale (acholic) stools and dark urine point to biliary obstruction — use a stool-color reference card.

- **Prioritize the treatable causes** — exclude biliary atresia (time-critical), sepsis, urinary tract infection, hypothyroidism, hypopituitarism, galactosemia, and tyrosinemia.[232]

◯ Investigate — order → look for → what it means

Fractionated (total + direct) bilirubin

LOOK FOR

Direct > 1.0 mg/dL (> 17 µmol/L), regardless of the total

WHAT IT TELLS YOU

= cholestasis — **always pathological**[232,233]

GGT, ALT/AST, albumin

LOOK FOR

Pattern of injury (high- vs low-GGT)

WHAT IT TELLS YOU

Narrows the differential[232]

Coagulation (PT/INR)

LOOK FOR

Coagulopathy

WHAT IT TELLS YOU

Fat-soluble vitamin deficiency → **give vitamin K**[232]

Abdominal ultrasound (fasting), first-line

LOOK FOR

Absent/small gallbladder, triangular-cord sign; choledochal cyst — **a normal**

ultrasound does NOT exclude biliary atresia

WHAT IT TELLS YOU

Clue to **biliary atresia** (time-critical)[232]

Septic + metabolic screen — glucose, ammonia, lactate, blood gas, urine reducing substances, thyroid, cultures

LOOK FOR

A treatable cause

WHAT IT TELLS YOU

Exclude sepsis/UTI, hypothyroidism, galactosemia, tyrosinemia[232]

Neonatal conjugated hyperbilirubinemia = a medical emergency → urgent pediatric gastroenterology consultation

ACT NOW

Start the workup above the **same day**; give **vitamin K** (cholestasis impairs fat-soluble vitamin absorption and risks bleeding); do not wait for an outpatient appointment.[232]

⚠ BILIARY ATRESIA IS TIME-CRITICAL

- The earlier the Kasai portoenterostomy, the better the native-liver survival — a

meta-analysis confirms the benefit of diagnosis and surgery **before 30 days of life**; by convention results fall off sharply after 60 days.[232]

- A delayed referral for "prolonged jaundice" can cost the native liver.
- When in doubt, fractionate the bilirubin and refer the same day.

ADMIT · DISCHARGE · REFER

- **Admit** — for workup and any decompensation — a medical emergency for evaluation.
- **Home from the emergency department** — a stable infant with an expedited outpatient workup.
- **Refer — now** — pediatric hepatology urgently for the admitted infant (exclude biliary atresia before 6 weeks).
- **Refer — clinic** — pediatric hepatology urgently (expedited) for the stable infant sent home (exclude biliary atresia before 6 weeks).

Foreign Body Ingestion HOURS

ESPGHAN 2026

X-ray to locate it first; then the object and where it sits decide the timing.

FIRST STEP

- Ask **what, when, and how many**.
- **Plain radiographs** — a **chest X-ray (PA or AP frontal + lateral**, including the neck / upper esophagus) and an **abdominal X-ray**; together these cover neck-to-pelvis. The **frontal (AP) film** shows the button-battery **double-ring / halo** sign and the **lateral** film its **step-off** (vs a coin), and the lateral also locates an esophageal object; the **abdominal film** tracks an object that has passed into the stomach or bowel.
- **Radiolucent objects** (most plastic, wood, glass, thin aluminum, fish/food bones) may not show — **a normal film does not exclude them**; consider further imaging or endoscopy if suspicion is high.[234]
- Keep child fasting (nothing by mouth) until disposition decided.[234]

Now
endoscopy ≤ 2 h

WHICH SWALLOWED OBJECTS

Button battery in the esophagus; **two or more magnets**, or a magnet plus a metal object, while still within endoscopic reach (beyond it, involve surgery)[235]; sharp or pointed object in the esophagus; esophageal blockage — drooling, unable to swallow saliva; airway distress or signs of perforation; **any symptomatic child**.

Within 24 h
next day at the latest

WHICH SWALLOWED OBJECTS

Any other object lodged in the esophagus — never leave one there beyond 24 h.[235] Sharp object sitting in the stomach or duodenum (very low threshold to remove).

Elective
planned, > 24 h

WHICH SWALLOWED OBJECTS

Large blunt object in the stomach (> 2.5 cm wide or > 6 cm long; smaller limits in infants/toddlers) — unlikely to pass: plan elective endoscopic removal under optimal conditions if asymptomatic; urgent if symptomatic.[235]

Observe
at home, elective

WHICH SWALLOWED OBJECTS

A single blunt object (e.g., a coin) already past the esophagus into the stomach, < 2.5 cm wide and < 6 cm long, with no battery or magnet. 80–90% pass within 1–2 weeks. No routine serial films; if passage has not been observed, repeat the abdominal X-ray at ~ 2–4 weeks (earlier if symptoms) and remove electively if the object is still in the stomach.[234,235]

Water beads
early: discuss emergency endoscopy; then admit & observe with surgery

WHICH SWALLOWED OBJECTS

Superabsorbent (water) beads are radiolucent — plain films miss them; use **abdominal ultrasound**. Small ingestions (a few beads) usually pass: admit, serial abdominal examination, watch for bilious vomiting, distension or pain. **Early presentation with beads possibly still in the stomach: discuss emergency endoscopy to attempt retrieval** (ESPGHAN 2026)[235]; if retrieval fails or is incomplete, or the beads are already post-pyloric, admit for close observation. **Involve pediatric surgery early** for large ingestions or any sign of obstruction — most symptomatic children need an operation.[236,237]

⚠ RED LINES

- Batteries and multiple magnets are never simply observed — an esophageal battery or two or more magnets is an emergency at any level (see **Button Battery Ingestion**).
- A confirmed **single magnet** with no other metallic object may be managed as a blunt object (keep away from other magnets/metal; if any doubt about a second magnet, treat as multiple).[235]
- An esophageal foreign body left beyond 24 h risks pressure

necrosis, perforation, and aorto-/tracheo-esophageal fistula.[234]

- Return for pain, vomiting, fever, drooling, bleeding, or black stool.

◈ **WHO REMOVES IT** A foreign body lodged in the **UPPER (CERVICAL) ESOPHAGUS, AT THE LEVEL OF THE CLAVICLES (T2)**, typically removed by ENT with a **RIGID ESOPHAGOSCOPE**; objects lower (esophagus/stomach) usually managed by GI with flexible endoscopy.

◈ **SEE ALSO** **Button (Lithium) Battery Ingestion**.

◣ **ADMIT · DISCHARGE · REFER**

- **Admit** — symptomatic, an esophageal object, or high-risk (magnets, sharp, long).
- **Home from the emergency department** — asymptomatic gastric blunt object with return advice.
- **Refer — now** — GI/surgery for endoscopy (esophageal, magnets, sharp objects).

Button (Lithium) Battery Ingestion

MINUTES ESPGHAN 2026

An esophageal battery burns within 2 hours — move fast.

LOCALIZE

Urgent **chest X-ray (PA or AP frontal + lateral)** covering neck to upper esophagus (add an **abdominal X-ray** if the battery is not seen). A "double-ring / halo" sign distinguishes battery from coin. Esophageal location = emergency. **Do not induce vomiting.** [238]

DECISION

Battery in the esophagus?

YES — ESOPHAGEAL

Endoscopic removal within 2 hours. See mitigation doses below — do not let them delay removal. **Delayed presentation (> 12 h since ingestion) or bleeding:** CT (angiography) and surgical/cardiothoracic/IR back-up before removal. At endoscopy, if no perforation, irrigate with 50–150 mL of 0.25% sterile acetic acid (where local protocol allows).[238]

PAST ESOPHAGUS, asymptomatic

Consider endoscopy (inspect the esophagus, remove the battery) if ingestion was unwitnessed or > 12 h earlier **and** age < 5 years **and** battery ≥ 20 mm, or with prior GI surgery/anatomical abnormality; in delayed diagnosis also consider CT to exclude vascular injury. Remove urgently if symptomatic or a magnet was co-ingested. Otherwise outpatient: repeat abdominal X-ray in 7–14 days (sooner if symptoms) and remove if not passed.[235]

Honey

DOSE

10 mL every 10 min, up to 6 doses

ROUTE & NOTES

Oral; only if ingestion was < 12 h ago. Pre-hospital. **Only if ≥ 12 months — never give honey under 12 months.** [238]

Sucralfate

DOSE

1 g every 10 min, up to 3 doses

ROUTE & NOTES

Oral; in-hospital, before removal; not if ingestion was > 12 h ago [238]

⚠ AFTER REMOVAL

Injury continues — watch for delayed strictures and tracheo-/aorto-esophageal fistula; an aorto-esophageal fistula can present up to ~ 28 days later — give written return advice. If mucosal injury is severe: CT/MRI within 24–48 h, repeated every 48–72 h if the injury is close to major vessels (ESPGHAN 2026). [238]

◣ ADMIT · DISCHARGE · REFER

- **Admit** — all esophageal batteries → emergency.
- **Home from the emergency department** — after confirmed passage past the esophagus in an

asymptomatic child, per protocol.

- **Refer — now** — GI/ENT/surgery IMMEDIATELY for esophageal lodgement — do not delay.

Functional Constipation & Fecal Impaction

ASSESS ESPGHAN/NASPGHAN · NICE

Common, benign, and clinical — but disimpact before maintenance and screen for red flags.

RECOGNIZE (ROME IV)

- **< 4 years** — ≥ 2 of the following for ≥ 1 month; **≥ 4 years** — ≥ 2 at least once a week for ≥ 1 month (with insufficient criteria for IBS):
- ≤ 2 defecations/week
- painful or hard stools
- large-diameter stools
- a large fecal mass in the rectum
- excessive stool retention
- (if toilet-trained) ≥ 1 episode of fecal incontinence/week or a history of large stools that may obstruct the toilet.[239]

- Retentive posturing / withholding — often presents as **overflow soiling** mistaken for diarrhea.
- Acute presentations: abdominal pain, a palpable fecal mass, urinary symptoms, or a distressed withholding child.

DIAGNOSE — CLINICAL

- History + examination make the diagnosis. **Without a red flag, no routine investigations** — no bloods (celiac, thyroid, calcium, lead), imaging, allergy testing, or transit studies.[239]
- **A digital rectal exam is not needed when ≥ 2 Rome IV criteria are met** — reserve it for a single criterion, a red flag, or to confirm impaction when the abdominal exam is unclear. A plain abdominal film is not used to diagnose constipation.[239]

⚠ RED FLAGS — THINK ORGANIC DISEASE, DO NOT JUST TREAT

- Onset from birth or delayed meconium > 48 h (Hirschsprung)
- ribbon stools
- failure to thrive

- unintentional weight loss or slow growth
- bilious vomiting
- severe distension
- blood without a fissure
- abnormal anal position or tone, absent anal/cremasteric reflex, sacral dimple, hair tuft or lower-limb weakness (spinal)
- perianal scarring or extreme fear on exam (safeguarding)
- family history of autoimmune disease or cystic fibrosis.
- Examine the perineum and back.[240]

TREAT

- Disimpact first if a fecal mass is present — **maintenance alone will worsen overflow soiling.** Then start maintenance the same day, add behavioral measures, and review at 2 weeks.[240]
- **Goal — one soft, painless stool daily with no withholding or soiling.** Continue maintenance at goal for ≥ 2 months and until **symptom-free for ≥ 1 month** — in a toilet-training child, continue until trained — then **wean gradually rather than stopping abruptly**; do not stop while symptoms persist.[239]
- **Break the pain–withholding cycle** — an anal fissure or painful defecation drives retention; keeping stool soft (with topical fissure care) is what lets maintenance work.[241]

POLYETHYLENE GLYCOL (PEG 3350/4000) — FIRST-LINE FOR BOTH STEPS

Disimpaction

DOSE

PEG 1–1.5 g/kg once daily (oral) for 3–6 consecutive days

NOTES

Oral is as effective as enemas and less invasive; expect a few messy days. A rectal enema is an alternative if oral is refused or fails.[240] Sodium phosphate (pediatric Fleet) enema: **not under 2 years**; 2 to under 5 years half a bottle (~30 mL), 5–11 years one bottle (59 mL); no more than one in 24 h; ask a doctor first if the child has kidney disease or is on a sodium-restricted diet (product label).[242]

Maintenance

DOSE

PEG 0.4–0.8 g/kg/day in 1 or divided doses (start ~0.4 g/kg/day; titrate to effect)

NOTES

First-line and **superior to lactulose**. Titrate to the goal above; reassess at 2 weeks if inadequate. If not controlled at ~0.8 g/kg/day, re-check for impaction/adherence and add a stimulant rather than continuing disimpaction-range doses (ESPGHAN/NASPGHAN 2026).[824]

Add-on / alternative

DOSE

Stimulant (senna or bisacodyl, age-appropriate)
lactulose if PEG unavailable

NOTES

Second-line adjunct when PEG alone is insufficient — not a substitute for disimpaction.

◆ PEG — WITH OR WITHOUT ELECTROLYTES

- Same drug (macrogol); the only difference is added balancing salts. **With electrolytes** for high-volume **disimpaction**; **without** (more palatable) is an equal option for **maintenance**. The electrolyte-containing macrogol stocked locally covers both; improve palatability by chilling and mixing it into a flavored drink.[243,244]

◆ SIDE-EFFECTS & PRECAUTIONS

- **PEG (osmotic)** — dose-related loose stools, bloating, flatulence and nausea; over-titration can cause diarrhea or overflow soiling — **reduce the dose, do not stop**. Maintain adequate fluid intake. Clinically significant electrolyte

disturbance is rare (the electrolyte form guards against it further), and there is **no tolerance or dependence** with long-term use.[239]

- **Stimulants (senna, bisacodyl)** — abdominal cramps and diarrhea; in diaper-wearing or incontinent children, prolonged skin contact with senna can cause a blistering perianal ("senna") dermatitis, so keep the skin clean and barrier-protected. No good evidence for a "lazy bowel" at therapeutic doses.[239]
- **Lactulose** — flatulence, bloating and cramps, with more adverse events than PEG and inferior efficacy; reserve it for where PEG is unavailable, unlicensed, unaffordable or not tolerated.[245,824]
- **General** — titrate to one soft, painless stool daily; do not stop abruptly (relapse); recheck adherence and dose before escalating.

◈ **INFANTS < 1 YEAR**

- **≥ 6 MONTHS:** PEG is first-line; **LACTULOSE IS THE ALTERNATIVE** where

PEG is unavailable or unlicensed. **< 6 MONTHS:** evidence for PEG is lacking (expert experience only, usually unlicensed) — lactulose is a reasonable first choice; use PEG on specialist advice (ESPGHAN/NASPGHAN 2026).[824]

- In a **REFRACTORY** infant, consider a **2–4 WEEK TRIAL OF A COW'S-MILK-PROTEIN-FREE DIET**.
- **INFANT DYSCHEZIA** — straining then passing a *soft* stool, < 9 months — is **NOT** constipation and needs no laxative.[239]

✦ WHEN MAINTENANCE ISN'T WORKING

- **Check adherence and dose first** — under-dosing and stopping too early are the commonest reasons for relapse.
- Re-check for a **retained impaction**; re-disimpact if present.
- Add a **stimulant** (senna or bisacodyl); then reconsider the diagnosis / red flags.
- **Linaclotide** (6–17 years, 72 mcg once daily) may be considered by a pediatric gastroenterologist when PEG ± stimulant has failed (ESPGHAN/NASPGHAN 2026);

prucalopride and lubiprostone are **not established in children**.[240]

✦ DIET, BEHAVIOR & COUNSELING

- Normal fiber and fluid; **fiber supplements and extra fluid beyond the daily requirement are not proven**, routine probiotics are not recommended (one specific mixture has low-certainty evidence), and none replaces a laxative.[824]
- Demystify and remove blame; scheduled toilet sits ~5 min after meals with foot support; a stool diary and reward system.
- **Long-term PEG is safe and not habit-forming** — reassure families to keep the dose adequate.[239]
- Relapse is common and treatment often runs months; about half are off laxatives by 6–12 months — set expectations and follow up.[240]

◣ ADMIT · DISCHARGE · REFER

- **Admit** — rarely — failed disimpaction or severe symptoms.

- **Home from the emergency department** — most, with disimpaction, maintenance laxatives, and education.
- **Refer — clinic** — pediatric **gastroenterology** for red flags / suspected organic disease, failure of optimized maintenance after ~3 months, diagnostic uncertainty, or a child needing ongoing second-line therapy; **surgery for suspected Hirschsprung** — rectal suction biopsy is the gold standard (contrast enema and anorectal manometry are adjuncts).[239]

Reflux & GERD ASSESS

INFANT-FOCUSED · 2018

Distinguish the thriving "happy spitter" from true reflux disease.

REFLUX VS DISEASE

- **GER (physiological):** effortless regurgitation in a comfortable, thriving infant; peaks ~4 months, resolves by 12–18 months. Not a disease[246] — reassurance.

- **GERD:** reflux causing troublesome symptoms or complications — feeding refusal, faltering growth, esophagitis, recurrent aspiration.[246]

① REASSURE + CONSERVATIVE

- Parental education; avoid overfeeding; smaller, more frequent feeds; thickened feeds; hold upright after feeds; continue breastfeeding.
- Do **not** use prone/side positioning for sleep (SIDS risk).[246]

↓

② TRIAL IF NOT IMPROVING (INFANT)

2–4 weeks of extensively hydrolyzed (or amino acid) formula, or maternal dairy exclusion if breastfed — overlaps with cow's milk protein allergy.[246]

↓

INFANT · still not responding

Refer to gastroenterology — do **not** start acid suppression in an infant yourself. The gastroenterologist assesses and decides the next step: a **PPI / H2 trial**, or **upper-GI endoscopy or a contrast study**.[246]

OLDER CHILD · confirmed GERD

Time-limited **4–8 week** trial of acid suppression (proton-pump inhibitor or H2-antagonist), then **wean and reassess**.[246]

⚠ DO NOT ACID-SUPPRESS SIMPLE REFLUX

- Proton-pump inhibitors are **not** recommended for unexplained crying, distress, or visible regurgitation in an otherwise well infant — no benefit and real harms.[246]
- Avoid acid suppression for isolated cough/wheeze. **Red flags** (investigate / refer): bilious or projectile vomiting, blood in vomit or stool, onset after 6 months or persisting beyond 12–18 months, faltering growth, fever, lethargy, or a bulging fontanelle.

◣ ADMIT · DISCHARGE · REFER

- **Admit** — rarely — only for complications (apnea, faltering growth, aspiration) or diagnostic uncertainty.

- **Home from the emergency department** — uncomplicated reflux with reassurance and feeding advice.
- **Refer — clinic** — gastroenterology for red flags, faltering growth, or treatment failure.

Ingestion Injuries — See Also

Corrosive ingestion is covered in the Toxicology section.

◈ **CROSS-REFERENCE CAUSTIC (CORROSIVE) INGESTION** (Toxicology & Environmental) — acid/alkali esophageal injury; no charcoal, no emesis, airway first, endoscopy at 12–24 h.

Acute IBD Flare & Toxic Megacolon

MINUTES ESPGHAN-ECCO 2025

Bloody diarrhea with systemic upset — and the colon that dilates and can perforate.

RECOGNIZE

- Known or new IBD with **frequent bloody stools**, abdominal pain, fever, tachycardia and raised inflammatory markers; grade severity (e.g. **PUCAI** in ulcerative colitis).
- **Toxic megacolon** — transverse colon ≥ 56 mm on abdominal X-ray (> 40 mm if under 10 years) with systemic toxicity (fever, tachycardia, tenderness/distension); a surgical emergency.[247]

⚠ WHAT MAKES IT WORSE

- **Avoid antimotility agents, opioids, anticholinergics and NSAIDs** — they can precipitate toxic megacolon or worsen the colitis.[247]
- Exclude infection (including **C. difficile** and enteric pathogens) before/while escalating immunosuppression.

- Rising distension, worsening toxicity, or free air means **surgery**.

WORKUP

- **PUCAI at admission and daily** (score it below) — acute severe colitis = PUCAI ≥ 65. **Day 3 > 45** → plan second-line therapy (screen, discuss); **day 5 ≥ 65** → start second-line; **35–65 on day 5** → continue IV steroids 2–5 more days with daily scoring; **< 35** → responding, continue and transition to oral.[247]
- CBC, CRP/ESR, albumin, electrolytes, renal and liver function.
- **Stool infection panel including *C. difficile*** (consider CMV on biopsy if steroid-refractory).
- **Abdominal X-ray** for colonic dilatation / toxic megacolon; limited unprepped sigmoidoscopy where needed.

PUCAI — SIX CLINICAL ITEMS, NO LABS (0–

85)

Abdominal pain

SCORE
none **0** · can be ignored **5** · cannot be ignored **10**

Rectal bleeding

SCORE
none **0** · small amount, in < 50% of stools **10** · small amount with most stools **20** · large amount (> 50% of stool content) **30**

Stool consistency (most stools)

SCORE
formed **0** · partially formed **5** · completely unformed **10**

Stools per 24 h

SCORE
0–2 **0** · 3–5 **5** · 6–8 **10** · > 8 **15**

Nocturnal stools (waking the child)

SCORE
no **0** · yes **10**

Activity level

SCORE
no limitation **0** · occasional limitation **5** · severely restricted **10**

- **< 10** remission · **10–34** mild · **35–64** moderate · **≥ 65** severe (acute

severe colitis — admit for IV steroids).[247,248]

Resuscitate

APPROACH

IV fluids, correct electrolytes (esp. K^+), transfuse if needed

NOTES

Monitor for toxic megacolon

Treat the flare

APPROACH

IV methylprednisolone 1 mg/kg once daily (max 40 mg); 1.5 mg/kg (max 60 mg) at the gastroenterologist's discretion; total IV course no longer than 7–10 days

NOTES

Gastroenterology-directed; **escalate by day 5 if inadequate response — infliximab preferred** (cyclosporine or tacrolimus as alternatives); **consider pharmacologic VTE prophylaxis in every child admitted with acute severe colitis** — enoxaparin 1 mg/kg SC once daily (max 40 mg), or 0.5 mg/kg twice daily under 40 kg, continued until discharge[247]

Toxic megacolon

APPROACH

Bowel rest, decompression, urgent surgical review

NOTES

Colectomy if deteriorating/perforation

ADMIT · REFER

- **Admit** — all acute severe colitis.

- **Refer — now** — pediatric gastroenterology and surgery (early joint care for toxic megacolon).

09

Hematologic & Oncologic

Neutropenia · tumor lysis · sickle cell · bleeding

Chemotherapy-induced Febrile Neutropenia

MINUTES

Fever in a child on chemotherapy — a medical emergency until proven otherwise.

◈ NOT ON CHEMOTHERAPY?

- This card is for the **oncology / chemotherapy (or post-transplant) patient**. For a **well, previously healthy, immunocompetent child** with an incidental fever + neutropenia, use **Febrile Neutropenia — Otherwise Healthy Child** instead — empiric

antibiotics are usually **not** required.[249,250]

DEFINE

- Fever — single oral temp ≥ 38.3 °C, or ≥ 38.0 °C sustained over 1 h between checks, **without antipyretic use** (even if first reported at home) — **plus** absolute neutrophil count < 500 cells/µL (or expected to fall below 500 within 48 h).[825]

Empiric broad-spectrum antibiotics immediately — target within 1 hour (NICE: an acute medical emergency; IDSA: within 2 h) — do not wait for the count[825,826]

WORKUP

- Blood cultures (peripheral + each central line lumen — at least one must be drawn, central preferred; do not delay antibiotics waiting for both), full blood count with differential, renal panel (electrolytes, creatinine, glucose), lactate, urinalysis ± culture, focused exam (skin, mouth, perianal inspection, line site) — no rectal temperatures (oral or axillary only) and avoid rectal manipulation
- Start antibiotics immediately if unstable — even without labs collected.[251]

Piperacillin-tazobactam

DOSE

75–80 mg/kg/dose (piperacillin component) every 6 h (max 4000 mg/dose)

ROUTE & NOTES

IV; first-line anti-pseudomonal monotherapy[251,252]

Cefepime

DOSE

50 mg/kg/dose every 8 h (max 2000 mg/dose)

ROUTE & NOTES

IV; alternative monotherapy if piperacillin-tazobactam is unavailable[252]

Meropenem

DOSE

20 mg/kg/dose every 8 h (max 1 g/dose)
CNS infection (or severe/resistant infection on ID advice): 40 mg/kg/dose every 8 h (max 2 g/dose)

ROUTE & NOTES

IV; an option in penicillin or cephalosporin allergy (low carbapenem cross-reactivity) — **NOT after SJS/TEN/DRESS to any β-lactam**; with previous anaphylaxis discuss with ID/allergy (non-β-lactam alternative: aztreonam + vancomycin, or ciprofloxacin + clindamycin); also for resistant organisms, CNS infection, or instability[252]

Ceftazidime (+ vancomycin)

DOSE

50 mg/kg/dose every 8 h (max 2000 mg/dose)

ROUTE & NOTES

IV; if piperacillin-tazobactam is unavailable — give with vancomycin for gram-positive cover[252]

Vancomycin (add only if indicated)

DOSE

15 mg/kg/dose every 6 h if < 12 yr
every 8 h if ≥ 12 yr (max 1 g/dose; level-guided)

ROUTE & NOTES

IV; for instability, line/skin infection, known resistant organism — not routine; requires drug-level monitoring

◈ **LOCAL CHOICE**

- Follow your local antibiogram — the empiric agent should match local

resistance.

- Add an **AMINOGLYCOSIDE** (amikacin or gentamicin) **ONLY** for hemodynamic instability or known/suspected multidrug-resistant gram-negative rods, and until culture results are available.[252]
- **SELECTED LOW-RISK** (including but not limited to: anticipated neutropenia ≤ 7 days, no comorbidity, stable, tolerating oral intake, reliable caregiver & transport) may be managed as an outpatient as per local protocol: day-1 IV **CEFTRIAXONE** (100 mg/kg, max 4 g) + gentamicin, stepping down to oral ciprofloxacin + amoxicillin-clavulanate; review daily.[252]
- Do not routinely add vancomycin (other than as the gram-positive companion to ceftazidime above).[251] Granulocyte colony-stimulating factor only in consultation with hematology/oncology. **AGE < 2 MONTHS** (rare): ampicillin + ceftazidime, in consultation with infectious diseases / pediatric hematology-oncology (expert practice — not guideline-stated).

ADMIT · DISCHARGE · REFER

- **Admit** — high-risk febrile neutropenia (oncology/chemotherapy) → immediate empiric antibiotics.
- **Home from the emergency department** — only selected low-risk oncology patients, after formal risk assessment, the first antibiotic dose and agreement with oncology, within an established outpatient pathway with daily review. (The well non-oncologic child: see **Febrile Neutropenia — Otherwise Healthy Child**.)
- **Refer — now** — oncology/hematology.

Febrile Neutropenia — Otherwise Healthy Child

ASSESS · IMMUNOCOMPETENT CHILD

The well child with fever, commonly a viral illness, found to have an incidental low ANC — usually transient and benign, unlike chemotherapy-induced neutropenia from

myelosuppression. Some malignancies (e.g., a localized brain tumor) do not suppress the marrow and so do not cause neutropenia.

◈ THE KEY QUESTION — WHICH CAME FIRST?

- **INFECTION → NEUTROPENIA** (a virus transiently suppresses or consumes neutrophils in a healthy child) behaves very differently from **NEUTROPENIA → INFECTION** (marrow failure, malignancy, post-transplant).[249]
- Most well, febrile children with incidental neutropenia are the former and do **NOT** need empiric febrile-neutropenia antibiotics.[249]

◣ DEFINITIONS & MECHANISM

- **Neutropenia = absolute neutrophil count (ANC) < 1500/µL.**
- Mild 1000–1500
- moderate 500–1000
- **severe < 500**; very severe < 200.
- Normal ANC varies by age and ancestry: **Duffy-null associated neutrophil count (DANC**, formerly 'benign ethnic neutropenia') is common in people of Middle Eastern and African ancestry — a lifelong

lower ANC (often about 1000–1500/µL, sometimes lower) without added infection risk; in a well child with persistent isolated neutropenia consider a red-cell Duffy phenotype (Fy a−b−) with hematology (JCO Glob Oncol 2026; CERSI-PGx guideline 2026).

- **Fever:** temperature > 38 °C (CPS). The oncology definition (single oral ≥ 38.3 °C, or ≥ 38.0 °C sustained over 1 h) applies to **Chemotherapy-induced Febrile Neutropenia**. Avoid rectal temperatures (mucosal trauma).[249]
- **Common viral triggers:** RSV, influenza A/B, parvovirus B19, Epstein-Barr virus (EBV), cytomegalovirus (CMV), human herpesvirus 6 (HHV-6), varicella-zoster. Other unidentified viruses may also cause neutropenia or other transient cytopenias. Mechanisms: transient marrow suppression, peripheral destruction/margination, or an autoimmune process.[249]

WHAT MAKES IT LOW-RISK (USUALLY PRESUMED VIRAL)

- **Age 6 months–18 years, first episode, well-appearing**, immunocompetent and fully immunized, clear viral context, no features of sepsis or primary immunodeficiency, no central line or chronic disease (e.g., sickle cell disease), no other cytopenia or high MCV, no hepatosplenomegaly or lymphadenopathy. **Under 6 months: not covered by this pathway** — discuss with hematology (see also **Fever in a Well-Appearing Infant < 2 Months**). ANC < 500/µL: review within 24–48 h; at ANC 0–200/µL empiric antibiotics may be considered.[249]
- **Short anticipated duration** — viral neutropenia typically resolves within ~2–4 weeks, rarely beyond 6 weeks; risk rises mainly when neutropenia is prolonged[249] (> 30 days).
- No prior neutropenia, recurrent/severe infections, failure to thrive, or family history of a congenital syndrome; not on a neutropenia-inducing drug; not immunosuppressed.

DECISION

Ill-appearing or any high-risk feature?

LOW-RISK · WELL CHILD

Well-appearing, presumed viral, short-duration, no clue to an underlying cause. **Low risk of serious infection** — manage supportively with close follow-up. A history of a previously normal ANC is reassuring here.

HIGH-RISK

Ill-appearing (hypothermia, hypotension, lethargy), or known/suspected **severe congenital neutropenia (no prior normal ANC on record; e.g., Kostmann), aplastic anemia, or other marrow-failure/immunodeficiency** → medical emergency.

Most transient neutropenia is viral — it does not require antimicrobial therapy.[249]

Cultures

WHAT TO DO

Blood culture stratified by severity: not required in mild (ANC 1000–1500), consider in moderate (500–1000), obtain in severe (< 500)
consider urine culture (esp. young / female)

NOTES

CPS: ensure a peripheral blood culture in severe neutropenia (ANC < 0.5 $\times 10^9$/L) and in any ill-appearing child; consider urinalysis/urine culture in incontinent children (generally < 24 months) or with UTI risk factors.[249] Don't rely on urinalysis — pyuria is often absent in neutropenia (expert consensus). In a meta-analysis of well-appearing febrile neutropenic children, serious bacterial infection was uncommon (pooled 1.9%, range < 0.01–11%), similar to non-neutropenic children.[250]

Blood film

WHAT TO DO

Peripheral blood film in all newly discovered neutropenia (if not already done)

NOTES

Look for blasts, dysplasia or a left shift — helps exclude malignancy / marrow failure.

Identify the virus

WHAT TO DO

Consider a respiratory multiplex PCR (not just influenza/RSV)

NOTES

Confirming a viral cause supports a benign, transient course; may not always identify a specific viral species.

Targeted tests

WHAT TO DO

As indicated: chest radiograph, abdominal imaging, lumbar puncture, stool testing

NOTES

A normal radiograph can mislead — infiltrates may appear only as the ANC recovers.

Disposition

WHAT TO DO

Discharge home with close follow-up if well and follow-up assured

NOTES

Recheck CBC to confirm recovery[249]; most normalize within ~2–4 weeks.

HIGH-RISK — MANAGEMENT

Act promptly

AGENT / APPROACH

Full infectious work-up, hospitalize, start empiric antimicrobials without waiting for the ANC trend

NOTES

Involve hematology ± infectious diseases early.

First-line

AGENT / APPROACH

Piperacillin-tazobactam (broad-spectrum, anti-pseudomonal)

NOTES

Backbone of high-risk empiric cover, as in chemotherapy-related FN.[251]

Tailor by risk

AGENT / APPROACH

Adjust for known colonization (MDRO, MRSA), prior prophylaxis, local antibiogram

NOTES

Add MRSA cover (vancomycin) for hemodynamic instability, line, or skin/soft-tissue infection.

⚠ DON'T OVER-TREAT — OR UNDER-TREAT

- The well child with an incidental low ANC during a viral illness is **not** chemotherapy-induced myelosuppression — reflexive broad-spectrum antibiotics add resistance and harm with little benefit.

- Conversely, never anchor on “just a virus”: an **ill-appearing** child, **prolonged** neutropenia (> 30 days), recurrent/severe or unusual infections, oral ulcers, or failure to thrive warrant a congenital/marrow-failure work-up and prompt treatment.[249]

ADMIT · DISCHARGE · REFER

- **Admit** — only if febrile with concerning features or a suspected/confirmed bacterial infection.
- **Home from the emergency department** — well child — expectant management with a scheduled recheck of counts.
- **Refer — clinic** — hematology for persistent (> 6 weeks), profound (< 500 consistently), or recurrent neutropenia.

Tumor Lysis Syndrome MINUTES

BSH 2025 · COIFFIER 2008

Massive cell breakdown — after starting chemotherapy, or spontaneously in high-burden leukemia/lymphoma.

THE BIOCHEMICAL QUARTET

- **High** potassium, **high** phosphate, **high** uric acid; **low** calcium → acute kidney injury (see **Acute Kidney Injury**), arrhythmia, seizures.[253]

① HYDRATION IS THE BACKBONE OF CARE

- **Established TLS:** IV hyperhydration starting at **3 L/m²/day, up to 4 L/m²/day** in children by renal function and fluid status (BSH 2025); adjust to keep urine output ≈ **100 mL/m²/h** (80–100 mL/m²/h; 4–6 mL/kg/h if ≤ 10 kg); 200 mL/kg/day if ≤ 10 kg.[253,254]
- **No potassium in any IV fluid** — balanced crystalloids (Hartmann's, Plasma-Lyte) contain potassium; avoid potassium and phosphate supplements; loop diuretic only for fluid overload; caution in high-count leukemia with low hemoglobin (hemodilution).[254]
- **Prophylaxis:** oral fluids 2–3 L/m²/day the day before, the day of and the day after starting therapy; IV hydration if high risk or unable to drink.[254]
- Routine urinary alkalinization not recommended.[253,254]

DECISION

Risk level?

INTERMEDIATE

Allopurinol + hydration.[253]

HIGH / ESTABLISHED

Rasburicase + hydration. Do not give allopurinol on a rasburicase day. High risk (BSH 2025) includes acute leukemia with white cell count ≥ 100 $\times 10^9$/L (ALL also with bulky disease); Burkitt or lymphoblastic lymphoma at advanced stage, or with LDH ≥ 2× the upper limit of normal or bulky disease; and late-stage high-grade lymphoma with LDH ≥ 2× the upper limit or bulk.[254] The older Coiffier 2008 scheme set the AML threshold lower, at ≥ 50 $\times 10^9$/L.[253] Pre-existing high uric acid, potassium or phosphate, or renal impairment, raises the risk further.[253]



② TREAT THE ELECTROLYTES

- Manage hyperkalemia (see **Electrolyte Emergencies**).
- Treat symptomatic hypocalcemia with appropriate replacement.
- For refractory derangement or oliguric kidney injury, escalate urgently to nephrology/PICU — dialysis is a specialist decision (AEIOU indications); the threshold is lower than in other AKI because lysis is ongoing.[254]
- **Monitor** potassium, uric acid, phosphate, calcium and creatinine every 6–12 h in established TLS (more often for life-threatening hyperkalemia); at least twice daily, up to 3–4×/day, in high-risk prophylaxis; strict fluid balance and urine output.[254]

Allopurinol

DOSE

10 mg/kg/day PO divided every 8 h (max 800 mg/day)
= 100 mg/m² 8-hourly (BSH)

ROUTE & NOTES

PO; start ≥ 12 h before chemotherapy; prevents new urate; reduce the dose by 50% in renal impairment; **reduce 6-mercaptopurine or azathioprine by 50–70%** when given together; interactions also with thiazide diuretics, amoxicillin/ampicillin and cyclophosphamide; skin reactions.[253,254]

Rasburicase — oncology-directed

DOSE

0.2 mg/kg IV over 30 min once daily
Repeat doses and duration are decided with the oncology team by uric acid and clinical response (licensed course up to 5 days; 3–5 days is often sufficient; BSH allows up to 7 days for established TLS in adults)
Stop allopurinol while on rasburicase; restart 24 h after the last dose

ROUTE & NOTES

Breaks down existing urate. Start, repeat doses and duration are the oncology team's decision — the licensed 0.2 mg/kg/day is the recommended pediatric dose.[254,255] Samples for uric acid **on ice**. **Do NOT give in known G6PD deficiency**; in a very unwell child the consultant may give it without waiting for the result after weighing the risks.[254]

⚠ RASBURICASE + G6PD DEFICIENCY

- Rasburicase is **contraindicated** in glucose-6-phosphate

dehydrogenase deficiency (causes hemolysis and methemoglobinemia) — screen at-risk patients before giving — **G6PD level** if status unknown (e.g., new diagnosis not yet screened); especially relevant here given high prevalence.[256]

- Send urate samples on ice.[253]

ADMIT · DISCHARGE · REFER

- **Admit** — all at-risk or established TLS → hyper-hydration and monitoring (allopurinol for intermediate risk; rasburicase for high risk or rapidly rising uric acid); severe/refractory → PICU with the dialysis team (nephrology).
- **Home from the ward** — not acutely; after resolution of TLS and confirmed stability.
- **Refer — now** — oncology/nephrology (dialysis for refractory).

Sickle Cell Crises MINUTES

Pain crisis, acute chest syndrome, splenic sequestration, and stroke — plus every patient is functionally asplenic.

VASO-OCCLUSIVE (PAIN) CRISIS

Analgesia — fast

ACTION

Opioid within 30–60 min; add NSAID/acetaminophen

NOTES

Use a pain protocol; reassess every 15–30 min. **Do not delay analgesia** — splinting (shallow, guarded breathing from pain) can progress to acute chest syndrome.[257,258]

Hydration

ACTION

Oral if able; if unable to drink, IV at no more than maintenance rate

NOTES

Avoid over-hydration (acute chest risk)[259]

Oxygen + warmth

ACTION

If SpO_2 < 95% on room air[259] (or below baseline)

NOTES

Keep warm; treat the trigger

⚠ ACUTE CHEST SYNDROME

- **Definition:** new pulmonary infiltrate + respiratory symptoms / fever / chest pain — the leading cause of death in patients with sickle cell disease.
- **Treatment:** oxygen (keep SpO_2 > 95%), broad-spectrum antibiotics covering atypicals (cefotaxime + azithromycin/clarithromycin), bronchodilator if wheezing, incentive spirometry while awake.[259]
- **Escalation:** early hematology/PICU discussion for **simple vs exchange transfusion** if severe hypoxia or falling hemoglobin.[259] **Severe** acute chest syndrome → red cell exchange (automated preferred) over simple transfusion; **moderate** → simple transfusion or exchange, moving to exchange if it progresses rapidly, fails to respond to simple transfusion, or the hemoglobin is too high for a simple transfusion (ASH 2020 transfusion guideline).[260]

⚠ SPLENIC SEQUESTRATION

- Rapidly enlarging spleen + falling hemoglobin **and/or platelet count** → hypovolemic shock. Give fluids for shock and consult hematology immediately.
- Transfuse **cautiously** to raise the hemoglobin to a stable level, not to normal.[259] Over-transfusion risks rebound hyperviscosity as the spleen releases trapped cells (expert consensus).
- **Any red-cell transfusion in sickle cell disease:** ABO/RhD plus **Rh (C, E) and K-matched** units; an extended red-cell antigen profile (genotype preferred) before the first transfusion. When transfusing before surgery, do not exceed a post-transfusion hemoglobin of 11 g/dL (ASH 2020 transfusion guideline).[260]

⚠ ACUTE STROKE

- Sudden focal deficit, seizure, or new altered consciousness → **urgent neuroimaging** with immediate hematology and neurology involvement.

- **Ischemic stroke** — transfuse urgently, **within 2 h of presentation** (ASH 2020). **Exchange transfusion is preferred** (post-exchange HbS typically 15–20% per ASH — < 30% in other guidance; keep total Hb ≤ 10 g/dL to avoid hyperviscosity), under hematology and neurology. If exchange cannot start within 2 h and **Hb is ≤ 8.5 g/dL**, give a **simple (top-up) transfusion first** — do not raise Hb above ~10 g/dL — and proceed to exchange as soon as it is available.[261]
- **Hemorrhagic stroke** is managed case by case, in tandem with neurosurgery.

◈ **FEVER IN SICKLE CELL DISEASE IS AN EMERGENCY**
All patients functionally asplenic, at risk of overwhelming infection by encapsulated organisms — **FEVER ≥ 38.5 °C:** urgent CBC + differential, reticulocyte count and blood culture (urine culture if UTI suspected; chest X-ray if cough, tachypnea, dyspnea or rales), then prompt empiric parenteral antibiotics — **CEFTRIAXONE** 50–75 mg/kg IV/IM (max 2 g) is the agent of choice (once-daily; enables outpatient management of low-risk cases). **ADMIT IF ≥**

39.5 °C AND ILL-APPEARING (NHLBI 2014). Use **CEFOTAXIME IN INFANTS < 1 MONTH**, in whom ceftriaxone is contraindicated (bilirubin displacement); another broad-spectrum agent covering encapsulated bacteria may be used if allergic.[257,262] Assess for the crises above. **CONSIDER ORAL ANTIBIOTICS ONLY IF STRICTLY LOW-RISK (PER LOCAL PROTOCOL):** age > 1 year and clinically well with normal vitals ($SpO_2 \geq 95\%$); no focal source, severe pain, acute chest, or sequestration; reassuring labs (WBC 5–30 $\times 10^9$/L, reticulocytes > 100 $\times 10^9$/L, platelets > 100 $\times 10^9$/L); a first parenteral antibiotic dose given in the ED with 2–4 h observation; and a reliable home situation with guaranteed 24-h follow-up.

ADMIT · DISCHARGE · REFER

- **Admit** — severe uncontrolled pain, acute chest syndrome, sequestration, stroke, priapism, or sepsis.
- **Home** — pain controlled on oral analgesia, well and hydrated, with follow-up.
- **Refer — now** — hematology; PICU for acute chest/stroke; exchange-transfusion decisions.

Acute Bleeding in Hemophilia

MINUTES

"Factor First" — replacing clotting factor is always the priority; give factor before imaging or detailed assessment so there is no delay to life/limb-saving treatment.

PRINCIPLE

- In any serious bleed — especially head injury — give factor **immediately**, before the CT scan or full work-up. Each unit/kg of factor VIII (factor 8) raises the level by ~2%; each unit/kg of factor IX (factor 9) by ~1%.[263]

Hemophilia A — severe / head injury

DOSE

Factor VIII ~50 units/kg

TARGET & NOTES

IV; aim factor level 80–100%[263]

Hemophilia A — minor bleed

DOSE

Factor VIII ~25 units/kg

TARGET & NOTES

IV; aim ~50%[263]

Hemophilia B — severe

DOSE

Factor IX 100–140 units/kg (product-dependent: the upper end allows for the lower recovery of recombinant factor IX — confirm the product with hematology)

TARGET & NOTES

IV; aim 80–100% (100% correction for major bleeds[264]; the WFH peak for hemophilia B is 60–80 IU/dL[263])

Mild hemophilia A

DOSE

Desmopressin (DDAVP)

TARGET & NOTES

Only if a documented prior response; not for major bleeds[263]

Known inhibitor — life/limb threat

DOSE

rFVIIa 90 mcg/kg (repeat per hematology, no more often than every 2 h), or FEIBA 75–100 units/kg
On emicizumab (or within 6 months of the last dose): rFVIIa only (90–120 mcg/kg)

TARGET & NOTES

IV; bypassing agents — call hematology urgently. ⚠ **First ask: is the child on emicizumab?** If yes, avoid FEIBA (thrombotic microangiopathy / thrombosis); if there is no alternative, ≤ 50 units/kg per dose and ≤ 100 units/kg/24 h with monitoring. Emicizumab without an inhibitor: treat bleeds with factor VIII at the usual doses[263]

Tranexamic acid (mucosal / oral bleeds)

DOSE

25 mg/kg/dose PO (max 1.5 g) every 8 h, or 10 mg/kg/dose IV (max 1 g) every 8 h

TARGET & NOTES

Excellent adjunct for oral/mucosal bleeds. **Avoid with FEIBA** (thrombosis risk) and **in hematuria** (ureteric clot obstruction).[263]

⚠ HEAD INJURY

- Treat to 100% factor level immediately and **before** the CT — the severe/head-injury doses in the table above.
- Contact the on-call hematologist.
- Do not hesitate to give factor; use the Broselow (length-based) tape to estimate weight if unknown.[264]

◣ ADMIT · DISCHARGE · REFER

- **Admit** — major or life-threatening bleeds (head, neck, gut, compartment).
- **Home from the emergency department** — minor bleeds controlled after factor, with a home plan.

- **Refer — now** — hematology for all; neurosurgery/surgery as needed — give factor before imaging.

Immune Thrombocytopenia (ITP)

ASSESS ASH 2019

Isolated thrombocytopenia in a well child — treat the bleeding, not the number.

RECOGNIZE

- Sudden bruising, petechiae or mucosal bleeding in an otherwise **well** child (often 1–4 weeks after a viral illness), **isolated** platelets < 100 $\times 10^9$/L with normal hemoglobin, white count and film.[265]
- Grade the bleeding, not just the count: **"dry" purpura** (skin only) vs **"wet" purpura** (mucosal — oral blood blisters, epistaxis, GI/urinary) — wet bleeding drives treatment.[265]

⚠ RED FLAGS — THIS IS NOT SIMPLE ITP

- Hepatosplenomegaly, lymphadenopathy, bone/joint pain, pallor or fatigue, **any other**

cytopenia, or an atypical film → suspect **leukemia, aplastic anemia, HUS or NAI** and involve hematology before steroids.

- Steroids can partially treat and mask leukemia — **never start empiric steroids without a film reviewed by hematology**[265].

✦ FIRST DECISION – OBSERVE OR TREAT

- For a child with **no or minor (dry) bleeding**, observation is preferred **regardless of platelet count** — most childhood ITP is self-limiting.[265]
- Drug therapy is for **significant mucosal (wet) bleeding** or bleeding that affects daily life, not for a low number alone.[265] Actively bleeding toddlers with counts < 10 $\times 10^9$/L may need a short oral-steroid course — decided case by case.

◣ WORKUP

- **CBC + peripheral blood film** — confirm **isolated** thrombocytopenia and look for blasts, schistocytes or other cytopenias.

- **Blood group**, and a **direct antiglobulin test** (Coombs test) before anti-D.[265]
- **No routine bone marrow** in typical ITP — not needed before corticosteroids, after IVIG failure, or before splenectomy; reserve it for atypical features (other cytopenias, organomegaly, constitutional symptoms).[265]

Prednisolone / prednisone

DOSE

2–4 mg/kg/day (max 120 mg/day) for 5–7 days, then stop

ROUTE & NOTES

PO; short courses need no taper (taper only if prolonged/recurrent); ideally the film is seen first; cost-effective with tolerable short-course side-effects[265]

IV immunoglobulin (IVIG)

DOSE

0.8–1 g/kg as a single dose (may repeat once)

ROUTE & NOTES

IV; fastest platelet rise — first-line when a rapid rise is needed; expensive and requires special access[265]

Anti-D immunoglobulin

DOSE

50–75 µg/kg once (formulary dosing) [42]

ROUTE & NOTES

IV; only if Rh(D)-positive, non-splenectomized, no autoimmune hemolysis [265] — watch for hemolysis

Tranexamic acid

DOSE

PO 15–25 mg/kg/dose (max 1.5 g) every 8 h
IV 10 mg/kg/dose (max 1 g) every 8 h by slow injection

ROUTE & NOTES

PO/IV; adjunct for mucosal bleeding. Pediatric doses (4 weeks–18 years: PO 15–25 mg/kg max 1.5 g, IV 10 mg/kg max 1 g, two to three times daily — Perth Children's Hospital monograph, citing BNF for Children 2024) [815]; the same figures are the SmPC adult doses [266,816] — **avoid in hematuria** (upper urinary tract bleeding risks ureteric obstruction) [266]

Platelet transfusion

DOSE

Only for life-threatening bleeding

ROUTE & NOTES

Give **with** IVIG + steroid; consumed rapidly — not for the count alone [265]

◈ **BRIDGE TO DEFINITIVE CARE**

- For life-threatening bleeding (intracranial, massive GI): platelets + IVIG 1 g/kg + IV methylprednisolone 30 mg/kg (max 1 g) + tranexamic

acid together, and call hematology/critical care (international consensus report: Provan et al., Blood Adv 2019;3:3780–3817).

- Avoid IM injections, aspirin/NSAIDs and contact sport while counts are low.

ADMIT · REFER

- **Admit** — wet purpura, severe bleeding, or any diagnostic doubt.
- **Refer — now** — hematology (call) for all new severe thrombocytopenia; urgently if red flags for malignancy — do not hesitate to reach out for guidance.

New-Diagnosis Oncologic Emergencies

MINUTES ELN 2019 · REVIEW-BASED

The child who arrives before anyone knows they have cancer — new malignancies can present with emergencies that are lethal in hours.

PATTERNS TO RECOGNIZE

- **Hematologic malignancy** (5): febrile neutropenia / sepsis (functionally neutropenic despite a high WBC), hyperleukocytosis, mediastinal mass, tumor lysis syndrome, and severe coagulopathy (a subset of leukemia — APML).
- **Solid tumors** (3): tumor lysis syndrome, mediastinal mass (by origin/location), and local effects (spinal cord compression, raised ICP).

MEDIASTINAL MASS (SVC COMPRESSION SYNDROME)

- Orthopnea, stridor, facial/neck swelling and plethora, distended neck veins, cough worse when

supine — often T-cell lymphoma/leukemia.[267]

- **Do NOT sedate or lie the child flat** and avoid general anesthesia — the airway and great vessels can collapse irreversibly. Keep **upright**, give oxygen, get an **erect** chest film / echo, and call oncology + anesthesia/critical care.[267] **Always consult hematology-oncology once a mediastinal mass is identified.**
- **Getting tissue safely:** obtain the diagnosis by the least-invasive route that avoids general anesthesia — peripheral node, bone marrow, or pleural/pericardial fluid. If a procedure is unavoidable in a cooperative child, use light sedation with local/regional anesthesia and **preserve spontaneous ventilation** (avoid muscle relaxants and positive-pressure ventilation). When general anesthesia, rigid bronchoscopy, or ECMO might be needed, give **steroids** and — if the child is stable — postpone to let the mass shrink; if general anesthesia is unavoidable in moderate-to-high-risk disease, plan to escalate fast: rigid bronchoscopy, airway stent, and ECMO on standby.[110]

HYPERLEUKOCYTOSIS / LEUKOSTASIS

- WBC > 100 $\times 10^9$/L with headache, hypoxia, confusion, priapism or visual change.[267]
- Hydrate at about 3 L/m²/day (≈ 2× maintenance; 200 mL/kg/day if ≤ 10 kg) with no potassium, watching fluid balance closely; start **tumor-lysis** prophylaxis (see **Tumor Lysis Syndrome**), and **avoid red-cell transfusion** unless critically anemic — it raises viscosity. Keep platelets ≥ 20–30 $\times 10^9$/L. Urgent oncology ± leukapheresis.[267]

COAGULOPATHY (SUSPECT APML)

- Deranged coagulation studies in suspected leukemia are a medical emergency. Inform hematology/oncology and the hematopathologist promptly to identify **acute promyelocytic leukemia (APML)** on morphology.[268]
- If APML is **suspected** (smear + coagulopathy), start **All-Trans Retinoic Acid (ATRA)** immediately on hematology/oncology advice — **do not wait for cytogenetic/molecular confirmation** (it is simply stopped if

APML is excluded).[268] At the same time correct the coagulopathy and keep it corrected: platelets > 30–50 $\times 10^9$/L, fibrinogen > 1–1.5 g/L, INR < 1.5. **Avoid central lines, lumbar puncture and leukapheresis** until the coagulopathy is controlled.

MALIGNANT SPINAL CORD COMPRESSION

- Back pain (esp. night/waking) — or **neck pain with arm weakness or numbness** when the compression is cervical — leg weakness, a sensory level, urinary retention or constipation — a neurosurgical-oncological emergency (expert consensus).
- Give **dexamethasone** immediately, arrange **whole-spine MRI**, and call oncology plus the **pediatric spine service — orthopedics or neurosurgery, depending on local coverage** — outcome depends on how quickly power is preserved (expert consensus).

WORKUP

- **All:** CBC + differential, **peripheral blood smear**, electrolytes, renal & liver profile, **uric acid, LDH, phosphate, potassium, calcium**, and coagulation screen (tumor-lysis / DIC).[267]
- **Mediastinal mass / SVC: erect (upright) PA + lateral chest X-ray** and echocardiogram; CT chest only if the child can hold the position comfortably without sedation (semi-upright, lateral or prone if needed; anesthesia informed) — **never lay a symptomatic child flat**; obtain the **least-invasive** diagnostic tissue (peripheral blood, effusion, marrow).
- **Leukostasis:** WBC, coagulation, type & crossmatch; neuroimaging if neurological signs.
- **Cord compression: whole-spine MRI with contrast** — do not wait for it to start dexamethasone if the deficit is progressing (expert consensus).

Dexamethasone (cord compression)

DOSE

1–2 mg/kg IV once (max 10 mg), then per oncology

ROUTE & NOTES

IV; do not delay for imaging if deficit is progressing — but confirm no undiagnosed leukemia first where possible. Dose: expert/formulary practice — not given in the cited review.

Methylprednisolone (anterior mediastinal mass)

DOSE

16 mg/m²/dose IV every 12 h
if IV access is difficult, PO prednisone 20 mg/m²/dose every 12 h

ROUTE & NOTES

IV/PO; **obtain a biopsy first if the patient's condition allows** — steroids can rapidly shrink lymphoma and obscure the diagnosis. If a malignant effusion is present, it may be aspirated and sent for flow cytometry. **Assess airway security** before any sedation or positioning. Dose: expert/formulary practice — not given in the cited review.

IV fluids (leukostasis / TLS)

DOSE

About 3 L/m²/day (≈ 2× maintenance; 200 mL/kg/day if ≤ 10 kg), no potassium initially

ROUTE & NOTES

IV; with rasburicase/allopurinol per **Tumor Lysis Syndrome**

⚠ TWO TRAPS

- Sedating a child with an anterior mediastinal mass for a “quick CT” or line has caused fatal airway collapse — imaging is **erect and unsedated**.
- And giving steroids before a film in possible hematological malignancy can obscure the diagnosis — coordinate with oncology.[267]

◣ REFER

- **Refer — now** — call pediatric oncology urgently for all of the above; involve critical care, anesthesia, neurosurgery and hematopathology as required.

10 Neonatal

NRP 2025 · AAP hyperbilirubinemia 2022

Neonatal Resuscitation MINUTES

NRP 2025

Effective ventilation is the single most important step.

DECISION

Term? Good tone? Breathing or crying?

YES

Delayed cord clamping ≥ 60 s, dry, skin-to-skin, keep warm, monitor.[269]

NO

Warm, dry, stimulate, position airway, clear secretions if needed. SpO_2 (right hand) + ECG. Keep temperature 36.5–37.5 °C.

`apnea / gasping / HR < 100`

GOLDEN MINUTE

Start PPV within 60 s. Starting oxygen (NRP 2025): ≥ 35 wk 21%; 32–34 wk 21–30%; < 32 wk 30–100% — then titrate to the pre-ductal SpO_2 targets: 2 min 65–70% · 3 min 70–75% · 4 min 75–80% · 5 min 80–85% · 10 min 85–95%. Assess for chest rise after 15 s; if none, perform MR SOPA corrective steps.[269]

HR < 60 after 30 s effective PPV

COMPRESSIONS

Coordinate 3:1 (90 compressions + 30 breaths/min), increase to 100% oxygen, ideally via a secured airway. Reassess after 60 s. **Compressions are effective only after establishing good chest rise.**[269]

HR still < 60

Give epinephrine; treat hypovolemia; reconsider airway, pneumothorax, dose, technique.[269]

After any major resuscitation (prolonged PPV, compressions, epinephrine, low Apgar at 10 min, severe acidosis): check glucose, avoid hyperthermia (keep ≤ 37.5 °C), and examine for encephalopathy (consciousness, tone, reflexes, seizures). **Term/late-preterm infant with moderate–severe encephalopathy → call the NICU / cooling center immediately — therapeutic hypothermia must start within 6 h of birth.**

Epinephrine (adrenaline)

DOSE

IV/IO 0.02 mg/kg (0.2 mL/kg)
ET 0.1 mg/kg (1 mL/kg)

ROUTE & NOTES

0.1 mg/mL (1:10,000). IV/IO preferred; ET only while establishing access.[269] Repeat every 3–5 min.

Volume (saline or blood)

DOSE

10 mL/kg

ROUTE & NOTES

IV/IO, for hypovolemia[269]

◈ **ALGORITHM** Full AHA/AAP neonatal resuscitation algorithm — cpr.heart.org



Critical CHD — Pulse Oximetry Screening

ASSESS ≥ 24 H · AAP 2025

Screen every well newborn before discharge — catches duct-dependent lesions before they collapse.

WHO & HOW TO SCREEN

- **Who:** asymptomatic infants at **≥ 24 hours** of age (or shortly before discharge if earlier), in the well-baby nursery, **not on supplemental oxygen**.[270]
- **How:** measure SpO_2 in the **right hand (pre-ductal)** and **either foot (post-ductal)**.[270]

DECISION

Result of the screen?

PASS

SpO_2 **≥ 95% in BOTH** limbs **and** ≤ 3% difference between them. Routine newborn care.[270]

IMMEDIATE FAIL

Any reading **< 90%** in either limb → straight to echocardiography.[270]

`borderline`

RETEST ONCE

90–94% in either/both limbs, **or** > 3% hand–foot difference → repeat **once after 1 hour** (one retest, not two).[270] Still not passing → fail.

`any fail`

Urgent echocardiography — and rule out sepsis, PPHN, and respiratory causes (4–5× more common than CCHD)[270]

⚠ SCREENING DOES NOT REPLACE EXAMINATION

- It can **miss left-sided obstruction**, especially coarctation of the aorta.
- Check **femoral pulses** and four-limb saturations/blood pressure on every newborn.

- Some CCHD is not hypoxemic in the first hours — a normal screen does not exclude it.[270]
- For the lesions, presentation, and emergency management, see **Neonatal & Infant CHD** (Cardiac & Shock).

ADMIT · DISCHARGE · REFER

- **Admit** — a failed screen → keep for echo; cyanosis/shock → NICU + alprostadil.
- **Home from the ward** — a passed screen with a normal exam (newborn nursery, before discharge).
- **Refer — now** — pediatric cardiology for any failed screen (echo before discharge).

SEE ALSO Lesion recognition & management: **Neonatal & Infant CHD** and the **Hypercyanotic (Tet) Spell** (Cardiac & Shock).

Persistent Pulmonary Hypertension (PPHN)

MINUTES TERM / LATE PRETERM

Labile, severe hypoxemia out of proportion to the lung disease — the circulation never made the switch.

RECOGNIZE

- Severe cyanosis/desaturation **poorly responsive to oxygen**, often labile (large swings with handling).[271]
- **Differential cyanosis:** pre-ductal SpO_2 (right hand) higher than post-ductal (foot) by **> 5–10%** — right-to-left shunt across the duct.[271]
- Common settings: meconium aspiration, sepsis/pneumonia, birth asphyxia, congenital diaphragmatic hernia, or idiopathic.[271]
- Confirm by **echocardiography** — and exclude duct-dependent congenital heart disease before committing to therapy.[271]

① OPTIMIZE LUNGS, AVOID SWINGS

- **Intubate and ventilate** — recruit the lung (gentle ventilation; surfactant if parenchymal disease — meconium aspiration / RDS). **Minimal handling**, cluster cares, sedation/analgesia.
- Keep temperature, glucose, calcium, and pH normal.[271]



② TARGETS

Pre-ductal SpO_2 low-to-mid 90s, PaO_2 55–80 mmHg (7.3–10.6 kPa). Support blood pressure and cardiac output with fluids/inotropes[271] so systemic pressure ≥ pulmonary pressure.



③ PULMONARY VASODILATOR

- Suspected PPHN needs urgent neonatology/cardiology/PICU care; iNO, milrinone, norepinephrine, and ECMO referral are specialist-directed.[271]
- Start **inhaled nitric oxide** once the oxygenation index is ≥ 20–25 (after lung recruitment)
- Response is a clear rise in oxygenation within ~30 min.[272]



No response with OI rising toward ~40, or refractory shock → ECMO — refer to an ECMO center early.[271]

⚠ ECHOCARDIOGRAM – ALWAYS

- A neonatal echocardiogram should **always** be performed when PPHN is suspected — to confirm the diagnosis and exclude underlying congenital heart disease; iNO can be detrimental in some CHDs.[271]

Inhaled nitric oxide

DOSE / SETTING

`start 20 ppm`

NOTES

Above 20 ppm rarely adds benefit and raises methemoglobin/NO_2 — monitor. Assess response after 20–30 min. Do not stop abruptly (rebound)[272]

Milrinone / inotropes

DOSE / SETTING

`specialist-directed`

NOTES

Support cardiac output; milrinone for left-ventricular dysfunction, in addition to its pulmonary vasodilator properties

Norepinephrine

DOSE / SETTING

`specialist-directed`

NOTES

Add-on to milrinone when blood pressure drops — raises systemic vascular resistance and further lowers the pulmonary/systemic pressure ratio[273]

◈ **NOTE**

- The approach above is suggested when the cause of pulmonary hypertension is **INCREASED PULMONARY VASCULAR RESISTANCE (PVR) AND** evidence of an ischemic hit is absent. Other scenarios of pulmonary hypertension are approached differently.
- A trial of **ORAL SILDENAFIL** can be attempted where iNO is not available, after specialist consultation.[274]

⚠ **OXYGENATION INDEX & A KEY CONTRAINDICATION**

- OI = (mean airway pressure × FiO_2 × 100) ÷ PaO_2 in mmHg. **Do not give inhaled nitric oxide in duct-dependent congenital heart disease** — confirm the heart on echo first.[271]

- Wean FiO_2 and settings slowly; sudden small drops can trigger prolonged desaturation.[271]

ADMIT · DISCHARGE · REFER

- **Admit** — all → NICU/PICU.
- **Home from the ward** — not acutely; after weaning support, with follow-up.
- **Refer — now** — neonatology/cardiology; an ECMO center if refractory.

◈ **SEE ALSO** Neonatal & Infant CHD — exclude duct-dependent CHD before attributing cyanosis to PPHN.

Neonatal Hypoglycemia HOURS

CPS 2019

Often asymptomatic — screen the at-risk, treat early, find the persistent few.

RECOGNIZE & WHO TO SCREEN

- Signs are non-specific: jitteriness, poor feeding, lethargy, hypotonia, temperature instability, apnea — and,

when severe, seizures. **Many affected newborns are asymptomatic, so at-risk infants must be screened.**[180]

- Screen at-risk infants from ~2 h of age, pre-feed: infant of a diabetic mother (IDM), large- or small-for-gestational-age (LGA / SGA-IUGR), late-preterm / preterm, perinatal stress or asphyxia, hypothermia or sepsis, maternal beta-blocker, and congenital syndromes (e.g. Beckwith-Wiedemann) or midline / microphallus features (suggesting hypopituitarism).[180]
- Confirm a low point-of-care (POC) reading with a **laboratory plasma glucose** — whole-blood / POC reads ~15% lower and falls further with processing delay — but **treat first; do not wait for the lab**[180].

Transitional — first 72 h

THRESHOLD

< 2.6 mmol/L (47 mg/dL)

MEANING

The physiologic nadir is normal — catch the at-risk or persistently low infant, don't over-treat healthy transitional dips.[275]

Persistent — beyond 72 h

THRESHOLD

< 3.3 mmol/L (60 mg/dL)

MEANING

Also applies to hypoglycemia first presenting after 72 h — below this warrants investigation for a hypoglycemia disorder.[180,275]

On IV dextrose

THRESHOLD

first 72 h: keep ≥ 2.6 mmol/L (47 mg/dL); after 72 h: ≥ 3.3 mmol/L (60 mg/dL); suspected/confirmed hyperinsulinism: > 3.9 mmol/L (70 mg/dL)

MEANING

Suspect a disorder if the target cannot be held without a GIR above 8–10 mg/kg/min.[275] PES 2015 advises > 3.3 mmol/L for any at-risk neonate needing IV dextrose.[180]

DECISION

First 72 h — glucose < 2.6 mmol/L (47 mg/dL): symptomatic or asymptomatic?

SYMPTOMATIC with glucose < 2.6 mmol/L, or any glucose < 1.8 mmol/L (32 mg/dL)

IV D10 mini-bolus 2 mL/kg, then infusion at 80 mL/kg/day (GIR ≈ 5.5 mg/kg/min). Recheck in 30 min; increase the glucose supply stepwise, rechecking 30 min after each step.[275] No IV access → glucagon IM.

ASYMPTOMATIC 1.8–2.5 mmol/L (32–45 mg/dL)

Feed + buccal 40% dextrose gel 0.5 mL/kg; recheck in 30 min.[275,276]

still 1.8–2.5 mmol/L

REPEAT ONCE

Feed ± a second buccal gel dose; recheck in 30 min.

second repeat, or symptoms appear

Start IV D10 — mini-bolus 2 mL/kg then GIR 5–8 mg/kg/min; escalate as needed.

Dextrose 10%

DOSE

2 mL/kg (200 mg/kg) bolus

ROUTE & NOTES

IV/IO; then infusion at GIR 5–8 mg/kg/min, escalate by 2 mg/kg/min as needed. Concentrations > 12.5% need central access.

Dextrose gel 40%

DOSE

0.5 mL/kg (200 mg/kg) buccal

ROUTE & NOTES

First-line for asymptomatic; massage into buccal mucosa, then feed. May repeat once.[276]

Glucagon

DOSE

0.2 mg/kg (200 mcg/kg) — max 1 mg

ROUTE & NOTES

IV bolus (CPS: 0.1–0.3 mg/kg, or infusion 10–30 mcg/kg/h), or IM/SC as a bridge when IV access is not yet available; in hyperinsulinism it typically raises glucose within 10–15 min (PES: 0.5–1 mg usually effective).[180,275] Watch for hyponatremia.

Diazoxide

DOSE

`1.7–5 mg/kg/dose PO q8h`

ROUTE & NOTES

Endocrinology-led, for confirmed hyperinsulinism; start a thiazide diuretic with it (chlorothiazide). Echocardiogram at baseline where feasible and again ~1 week after starting, and with any respiratory deterioration (fluid retention, pulmonary hypertension); baseline CBC (International Hyperinsulinism Guidelines, De Leon et al. 2024).

⚠ PERSISTENT / REFRACTORY — THINK HYPERINSULINISM

Persisting beyond 48–72 h, recurring, or needing **GIR > 8–10 mg/kg/min** to stay euglycemic warrants a **critical (hypoglycemia) sample**, drawn when plasma glucose is < 2.8 mmol/L (< 50 mg/dL), *before* correcting: plasma glucose, insulin, C-peptide, beta-hydroxybutyrate (ketones), free fatty acids, cortisol, growth hormone — plus ammonia, lactate, and an acylcarnitine profile / urine organic acids. Hyperinsulinism = inappropriately low ketones and free fatty acids with detectable insulin, a glycemic response to glucagon, and a high glucose requirement. Refer to endocrinology / metabolic.[180]

✦ PEARLS

- Glucose is normally lowest in the first 24–72 h (transitional); the goal is to catch the at-risk or persistently low infant, not to over-treat healthy transitional dips.
- **Prophylactic** dextrose gel given to at-risk infants before any low glucose is measured is **not** recommended: at 6–7 years it did not reduce neurocognitive impairment (59% vs 57%) and was associated with more emotional-behavioral difficulty (24% vs 18%). Gel is for a **measured** asymptomatic low glucose (table above).[843]
- Do not discharge an at-risk infant until persistent hypoglycemia is excluded — i.e. pre-feed glucose stays above target[180] through a normal feed–fast cycle.

◣ ADMIT · DISCHARGE · REFER

- **Admit** — symptomatic, persistent, or needing IV dextrose/high glucose-infusion rate.
- **Home from the ward** — transient, resolved, feeding well with stable pre-feed glucose.
- **Refer — now** — endocrinology/metabolic for persistent or recurrent hypoglycemia (hyperinsulinism workup).

Neonatal Hyperbilirubinemia HOURS

≥ 35 WK · AAP 2022

Use total serum bilirubin against the hour- and gestation-specific nomogram.

ASSESS & DECIDE

- Any jaundice under 24 h, or visible jaundice → measure bilirubin. **Transcutaneous bilirubin (TcB)** is a valid screen; **confirm with a total serum bilirubin (TSB)** when the TcB is within 3 mg/dL (50 µmol/L) of the phototherapy threshold, is ≥ 15 mg/dL (250 µmol/L), or once phototherapy has started.[277] Use the **total** value against the threshold (do not subtract the direct fraction).[278] **Severe hyperbilirubinemia** = peak TSB > 425 µmol/L (25 mg/dL) or need for exchange transfusion.[277]
- Thresholds for phototherapy and exchange depend on **gestational age (35–40 wk), age in hours, and neurotoxicity risk factors** — read the AAP nomogram or app each time, never a single fixed number.[278]
- **Neurotoxicity risk factors** that move the infant to the "WITH risk factor" graphs: albumin < 3.0 g/dL (30 g/L),

isoimmune hemolysis (positive DAT), G6PD deficiency or other hemolysis, sepsis, clinical instability in the prior 24 h. Gestation < 38 weeks is also a risk factor but is **already built into every curve** — if it is the only one, use the "NO risk factor" graphs.[278]

- **Suspect hemolysis** when the TSB rises ≥ 5 µmol/L/h (0.3 mg/dL/h) in the first 24 h or ≥ 3.5 µmol/L/h (0.2 mg/dL/h) thereafter, or fails to respond to intensive phototherapy → CBC, reticulocytes, smear, DAT, G6PD/pyruvate-kinase assay; sepsis screen if clinically indicated.[277]
- **Find the cause** when the level is high or rising — hemolytic: ABO/Rh isoimmunization (DAT), G6PD deficiency, hereditary spherocytosis; non-hemolytic: cephalohematoma or bruising, polycythemia, sepsis, hypothyroidism, and breast-milk vs inadequate-breastfeeding jaundice.[278]
- **Conjugated (direct) hyperbilirubinemia is a different problem** — for neonatal cholestasis see **Neonatal Cholestasis** in the GI & Hepatology section.

TREAT

At/above the phototherapy line → phototherapy + feeding/hydration + find the cause.[278]

hange line (CPS 2026; the AAP margin of 2 mg/dL is ≈ 34

ESCALATION OF CARE

Intensive phototherapy + IV fluids without delay; withhold enteral feeds; urgent TSB, direct bilirubin, CBC, albumin, chemistries, type & crossmatch, hemolysis work-up; **repeat TSB every 2–3 h**; consult neonatology and prepare transfer to a unit that can perform exchange. IVIG is not routine: give 0.5–1 g/kg over 2 h (may repeat once at 12 h) for **isoimmune** hemolytic disease at the pre-exchange threshold when exchange cannot be performed promptly.[277,278]

at/above exchange line, or encephalopathy

Immediate exchange transfusion for any sign of acute bilirubin encephalopathy (high tone, arching, high-pitched cry, lethargy). NICU.[278]

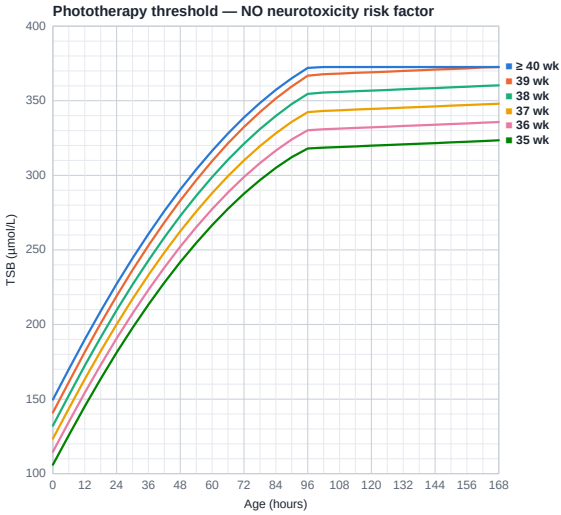
◈ NOMOGRAM & FOLLOW-UP

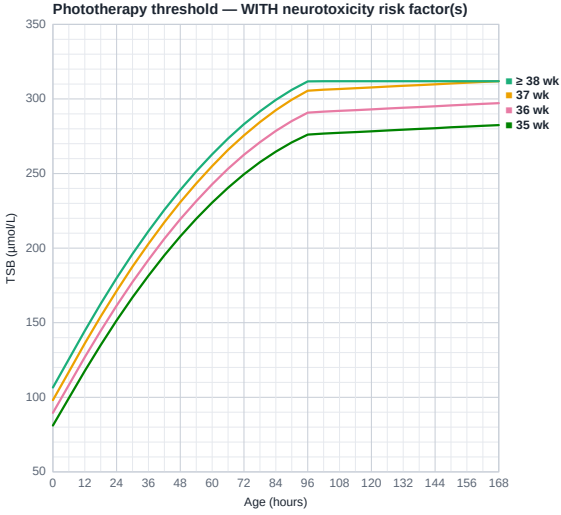
- Kuwait laboratories report bilirubin in **MMOL/L**. Plot the hour-specific total serum bilirubin on the **AAP 2022 THRESHOLD CURVES** — in µmol/L using the **CPS 2026 FIGURES** (Figures 2–3 phototherapy, Figures 6–7 exchange transfusion; AAP data reproduced with permission; cps.ca)[277,278] or the online calculators below, which accept either unit (**÷ 17.1** converts µmol/L to mg/dL). Decision values on this card are given in both units.
- Calculators: peditools.org/bili2022 or bilitool.org.
- Before discharge, set the follow-up interval by the **GAP BETWEEN THE TSB AND THE PHOTOTHERAPY THRESHOLD**: the smaller the gap, the sooner the recheck (often within 24 hours).[278]

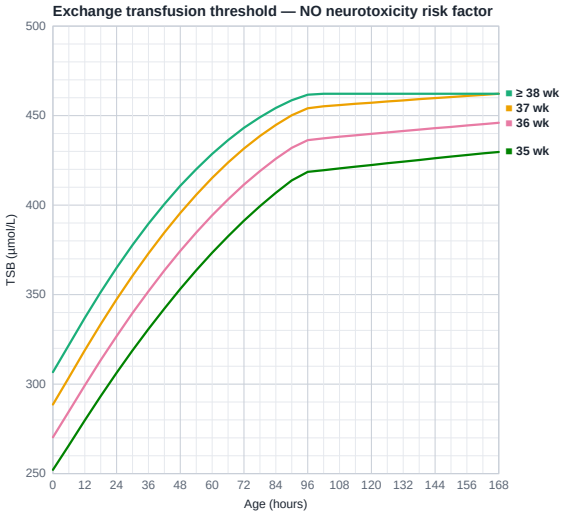
Treatment thresholds in µmol/L — AAP 2022 curves, 35 to ≥ 40 weeks

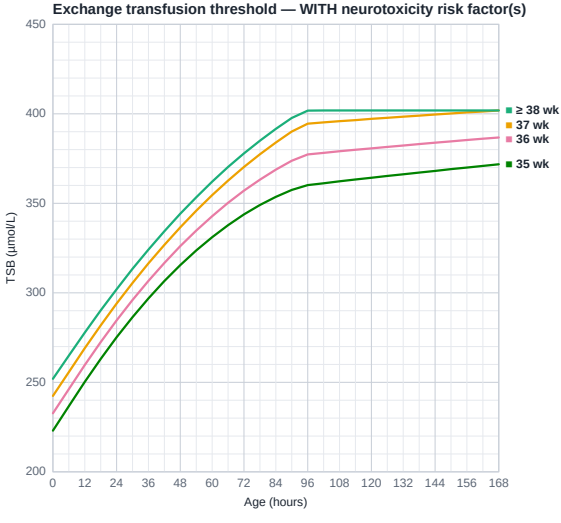
Redrawn from the AAP 2022 hour-specific thresholds as published in µmol/L by the Canadian Paediatric Society (2026), gridlines every 10 µmol/L and 6 h, 0–168 h; beyond 168 h some lines still rise by up to 20 µmol/L (35–38 weeks on the no-risk-factor phototherapy chart; 35–36 weeks on the other charts) and the rest are flat — use the calculator for days 8–14. Full text: CPS 2026 guideline (doi:10.1093/pch/pxaf034) · AAP 2022 guideline (doi:10.1542/peds.2022-058859). Neurotoxicity risk

factors: albumin < 30 g/L, isoimmune or other hemolytic disease, sepsis, significant clinical instability in the preceding 24 h.[277,278]









◈ ΔTSB — THE "RULES OF 30" (CPS 2026)

- **ΔTSB** = hour-specific phototherapy threshold – measured TSB or TcB (screen at ≥ 12 h of age, before discharge;

TcB valid only if not on phototherapy).[277]

- **ΔTSB ≤ 30 µmol/L** → delay discharge: < 24 h old, consider starting phototherapy; ≥ 24 h old, repeat TSB in 4–12 h and start phototherapy if rising. **31–60** → repeat TSB in 12–24 h. **61–90** → repeat in 24–48 h. **> 90** → routine follow-up with the primary provider.[277]
- With neurotoxicity risk factors, phototherapy may be started when the TSB is within 30 µmol/L of the threshold.[277]
- **Stop phototherapy** once the TSB is > 30 µmol/L below the threshold (≥ 38 wk) or > 60 µmol/L below (35–37 wk). Re-check TSB 12–24 h after stopping for rebound (re-crossing the threshold within 72–96 h); with hemolytic disease re-check at 6–12 h, then every 24 h until the TSB is falling and ΔTSB > 60. TcB may be used ≥ 18 h after phototherapy stops.[277]

⚠ DON'T RELY ON A SINGLE VALUE

- Plot against time.

- A rapidly rising level, early jaundice, or hemolysis can cross thresholds fast — recheck on the interval the nomogram specifies.[278]
- TcB should **not** be used for follow-up when the baby is on phototherapy — use serum bilirubin.[278]

ADMIT · DISCHARGE · REFER

- **Admit** — levels at/above phototherapy or exchange thresholds, or a rapid rise.
- **Home** — below threshold, feeding well, with a bilirubin-recheck plan.
- **Refer — now** — hematology for hemolysis; an exchange-capable unit near exchange thresholds.[277]
- **Refer — clinic** — **audiology** (formal hearing assessment) if peak TSB > 400 µmol/L, the pre-exchange threshold was reached, or exchange was performed; **neurodevelopmental follow-up** if the pre-exchange threshold was reached, exchange was performed, or neurological signs occurred; after

immune hemolytic disease, check hemoglobin at 4–10 weeks for late anemia.[277]

Neonatal Sepsis — Early-Onset (rapid approach)

MINUTES

Non-specific: temperature instability, poor feeding, lethargy, apnea, distress.

ACT ON SUSPICION

- Septic screen (blood culture ≥ 1 mL ± CSF; blood count, CRP), check glucose. Urine culture is not part of the early-onset (< 72 h) screen — add it for late-onset sepsis. Start empiric antibiotics promptly — do not wait for results. Support airway/breathing/circulation; NICU.[279]

EARLY- VS LATE-ONSET

Early-onset (≤ 72 h) is vertically acquired — group B *Streptococcus*, *E. coli*, *Listeria*; empiric **ampicillin + gentamicin** (below). **Late-onset (> 72 h)** is often hospital-acquired, especially in

preterm infants with prolonged stays and invasive procedures (coagulase-negative staphylococci, *S. aureus*, Gram-negatives) and needs different empiric cover per your unit protocol.[280]

Ampicillin

DOSE

50 mg/kg/dose q8h (0–7 days), q6h (8–28 days)
Meningitis (term): 100 mg/kg/dose q8h (0–7 days), 75 mg/kg/dose q6h (8–28 days)

ROUTE & NOTES

IV; term intervals as shown (Lexicomp); preterm ≤ 34 weeks: every 12 h in the first week (Red Book). Use the meningitic dose if CSF not obtained or CNS involvement.[42,99]

Gentamicin

DOSE

4–5 mg/kg/dose

ROUTE & NOTES

IV, extended-interval dosing by gestational/postnatal age (e.g. NICE NG195: 5 mg/kg every 36 h) — **never 8–12-hourly**.[99]

Cefotaxime

DOSE

50 mg/kg/dose

ROUTE & NOTES

IV, add if meningitis suspected; every 12 h in the first week of life, every 8 h at 1–4 weeks (for meningitis use the intervals on the Fever in the Young Infant card).[99]

Acyclovir

DOSE

`20 mg/kg every 8 h`

ROUTE & NOTES

IV, add if herpes simplex suspected[99]

⚠ BILIOUS VOMITING IN A NEONATE

Green vomiting is **malrotation with volvulus until proven otherwise** — see Surgical.

ADMIT · DISCHARGE · REFER

- **Admit** — any neonate with clinical signs of sepsis → cultures, then empiric antibiotics without delay. Well-appearing infants ≥ 35 weeks with risk factors only → risk-stratify (categorical risk factors, Neonatal Early-Onset Sepsis Calculator, or structured serial examination, e.g. every 4–6 h through 48 h of age) rather than treating all.[279]
- **Home from the ward** — not until sepsis is excluded/treated; a reassuring 36–48 h course with negative cultures may stop antibiotics.
- **Refer — now** — neonatology/PICU for instability.

◈ **SEE ALSO** The neonate (≤ 28 days) is always high-risk in the febrile-infant pathway — use **Fever in the Young Infant** for the full age-stratified workup; this card is the neonatal-specific rapid approach.

Omphalitis & Delayed Umbilical Separation

HOURS NEONATE

Red or discharging umbilical stump — treat as neonatal sepsis; watch for necrotizing fasciitis.

RECOGNIZE

- Periumbilical **erythema, induration, tenderness**; purulent or malodorous discharge from the stump.[281]
- Spreading abdominal-wall cellulitis, or systemic signs (poor feeding, lethargy, temperature instability, tachycardia) = **invasive infection / sepsis**.[282]
- Uncommon with dry cord care in high-resource settings (~1 in 1000, AAP 2016)[283] but can progress rapidly[282] — treat as a neonatal emergency.

- **Risk factors:** low birth weight or prematurity, prolonged rupture of membranes or maternal infection, non-sterile or home delivery, umbilical catheterization, and unclean cord practices (e.g., cow-dung application — also a tetanus risk). Onset is typically around day 3.[281]

⚠ RED FLAGS → NECROTIZING FASCIITIS / MYONECROSIS (SURGICAL EMERGENCY)

- Pain or tenderness out of proportion, rapidly spreading or **dusky / bullous** skin, crepitus, peau-d'orange edema, systemic toxicity.
- It can deteriorate fast despite mild initial findings — reassess often and mark the margins.
- Any of these → **urgent pediatric surgery for debridement**; do not delay for imaging.[282]
- Debridement resects the umbilical vein, both arteries, and any urachal remnant (even if they look normal); reported mortality is high (~60–85%), so err toward early

surgical exploration in the critically ill infant.[282]

INVESTIGATE & TREAT

- Blood culture (+ discharge swab), CBC, CRP; full neonatal sepsis workup.
- Start IV antibiotics **immediately** — cover staphylococci (incl. MRSA), group A Streptococcus, Gram-negatives (E. coli, Klebsiella, Proteus) and anaerobes (Bacteroides, Clostridium); the exact regimen follows the local antibiogram and neonatal formulary.[281]
- If systemic: keep nil by mouth (septic ileus), IV fluids / parenteral nutrition; manage as neonatal sepsis.

EMPIRIC IV ANTIBIOTICS — NEONATAL DOSES, TERM NEONATE (PER DOSE · INTERVAL); PRETERM INFANTS: BY POSTMENSTRUAL AGE PER THE UNIT FORMULARY; ADJUST FOR HEPATIC/RENAL IMPAIRMENT; CONFIRM AGAINST THE LOCAL FORMULARY AND ANTIBIOGRAM

Cefotaxime

DOSE (PER DOSE · INTERVAL)

`50 mg/kg/dose q12h (0–7 days); q8h (8–28 days)`

ROLE

Gram-negative cover

+ Cefazolin

DOSE (PER DOSE · INTERVAL)

`per neonatal formulary`

ROLE

Gram-positive (MSSA) — use **vancomycin** where MRSA is prevalent

± Metronidazole

DOSE (PER DOSE · INTERVAL)

`7.5 mg/kg/dose q12h (< 8 weeks of age)`

ROLE

Add for anaerobes — foul discharge or maternal chorioamnionitis; accumulates if < 40 weeks' gestation

Meropenem

DOSE (PER DOSE · INTERVAL)

20 mg/kg/dose q8h (q12h if GA < 32 wk and age < 14 days); 30 mg/kg/dose q8h if GA ≥ 32 wk and age ≥ 14 days

ROLE

OR (severe cases) — alternative for necrotizing fasciitis (with vancomycin + clindamycin); 40 mg/kg q8h is the meningitis dose — specialist advice

± Vancomycin

DOSE (PER DOSE · INTERVAL)

15 mg/kg load, then 10 mg/kg/dose q12h (first week of life); q8h thereafter to 1 month

ROLE

Where MRSA is prevalent; level-guided; longer intervals in preterm infants

± Clindamycin

DOSE (PER DOSE · INTERVAL)

5 mg/kg/dose q8h (term, > 7 days; q12h in the first week)[303]

ROLE

Necrotizing fasciitis (antitoxin effect)

Infant > 28 days

DOSE (PER DOSE · INTERVAL)

general pediatric doses: cefotaxime 50 mg/kg q6h; vancomycin 15 mg/kg q6h (max 1 g/dose); metronidazole 7.5–10 mg/kg q6–8h; meropenem 40 mg/kg q8h (severe)

ROLE

Not for neonates

◈ DURATION

- About 7 days for uncomplicated periumbilical cellulitis; 10–14 days IV with bacteremia or sepsis; 14–21 days if meningitis; prolonged and surgically-guided in necrotizing fasciitis (local practice — not guideline-stated).
- Tailor to cultures, susceptibilities, and clinical response — older infants may step down to oral once clearly improving.

◈ DELAYED UMBILICAL SEPARATION

- Normal separation is by ~2 weeks (range 3–45 days, mean ~10 days); antiseptic cord care delays it versus dry care, so a **well** infant is usually benign.
- Not off by **3–4 weeks** = delayed (up to ~10% of newborns). ⚠ **Suspect leukocyte adhesion deficiency (LAD)** if delayed separation + omphalitis or soft-tissue infection that forms **no pus** + persistent marked leukocytosis without infection (often 40–60 $\times 10^9$/L) + poor wound healing → **consult immunology whenever LAD is**

suspected. There is a growing group of LAD syndromes with variable defects; normal expression of CD18 alone is not sufficient to exclude LAD-1 — functional assays must be performed if clinical suspicion is high.[281]

- Most isolated delay in a well infant with a normal white count is **not** LAD.[281]
- Other causes: a patent urachus or omphalomesenteric duct (see below), factor XIII deficiency (stump bleeding).

UMBILICAL GRANULOMA

- Moist pink granulation after separation → silver-nitrate cautery (protect surrounding skin) or topical salt.
- Refer if persistent discharge or a polyp suggests a duct remnant.[281]

⚠ DON'T MISS — PATENT DUCT REMNANTS

- **Patent omphalomesenteric (vitelline) duct** = persistent ileum-to-umbilicus connection; **patent urachus** =

bladder-to-umbilicus. Both present after cord separation with intermittent umbilical drainage: **small-bowel contents** (omphalomesenteric duct) or **clear urine-like fluid, more with crying or voiding** (urachus).[284,285]

- A sinus or small opening may be visible at the umbilical base; **ultrasound** may show a tubular structure extending deep to the umbilicus. If an opening is present it can be cannulated for a **sinogram/fistulogram** to demonstrate communication with the ileum or bladder.[285,286]
- Other remnants that mimic granuloma: **umbilical polyp** (bright-red, mucosa-covered, does not respond to silver nitrate — ectopic ileal/gastric mucosa) and urachal or omphalomesenteric **cyst/sinus** (persistent wetness, infected periumbilical mass).[287]
- ▸ **Refer all to pediatric surgery** — prolapsed bowel through a patent omphalomesenteric duct is a surgical emergency; small urachal remnants often close spontaneously in infancy, so excision is decided by the surgeon.[285,286]

ADMIT · DISCHARGE · REFER

- **Admit** — all → IV antibiotics (neonatal-sepsis pathway).
- **Home from the ward** — not acutely; complete the IV course — older infants may step down to oral.
- **Refer — now** — pediatric surgery for necrotizing fasciitis.
- **Refer — clinic** — pediatric surgery for a suspected duct remnant; immunology for suspected leukocyte adhesion deficiency.

Necrotizing Enterocolitis HOURS

Modified Bell

Preterm or stressed neonate: feeding intolerance, distension, bloody stools.

RECOGNIZE

- Feeding intolerance, bilious or rising gastric residuals, **abdominal distension and tenderness**, bloody stools.[288]

- Systemic: lethargy, apnea, temperature instability, shock. Mostly preterm (onset often the 2nd–4th week, later at lower gestation); term infants with congenital heart disease or asphyxia are also at risk.[288]
- Risk rises with prematurity and formula feeding; human (breast) milk and standardized feeding protocols are protective.[288]

CONFIRM

- Abdominal X-ray (supine + left-lateral decubitus): **pneumatosis intestinalis** (intramural gas — the radiologic hallmark), portal venous gas, a persistent fixed dilated loop, or free air.[289]
- Bloods: CBC, CRP, blood gas, lactate, blood culture, coagulation, electrolytes.
- Bowel ultrasound (wall thickness/perfusion, free fluid) is a useful adjunct.[290]
- Repeat X-ray every 6 h while acute.[289]

I — Suspected

FINDINGS

Nonspecific signs (apnea, temperature instability), distension, occult or gross blood
X-ray normal or ileus

BOWEL REST + ANTIBIOTICS

NPO + NG drainage ~3 days; stop antibiotics if NEC is excluded[289]

II — Definite (proven)

FINDINGS

Above + absent bowel sounds ± tenderness pneumatosis ± portal venous gas (IIB: metabolic acidosis, thrombocytopenia)[289]

BOWEL REST + ANTIBIOTICS

IIA: NPO + NG and antibiotics 7–10 days; IIB: 14 days[289]

III — Advanced

FINDINGS

Critically ill: shock, acidosis, DIC, peritonitis. IIIA bowel intact
IIIB perforated (pneumoperitoneum)[289]

BOWEL REST + ANTIBIOTICS

As IIB (14 days) plus fluid resuscitation, inotropes and ventilation; IIIB: surgery[289]

TREAT

- Stop enteral feeds (NPO), nasogastric tube on free drainage, IV fluids and parenteral nutrition.
- Broad-spectrum IV antibiotics[288] covering Gram-negatives and anaerobes — e.g. ampicillin + gentamicin + metronidazole (or piperacillin-tazobactam); add vancomycin if a central line or a resistant organism is suspected (regimen per local practice).
- Correct acidosis, thrombocytopenia, and coagulopathy; support blood pressure.
- Serial exams and X-rays.
- **Surgical consultation** if no improvement or signs of perforation are present.

⚠ SURGERY NOW

Pneumoperitoneum (perforation) is an absolute indication. Also: deterioration despite maximal medical therapy, a fixed dilated loop, abdominal-wall erythema, a palpable mass, or a positive paracentesis (stool / bile / pus). Options: laparotomy with resection, or a primary peritoneal drain in the unstable extremely-low-birth-weight infant[288] — in the NEST trial laparotomy was favored

when the preoperative diagnosis was NEC rather than isolated perforation.[291]

✦ PEARLS

- **Pneumatosis intestinalis is the radiologic hallmark**; portal venous gas signals more extensive disease and a worse prognosis.[288]
- **Spontaneous intestinal perforation (SIP) is a distinct entity** — earlier onset (first week), often after indomethacin or steroids, a focal perforation with *no* pneumatosis; treat with broad-spectrum antibiotics including anaerobic cover plus peritoneal drainage or laparotomy.[288]

◣ ADMIT · DISCHARGE · REFER

- **Admit** — all → NICU, nil by mouth, gut decompression, antibiotics.
- **Home from the ward** — not acutely; after recovery, with feeding advice.
- **Refer — now** — pediatric surgery (perforation or deterioration).

Neonatal Seizures MINUTES ILAE 2023

Often subtle — and often a treatable cause behind them.

RECOGNIZE & CONFIRM

- Subtle signs: lip-smacking, cycling or pedaling, eye deviation, apnea, focal clonic or tonic movements.[292]
- **Only focal clonic and focal tonic seizures can be diagnosed clinically** — all other types need EEG or amplitude-integrated EEG (aEEG) to confirm. Electrographic-only seizures are common, especially after the first drug (electroclinical dissociation), so monitor with EEG and **treat electrographic seizures**.[292]
- Common causes: hypoxic-ischemic encephalopathy (most common), stroke, intracranial hemorrhage, infection / meningitis, metabolic (low glucose, calcium, sodium, magnesium), inborn errors, and genetic or structural epilepsies.[292]
- ⚠ **Seizures or encephalopathy after perinatal asphyxia in a term or late-preterm baby < 6 h old → time-critical:** call the NICU / cooling

center now to assess for therapeutic hypothermia (must start within 6 h of birth); avoid hyperthermia; do not delay referral for imaging. Therapeutic hypothermia also lowers seizure burden in HIE.[292]

FIND THE CAUSE

- Glucose, calcium, magnesium, sodium; blood gas, lactate, ammonia.
- Sepsis screen including lumbar puncture, with **CSF HSV PCR** (start empiric IV acyclovir if neonatal HSV is possible)[292]
- Cranial ultrasound, then MRI. If unexplained: metabolic work-up (plasma amino acids, urine organic acids, CSF glucose / lactate / glycine) and genetic testing for early-onset epilepsy (e.g. KCNQ2, SCN2A). **Correct reversible causes first** — refractory hypocalcemia is often driven by low magnesium.[292]

Phenobarbital

DOSE

20 mg/kg IV load (further 10–20 mg/kg to ~40 mg/kg total)

ROUTE & NOTES

First-line regardless of etiology (superior to levetiracetam, NEOLEV2) — **except when a channelopathy is likely** (e.g. family history of neonatal seizures, KCNQ2/KCNQ3): start a sodium-channel blocker (phenytoin or carbamazepine) first.[292] Use the shortest course; discontinue before discharge once acute provoked seizures have stopped and there is no evidence of neonatal-onset epilepsy.[292]

Levetiracetam

DOSE

40 mg/kg IV load; a further 20 mg/kg if required (maintenance 40–60 mg/kg/day in 3 doses)

ROUTE & NOTES

IV; second-line — preferred when there is cardiac disease.[292]

Phenytoin / fosphenytoin

DOSE

20 mg/kg (PE) over 30 min

ROUTE & NOTES

IV; second-line; **first-line for a likely channelopathy** (e.g. KCNQ2/KCNQ3 self-limited familial neonatal epilepsy) — carbamazepine 10 mg/kg/day PO in 2 doses is the alternative.[292]

Midazolam infusion

DOSE

load 0.05–0.15 mg/kg, then 0.06 mg/kg/h (1 mcg/kg/min); increase in steps of 0.06 mg/kg/h to a maximum of 0.3 mg/kg/h (5 mcg/kg/min)

ROUTE & NOTES

IV; second-line/refractory; respiratory depression and hypotension — ventilatory support available.[292]

Lidocaine (lignocaine)

DOSE

specialist infusion (load, then taper)

ROUTE & NOTES

IV; refractory. **Avoid with phenytoin and in cardiac disease** (proarrhythmic).[292]

Pyridoxine

DOSE

100 mg IV

ROUTE & NOTES

Trial under EEG + cardiorespiratory monitoring (apnea / cerebral depression); for vitamin B6-dependent epilepsy or unexplained refractory seizures.

Pyridoxal-5-phosphate (PLP)

DOSE

30 mg/kg/day PO/NG ÷ 3 doses for 3–5 days

ROUTE & NOTES

If pyridoxine fails and PNPO deficiency is suspected.

Folinic acid

DOSE

3–5 mg/kg/day

ROUTE & NOTES

Add-on for pyridoxine-dependent epilepsy with incomplete response.

Dextrose 10% / calcium gluconate 10% / magnesium sulfate

DOSE

2 mL/kg / 0.5–1 mL/kg slow / 0.1–0.2 mmol/kg

ROUTE & NOTES

IV; correct hypoglycemia, hypocalcemia, hypomagnesemia.

✦ **PEARLS**

- **Phenobarbital remains first-line** (superior to levetiracetam for electrographic control, NEOLEV2 RCT[293]), but use the shortest course: after acute provoked seizures have stopped and with no evidence of neonatal-onset epilepsy, **discontinue before discharge home** regardless of MRI or EEG findings.[292]
- Refractory with no cause found: trial **pyridoxine**, then **pyridoxal-5-phosphate** if PNPO is suspected, then add **folinic acid** — these treat vitamin-responsive epilepsies that anticonvulsants miss.[292]

⚠ JITTERY IS NOT SEIZING

- Jitteriness stops with gentle holding and has no eye or autonomic features; true seizures do not stop with restraint.[292]
- Don't miss glucose, calcium, magnesium, or infection.

ADMIT · DISCHARGE · REFER

- **Admit** — all → NICU with monitoring/aEEG.
- **Home from the ward** — not acutely; under neurology with a plan.
- **Refer — now** — neurology and metabolic/genetics for the cause.

Vitamin K Deficiency Bleeding (VKDB)

MINUTES AAP 2022

Preventable with one injection at birth — the late form presents as catastrophic intracranial hemorrhage.

RECOGNIZE (THREE WINDOWS)

- **Early** (0–24 h) — usually maternal drugs that interfere with vitamin K: enzyme-inducing anticonvulsants, antituberculosis drugs (rifampicin, isoniazid), some antibiotics, and vitamin K antagonists (warfarin).[294]
- **Classic** (day 2–7) — bruising, GI or umbilical bleeding in a baby who missed prophylaxis.[294]
- **Late** (about 2 weeks to 6 months; peak 2–8 weeks) — exclusively breastfed, no/oral-only prophylaxis, or malabsorption/cholestasis; up to half present with **intracranial hemorrhage** (bulging fontanelle, seizures, pallor, poor feeding).[294]

⚠ ANY BLEEDING NEONATE

- Check a coagulation screen (prolonged PT/aPTT with normal platelets and fibrinogen suggests VKDB), give vitamin K without waiting for confirmation, and image the brain if any neurological sign.[294]
- Investigate for **cholestasis/malabsorption** in late VKDB.[294]

◣ WORKUP

- **Coagulation screen — prolonged PT** (most sensitive) and aPTT with **normal platelets and fibrinogen** (distinguishes from DIC); rapid correction after vitamin K confirms.[294]
- CBC / film.
- **Neuroimaging** (cranial ultrasound / CT) if any neurological sign — late VKDB commonly presents as intracranial hemorrhage.[294]

Prophylaxis at birth

DOSE

Phytonadione (vitamin K_1) 1 mg if > 1500 g; 0.3–0.5 mg/kg if ≤ 1500 g (AAP 2022; the CPS alternative is a flat 0.5 mg)

ROUTE & NOTES

IM — single dose within 6 h of birth; the reliable route[294]

Active bleeding

DOSE

Vitamin K_1 1–2 mg slow IV (formulary dosing)[42]

ROUTE & NOTES

Plus **FFP** or prothrombin complex concentrate for serious/intracranial bleeding (expert practice — not addressed by the AAP prophylaxis statement)

◈ COUNSELING

- IM prophylaxis at birth prevents both classic and late VKDB; purely oral regimens are less protective, especially in breastfed infants and cholestasis.[294]
- Reinforce with families who decline the injection.

◣ ADMIT · REFER

- **Admit** — any bleeding neonate; PICU/neurosurgery for intracranial hemorrhage.

- **Refer — now** — gastroenterology if underlying cholestasis/malabsorption.

Neonatal Abstinence Syndrome

ASSESS ESC-NOW · NEJM 2023

The jittery, inconsolable, poorly feeding newborn after in-utero drug exposure.

RECOGNIZE

- Tremors/jitteriness, irritability and a high-pitched cry, hypertonia, poor feeding/uncoordinated suck, vomiting/loose stools, sweating, sneezing, and disturbed sleep — typically within the first days after opioid exposure (later for long-acting agents).[295]

⚠ EXCLUDE MIMICS; WATCH FOR SEIZURES

Hypoglycemia, sepsis, hypocalcemia, hyperthyroidism and hypoxic-ischemic encephalopathy can look similar — check them. **Seizures** occur in severe withdrawal and warrant pharmacological treatment and escalation.[296] ⚠ **Do not give naloxone** to a newborn with known

or suspected chronic in-utero opioid exposure — it can precipitate acute withdrawal and seizures; support ventilation instead.

✦ NON-PHARMACOLOGICAL CARE FIRST

- The **Eat-Sleep-Console** approach — rooming-in, breastfeeding where appropriate, swaddling, low stimulation, skin-to-skin — reduces the need for medication and shortens stay.[295]
- Reserve opioids (morphine or methadone) for infants who cannot feed, sleep or be consoled despite optimal supportive care.[295]

◣ WORKUP

- Primarily **clinical** — the **Eat-Sleep-Console** assessment (feeds ≥ 1 oz / breastfeeds · sleeps ≥ 1 h · consoled ≤ 10 min).
- Confirm exposure with **maternal history + maternal/infant toxicology** (urine, meconium, or umbilical cord).[296]

- Exclude mimics: glucose, calcium, sepsis screen and thyroid studies as indicated.

ADMIT · REFER

- **Admit** — admit/observe for scoring (AAP 2020)[297]: **3 days** after immediate-release opioids, **4–7 days** after buprenorphine or sustained-release opioids, **5–7 days** after methadone; escalate if seizures or failure of supportive care. If a second drug is needed, the AAP favors clonidine over phenobarbital.
- **Refer — now** — neonatology, social work and safeguarding as indicated.

Neonatal Dosing by Postmenstrual Age (PMA)

DOSING

`Lexicomp · confirm against unit formulary`

The dose per kg barely changes — postmenstrual and postnatal age change the **interval**.

THE ONE IDEA

- **Postmenstrual age (PMA) = gestational age at birth + weeks since birth.**[298] Immature kidneys clear renally-eliminated drugs slowly, so the more premature the baby and the younger the postnatal age, the **longer the interval** between doses.[299,300]
- For aminoglycosides and vancomycin, the dose stays roughly the same per kg while the gap between doses stretches.[42]

⚠ LEVELS GOVERN, NOT A FIXED SCHEDULE

- Any published regimen is a **starting point** only.[301,302]
- After the first doses, the **drug level** sets the interval for gentamicin,

amikacin and vancomycin — take a trough immediately before the next dose (gentamicin: before the 2nd dose, then before every 3rd dose). **Do not withhold the dose while waiting for the result** unless there is evidence of impaired renal function (raised urea/creatinine, oliguria/anuria) or a previous high trough. If the trough is high (gentamicin ≥ 2 mg/L; aim < 1 mg/L if the course exceeds 3 doses), extend the interval. **Extend the interval (do not cut the dose)** for renal impairment / oliguria, perinatal asphyxia or therapeutic cooling, and concurrent indomethacin / ibuprofen or vancomycin.[42]

- Confirm every value against your unit's formulary and a live NeoFax / BNF for Children.[303,304]

DOSES — USE A NEONATAL REFERENCE

- Neonatal and premature dosing is **PMA- and postnatal-age-dependent**, and aminoglycoside/vancomycin regimens are titrated to **drug levels** — so specific doses and intervals are **not reproduced here**.[299,300,301]

- Use a maintained neonatal dosing reference — **NeoFax**, **Lexicomp**, or the **BNF for Children** — for gentamicin, amikacin, vancomycin and β-lactam dosing by PMA and postnatal age, and confirm every value against your **unit protocol / NICU formulary**.[42,303,304]

◈ **EMPIRIC EARLY-ONSET SEPSIS — AMPICILLIN + GENTAMICIN** (ampicillin covers group B *Streptococcus* and *Listeria*; gentamicin adds Gram-negative cover and synergy). Avoid ceftriaxone in neonates (bilirubin displacement, calcium precipitation).[25,279]

`AAP 2018 · FDA label`

✦ **CAFFEINE CITRATE — THE QUINTESSENTIAL NEONATAL DRUG**

- Apnea of prematurity: **load 20 mg/kg**, then **5 mg/kg once daily** maintenance (up to 10 mg/kg/day for refractory apnea).[305]
- Always prescribe as **citrate** — caffeine base is half the number (20 mg citrate = 10 mg base).[305]

`Caffeine · CAP trial`

Convulsive Status Epilepticus (> 1 month of age)

MINUTES

Seizure ≥ 5 minutes or repeated without recovery — treat by the clock.

0–5 MIN · STABILIZE (CLOCK STARTS AT SEIZURE ONSET)

- **Time is counted from the start of the seizure, not from arrival.** A child who reaches you already seizing ≥ 5 min gets the benzodiazepine **immediately** — airway, oxygen and IV/IO access proceed **in parallel**, never before the drug.[306,307]
- Airway + oxygen 10–15 L/min via non-rebreather mask · IV/IO · monitor.
- **Check glucose** (treat if low); send sodium, calcium, magnesium, glucose.[306]

5 min from onset · 1st line

BENZODIAZEPINE — MAY REPEAT ONCE AFTER 5 MIN (MAXIMUM 2 DOSES IN TOTAL, COUNTING ANY PRE-HOSPITAL DOSE)

Lorazepam IV/IO, or diazepam IV/IO; **no IV access → do not wait for one**: intramuscular midazolam (preferred), buccal/intranasal midazolam, or **rectal diazepam**.[306,307]

~15–20 min · 2nd line

ESETT: THE THREE ARE EQUALLY EFFECTIVE

Levetiracetam (often preferred — quick and simple to give, few interactions; in ESETT efficacy and safety did not differ between the three), valproate, or fosphenytoin/phenytoin (phenobarbital is an alternative).[308]

~40 min · refractory

3RD LINE · PICU **Refractory status epilepticus: urgent PICU/anesthesia/neurology (anesthetic infusion, continuous EEG, find the cause). Intubation is a team decision whenever needed — not reserved for this step.**[309]

FIRST LINE — BENZODIAZEPINES

Lorazepam

DOSE

0.1 mg/kg (max 4 mg)

ROUTE & NOTES

IV/IO

Diazepam

DOSE

0.2–0.3 mg/kg (max 10 mg) IV/IO · rectal 0.5 mg/kg (max 20 mg)

ROUTE & NOTES

IV/IO; rectal when there is no IV access — an accepted first-line route[306]

Midazolam

DOSE

0.1 mg/kg IV (max 4 mg)
0.2 mg/kg IM or intranasal (max 10 mg)
Buccal 0.2–0.5 mg/kg (max 10 mg) — in practice by age: 3 mo–< 1 y 2.5 mg · 1–< 5 y 5 mg · 5–< 10 y 7.5 mg · ≥ 10 y 10 mg

ROUTE & NOTES

IM/buccal/intranasal preferred when no IV access[306]

SECOND LINE — CHOOSE ONE

Levetiracetam

DOSE

40–60 mg/kg (max 4.5 g)

ROUTE & NOTES

IV; often preferred — quick and simple to give, few interactions (efficacy and safety did not differ between the three in ESETT)[308]

Valproate

DOSE

40 mg/kg (max 3 g)

ROUTE & NOTES

IV (given over 10 min in ESETT). Avoid in known/suspected mitochondrial (POLG) or metabolic disease including urea-cycle disorders, liver disease, thrombocytopenia/coagulopathy; **under 2 years use only on neurology advice** (boxed warning — fatal hepatotoxicity; ESETT enrolled ≥ 2 y only). Carbapenems (e.g., meropenem) sharply lower valproate levels.[308]

Fosphenytoin

DOSE

20 mg PE/kg (max 1,500 mg PE)

ROUTE & NOTES

IV at **≤ 2 mg PE/kg/min (max 150 mg PE/min)**; continuous ECG, BP and respiratory monitoring (PE = phenytoin sodium equivalents — prescribe in mg PE)

Phenytoin

DOSE

20 mg/kg (max 1.5 g)

ROUTE & NOTES

IV over ≥ 20 min: **≤ 1 mg/kg/min, never > 50 mg/min**; dilute in 0.9% saline only, in-line filter, large vein; continuous ECG + BP — use if fosphenytoin unstocked

Phenobarbital

DOSE

15–20 mg/kg IV

ROUTE & NOTES

Alternative second-line; monitor for respiratory depression and hypotension

◈ **DRAVET SYNDROME**

- Known/suspected Dravet syndrome (prolonged febrile hemiclonic seizures in infancy): prefer **LEVETIRACETAM** or **VALPROATE**; sodium-channel blockers (phenytoin/fosphenytoin) are avoided as **MAINTENANCE** but are **NOT** contraindicated for acute status epilepticus.[309]
- Phenobarbital is an alternative.

THIRD LINE — REFRACTORY (PICU)

Midazolam infusion

DOSE

0.2 mg/kg load → 0.05–0.4 mg/kg/h to start; PICU may titrate higher (up to 2 mg/kg/h) to EEG seizure suppression

ROUTE & NOTES

IV; titrate to EEG[309]

Ketamine / thiopental / propofol

DOSE

specialist dosing

ROUTE & NOTES

IV infusion titrated to EEG; **propofol short-term only** (propofol infusion syndrome — monitor labs)[309]

Pyridoxine

DOSE

100 mg IV

ROUTE & NOTES

Trial in refractory seizures in infants < 2 yr.[309]

Dextrose 10% (if low glucose)

DOSE

2 mL/kg

ROUTE & NOTES

IV/IO

ADMIT · DISCHARGE · REFER

- **Admit** — all → monitored bed; refractory or needing infusions → PICU.

- **Home from the ward** — not from the acute episode; a first seizure that stops may go home after workup, neurology follow-up.
- **Refer — now** — neurology (EEG, cause); **PICU for refractory status, or airway/hemodynamic compromise.**

Convulsive status epilepticus — treat by the clock

Stabilize → benzodiazepine at 5 min → second-line at ~20 min → refractory (PICU) at ~40 min.



Febrile Seizure

HOURS

6 MO–5 YR

Seizure with fever, no CNS infection or prior afebrile seizure, and no pre-existing neurologic abnormality.

SIMPLE VS COMPLEX

- **Simple:** generalized, under 15 minutes, once in 24 hours — benign; reassure, treat the fever source, antipyretics for comfort; no routine EEG, imaging, or LP.[310]
- **Complex:** focal, over 15 minutes, or recurs within 24 hours — evaluate more carefully.[310]

PEARL — NOT A SIMPLE FEBRILE SEIZURE

- Not a simple febrile seizure if any are present: **focal** features, duration **> 15 min** or recurrence within 24 h (complex), age **< 6 months or > 5 years (60 months)**, incomplete recovery, or a child unwell between events.[310]
- A febrile seizure is, by definition, a seizure with fever in a child **without** CNS infection, metabolic disturbance, or prior afebrile seizures.[311] When any of the features above is present,

exclude those first — meningitis/encephalitis (see **Bacterial Meningitis & Encephalitis**), hypoglycemia, electrolyte disturbance, and an underlying (non-febrile) epilepsy — before labeling it a *complex febrile seizure*.

⚠ LOWER THE THRESHOLD FOR LUMBAR PUNCTURE

- Consider meningitis with any meningism or history/exam suggesting CNS infection; in an infant 6–12 months **under-immunized against Hib or pneumococcus** (or of unknown immunization status); or in a child **pretreated with antibiotics** (may mask meningitis).[310]
- Age < 12 months alone is no longer an indication — AAP 2011 replaced the 1996 advice to "strongly consider" LP in every infant under 12 months; LP is now an *option* only for the under-immunized 6–12-month-old or the antibiotic-pretreated child.[310]
- A seizure lasting ≥ 5 minutes is status epilepticus (see **Convulsive**

Status Epilepticus) — treat as above.

ADMIT · DISCHARGE · REFER

- **Admit** — complex features, prolonged/focal, incomplete recovery, or a source needing admission.
- **Home from the emergency department** — simple febrile seizure, well child, normal exam, reliable carers with safety-net advice.
- **Refer — now** — neurology only for complex, recurrent, or atypical seizures — not routine for simple febrile seizures.

Bacterial Meningitis & Encephalitis

MINUTES > 2 MO

Fever plus altered consciousness, neck stiffness, or a bulging fontanelle — do the LP first, but never delay antibiotics for it.

RECOGNIZE & ACT

- **Infants (non-specific):** fever, poor feeding, lethargy or decreased interaction, vomiting, irritability, ± rash; inconsolable or worsening irritability with progressive lethargy are red flags. **Nuchal rigidity is uncommon in infants.** [312]
- **Older children:** headache, neck pain/stiffness, photophobia, vomiting, impaired consciousness, seizures, **non-blanching rash.** [115]
- Take **blood cultures** (weight-based volumes), then give **empiric IV antibiotics immediately** — do not delay if LP is deferred. [313]
- Add **acyclovir** if encephalitis features (behavior change, focal neurology, seizures). **Encephalitis criteria**: altered mental status ≥ 24 h plus ≥ 2 of — fever, new seizures,

focal neurology, CSF pleocytosis, abnormal neuroimaging, or abnormal EEG.[314]

- Watch for **SIADH** and **raised ICP** (see **Raised ICP**).

◈ BACTERIAL MENINGITIS SCORE — CSF PLEOCYTOSIS IN A WELL CHILD

- **Use only if** age ≥ 2 months, previously healthy, CSF white cells ≥ 10 cells/µL, and no antibiotics in the 72 h before the LP.[315]
- **Do not use** if critically ill (severely altered consciousness, signs of herniation, needs respiratory or blood-pressure support), purpura, ventricular shunt or recent neurosurgery, immunosuppression, or another bacterial infection that needs inpatient antibiotics.[315]

CSF Gram stain positive	**POINTS** 2
CSF neutrophils ≥ 1,000 cells/µL	**POINTS** 1

CSF protein ≥ 80 mg/dL (≥ 0.8 g/L)

POINTS
1

Blood neutrophils ≥ 10,000 cells/µL (≥ 10×10^9/L)

POINTS
1

Seizure before or at presentation

POINTS
1[316]

- **Score 0 → very low risk:** bacterial meningitis in 0.1% (sensitivity 98.3%, negative predictive value 99.9%; 3,295 children); pooled sensitivity 99.3% across 8 validation studies. Outpatient care may be considered.[315,316,317]
- **Score ≥ 1 → not low risk:** manage as bacterial meningitis — admit and give empiric antibiotics until cultures are back.[315]
- **Not for infants < 2 months:** both bacterial cases missed in the validation study were younger than 2 months; in infants ≤ 60 days the score's specificity is 1.6%.[315,318]

EMPIRIC & TARGETED THERAPY — MENINGITIC DOSES

Ceftriaxone

DOSE

50 mg/kg/dose q12h (or 100 mg/kg/dose once daily; max 4 g/day (2 g/dose if q12h))

ROUTE & NOTES

IV (IM if IV not immediate); first-line empiric. Covers *S. pneumoniae*, *N. meningitidis*, *H. influenzae*.[313]

Cefotaxime

DOSE

50–75 mg/kg/dose q6h (max 3 g/dose)

ROUTE & NOTES

IV; alternative to ceftriaxone — **preferred in neonates**.[312]

Vancomycin

DOSE

15–20 mg/kg/dose q6h
target trough 15–20 mg/L for CNS infection[313]; current consensus prefers AUC-guided dosing (AUC/MIC 400–600)[319] (max 1 g/dose)

ROUTE & NOTES

IV; add empirically for possible cephalosporin-resistant pneumococcus.[313]

Ampicillin

DOSE

75 mg/kg/dose q6h (or 50 mg/kg/dose q4h; max 12 g/day)
Term neonates: 100 mg/kg/dose q8h (0–7 days), then 75 mg/kg/dose q6h

ROUTE & NOTES

IV; add for *Listeria* in neonates / immunocompromised / at risk.[42,312]

Meropenem

DOSE

40 mg/kg/dose q8h (max 2 g/dose)

ROUTE & NOTES

IV; alternative if a 3rd-gen cephalosporin is contraindicated — get ID advice.

Dexamethasone

DOSE

0.15 mg/kg/dose q6h (max 10 mg/dose)

ROUTE & NOTES

IV; just before or with the first antibiotic dose (may still be started up to 4 h after it)[312] — see steroid note. **Not** in neonates.[313]

Acyclovir

DOSE

≤ 4 mo: use neonatal HSV dosing (20 mg/kg/dose every 8 h). > 4 mo–< 12 y: 10–15 mg/kg/dose every 8 h (AAP Red Book); up to 20 mg/kg/dose every 8 h is the FDA-label dose and absolute maximum but carries more nephro-/neurotoxicity — use only on ID advice with hydration and daily creatinine. ≥ 12 y: 10 mg/kg/dose every 8 h. Duration 21 days (CNS)

ROUTE & NOTES

IV, infuse over 1 h with adequate hydration + renal monitoring; add if HSV encephalitis suspected. Beyond the neonatal period the higher 20 mg/kg dose is **not** routine — increased neurotoxicity / nephrotoxicity (Lexicomp).[99]

◈ DURATION BY PATHOGEN

- *N. meningitidis* 5–7 days; *H. influenzae* type b 7–10 days; *S. pneumoniae* 10–14 days; group B Streptococcus 14–21 days; Listeria ≥ 21 days; aerobic Gram-negative bacilli 21 days (or ≥ 2 weeks after the first sterile CSF in neonates) — confirm the final duration with infectious diseases.[312,313]
- Confirm the pathogen and tailor to response.

◈ STEROIDS — DEXAMETHASONE

- Give 0.15 mg/kg/dose q6h just before, with, or **within 4 h** of the first antibiotic (earlier is better). **Continue 4 days if Hib or *S. pneumoniae*** is confirmed.
- Reduces hearing loss, especially in Hib.[313]

DURATION, TARGETED THERAPY & FOLLOW-UP

- When susceptibilities return, narrow therapy (penicillin-susceptible pneumococcus or meningococcus → penicillin G or ampicillin; GBS → penicillin/ampicillin + gentamicin).
- **IV duration:** by organism — see the duration list in this card (GBS longer if cerebritis/ventriculitis). **Formal audiology before discharge** for every child.[312]
- Repeat LP is not routine — reserve it for failure to improve, resistant pneumococcus, or selected neonates/complex cases after ID advice; also repeat the LP near the end of therapy for confirmed HSV CNS disease in young infants (to document a negative CSF HSV PCR).[99]

- Arrange **chemoprophylaxis** for close contacts of meningococcal (and Hib per criteria) via public health.[99,320]

⚠ DEFER THE LP (BUT NEVER THE ANTIBIOTICS) IF

- **Image first** (contrast-enhanced CT and/or MRI) if: reduced or fluctuating consciousness/coma, focal neurological deficit, papilledema or other signs of raised ICP, or new-onset seizures.
- **Do not LP** — imaging does not help — if: coagulopathy, skin infection over the site, signs of herniation, or cardiorespiratory instability/shock (stabilize first).[312]
- A purpuric / non-blanching rash with fever is meningococcal sepsis until proven otherwise[115] (see **The Rash**, **Septic Shock**).

◣ ADMIT · DISCHARGE · REFER

- **Admit** — all → hospital; reduced consciousness, shock, seizures, or raised ICP → PICU.
- **Home from the ward** — not from the acute illness; complete the course with audiology and

neurodevelopmental follow-up.

- **Refer — now** — infectious diseases/neurology; PICU for complications; public health for notification and contact prophylaxis.

Brain Tumor — New Presentation

HOURS HeadSmart / RCPCH

Persistent morning headache and vomiting with a visual, coordination, or behavioral sign — image the whole neuraxis, don't LP, and call neurosurgery.

RECOGNIZE — HEADSMART RED FLAGS

- **Raised ICP:** recurrent **headache worse on waking or lying down**, **persistent vomiting (classically early-morning)**, and **papilledema** or a falling conscious level.[321]
- **Visual / eye signs:** new squint or double vision, **nystagmus**, reduced acuity, an **abnormal head tilt**, or abnormal eye movements.[321]
- **Motor / coordination: ataxia** or unsteady gait, new focal weakness or facial droop, and in a young child **regression / loss of milestones**.[321]

- **Age-specific:** infants — **enlarging head, bulging fontanelle, "sunsetting" eyes, developmental regression**; older children / teens — **behavior or school change, fatigue, delayed or arrested puberty, polyuria/polydipsia** (diabetes insipidus), and **precocious puberty** — associated with intracranial (pineal / suprasellar) germ-cell tumors.[321]
- A new **focal seizure**, or any of the above that is **persistent or progressive**.[321]

⚠ **DO NOT LP**

With a mass or **obstructive hydrocephalus**, an LP can precipitate **herniation — image first.**[116] Don't dismiss persistent morning vomiting as gastroenteritis.[321]

◈ **DIAGNOSE**

- **MRI** is the imaging of choice, with **contrast CT** if MRI is not immediately available or to exclude acute hydrocephalus / hemorrhage.[322] Image the **whole spine with contrast** as well to

stage leptomeningeal / “drop” metastases.

- Look actively for **obstructive hydrocephalus** — it is a neurosurgical emergency.[321]

ACUTE MANAGEMENT

- **Position first:** head of bed up **30°**, neck midline (no venous obstruction), avoid hypotonic fluids and hyperthermia; treat seizures — the same first-line measures as for raised ICP (see **Raised ICP**).
- **Dexamethasone** for symptomatic peritumoral (vasogenic) edema / raised ICP — specialist-directed; commonly **0.25–0.5 mg/kg/day in 2–4 divided doses** (max 16 mg/day; many centers use ≈ 0.2 mg/kg/day, max 8 mg/day), and for severe edema or impending herniation a **1–2 mg/kg IV load (max 10–20 mg) then 1–1.5 mg/kg/day divided q6h** (max **16 mg/day**) — formulary dosing.[42]
- **Call neurosurgery urgently**; treat hydrocephalus (EVD / CSF diversion) as directed.[321]

- **Transfer to PICU** if drowsy or dropping conscious level, and manage as **Raised ICP** in the interim.

ADMIT · DISCHARGE · REFER

- **Admit** — any suspected tumor with raised ICP, hydrocephalus, a focal deficit, or a reduced conscious level.
- **Home** — not during the acute presentation; expedite imaging and specialist review.
- **Refer — now** — pediatric **neurosurgery / neuro-oncology** at a specialist center for resection and hydrocephalus management; involve oncology.

Brain Abscess

HOURS NEUROSURGICAL

Fever, headache, focal deficit, or new seizures — image with contrast MRI, treat by source, don't LP.

RECOGNIZE

- **Subacute:** headache (most common), fever, **focal neurological deficit**, new-onset seizures, and features of **raised ICP** (vomiting,

altered consciousness, papilledema). The classic triad (fever + headache + focal deficit) occurs in a **minority**.[323]

- **The source predicts the organisms:** contiguous — **otitis/mastoiditis, sinusitis, dental,** meningitis; hematogenous — **cyanotic congenital heart disease** (right-to-left shunt), endocarditis, pulmonary; direct — penetrating trauma or neurosurgery; **immunocompromise** (add fungi, *Nocardia*, *Toxoplasma*).[323]

◈ **DIAGNOSE**

- **Contrast MRI with diffusion-weighting** is the test of choice — abscess shows **restricted diffusion** (a tumor usually does not); contrast CT if MRI unavailable.[324]
- Take **blood cultures**. **LP only after neurosurgical evaluation** — low yield, herniation risk with a focal mass; abscess drainage and culture is best.[324]
- Contrast MRI + neurosurgery + IV antibiotics by source.

- Urgent neurosurgery + ID; empiric therapy follows source and local resistance.

DECISION — WHAT IS THE LIKELY SOURCE?

OTOGENIC / SINUS / DENTAL / HEMATOGENOUS

Ceftriaxone (or cefotaxime) + metronidazole — covers the *Streptococcus anginosus* (milleri) group and anaerobes;[324] **add vancomycin only if** *S. aureus*/MRSA is plausible (hematogenous spread/endocarditis, penetrating trauma, known MRSA) or the child is critically ill.

POST-TRAUMA / POST-NEUROSURGICAL

Vancomycin + an antipseudomonal beta-lactam (cefepime, ceftazidime, or meropenem) — covers *S. aureus* (incl. MRSA), Gram-negatives and *Pseudomonas*.[324]

EMPIRIC AGENTS — PEDIATRIC DOSES

Ceftriaxone

DOSE

50 mg/kg/dose q12h (or 100 mg/kg/dose once daily; max 4 g/day (2 g/dose if q12h))

ROUTE & NOTES

IV; streptococci + Gram-negatives. Cefotaxime is an alternative.

+ Metronidazole

DOSE

7.5 mg/kg/dose q6h (max 500 mg)

ROUTE & NOTES

IV; anaerobic cover for otogenic / sinus / dental sources.

+ Vancomycin

DOSE

15 mg/kg/dose q6h; trough 15–20 mg/L (max 1 g/dose)

ROUTE & NOTES

IV; add for *S. aureus* / MRSA or severe disease.

Meropenem (OR — alternative)

DOSE

40 mg/kg/dose q8h (max 2 g)

ROUTE & NOTES

IV; cephalosporin allergy, resistant Gram-negatives, or suspected *Nocardia*.

± Vancomycin

DOSE

15 mg/kg/dose q6h (max 1 g/dose)

ROUTE & NOTES

Add to meropenem where *S. aureus* / MRSA is likely.

SURGERY, DURATION & ADJUNCTS

- **Neurosurgical aspiration or excision** for diagnosis and for potential abscess drainage, or if not responding — send pus for aerobic, anaerobic, fungal and mycobacterial studies. **IV antibiotics 6–8 weeks** (any shorter course only on infectious-diseases/neurosurgical advice), guided by clinical response and serial imaging; involve **infectious diseases**.[3][2][4] **Treat the source** (mastoid, sinus, dental). **Urgent PICU consult for ICP management**; give **anticonvulsants** for seizures.
- Reserve **steroids** for significant edema / mass effect — they can reduce antibiotic penetration.[3][2][4]

⚠ DON'T LP RIGHT AWAY – WATCH FOR HERNIATION

- With a focal mass, an LP can precipitate herniation and rarely changes management[323] — image first.
- Rapid deterioration, a large abscess with midline shift, or impending herniation → emergency neurosurgery & PICU consult (see **Raised ICP / The Comatose Child**).

ADMIT · DISCHARGE · REFER

- **Admit** — all → for treatment and monitoring; potential abscess drainage.
- **Home from the ward** — after prolonged IV therapy and imaging response, with follow-up.
- **Refer — now** — neurosurgery (drainage) and infectious diseases; find the source (ENT/dental/cardiac).

Raised ICP / The Comatose Child

MINUTES

Protect the brain: airway, glucose, and reverse herniation fast.

RECOGNIZE HERNIATION

- Falling conscious level (GCS / AVPU), unequal or fixed pupils, abnormal posturing, and the **Cushing triad** (hypertension + bradycardia + irregular breathing) = impending herniation.
- Coma work-up — **DEFG: "Don't Ever Forget Glucose."** Sort causes with **AEIOU-TIPS**: alcohol/toxins, epilepsy, insulin/glucose, opioids, uremia/metabolic, trauma, infection, psychiatric, stroke/shock.

STABILIZE

- Airway (add C-spine control if trauma; use an appropriately sized collar), oxygen, ventilation.
- Check glucose; treat seizures.
- Position the head midline and elevate the head of the bed to 30°.[217]
- Keep normothermic and normoglycemic; avoid hyponatremia — keep sodium in the normal-to-high range.[217]
- **Call PICU.**



LOWER ICP

Maintain oxygenation and **normocapnia** (avoid routine hyperventilation); give hyperosmolar therapy; urgent CT + neurosurgery (measures extrapolated from pediatric severe-TBI guidance).[217]

Hypertonic saline 3%

DOSE

2–5 mL/kg over 10–20 min

ROUTE & NOTES

IV; for raised ICP / herniation[217]

Mannitol

DOSE

0.5–1 g/kg over 10–15 min

ROUTE & NOTES

IV; alternative (caution if hypovolemic/hypotensive) — formulary dosing[42]

Dextrose 10% — hypoglycemia only

DOSE

2–5 mL/kg (0.2–0.5 g/kg); recheck glucose

ROUTE & NOTES

IV/IO **only to correct documented hypoglycemia** (“don't ever forget glucose”); use the smallest effective dose.

⚠ FLUIDS — AVOID FREE WATER

In suspected raised ICP, **avoid dextrose-containing and hypotonic fluids** as a bolus or maintenance — once the glucose is metabolized the leftover free water worsens cerebral edema. Maintain with **isotonic 0.9% saline** (expert consensus — not guideline-stated). The one exception is **documented hypoglycemia**, which injures the brain and must be corrected.

⚠ DO NOT DELAY TRANSFER

Do not delay transfer to PICU/neurosurgery; repeat hyperosmolar therapy is specialist-guided.

⚠ HYPERVENTILATION

Brief hyperventilation **only** as a bridge for impending herniation; sustained hypocapnia causes cerebral ischemia.[217]

ADMIT · DISCHARGE · REFER

- **Admit** — all → PICU.
- **Home from the ward** — not from the acute episode.
- **Refer — now** — neurosurgery/neurology and the primary-cause specialty (tumor, infection, metabolic, trauma).

Guillain–Barré Syndrome / Acute Flaccid Paralysis

MINUTES EAN/PNS 2023

Ascending weakness that can reach the diaphragm — the emergency is respiratory failure and autonomic instability.

RECOGNIZE

- Progressive, fairly **symmetric ascending weakness** with **reduced/absent reflexes**, often after a GI or respiratory infection; a refusal to walk in a young child.[325]
- CSF (if done) shows **high protein with normal cell count** (albuminocytologic dissociation) — may be normal in the first week; MRI may show nerve-root enhancement.[325]

⚠ THE TWO THINGS THAT KILL

- **Respiratory failure** — track vital capacity/effort; rising CO_2 and a falling forced vital capacity (roughly < 15–20 mL/kg) mean elective intubation, not a trial of NIV — **avoid succinylcholine** (denervation → hyperkalemic

arrest; use rocuronium) and expect hemodynamic lability at induction. **Autonomic instability** — labile blood pressure, arrhythmia, ileus; put the child on a cardiac monitor.[325]

- Rapid progression or bulbar weakness (choking, weak cough) = ICU.[325]

✦ DON'T BE REASSURED BY A NORMAL EARLY TAP

- Weakness can outrun the CSF and the reflexes early on.
- If the picture fits, admit and monitor breathing serially rather than discharging on a single normal test.
- Always exclude a compressive cord lesion (a sensory level, back pain or sphincter loss points to the cord, not GBS).[325]

WORKUP

- **Lumbar puncture** — albuminocytologic dissociation (high protein, normal cells); **may be normal in the first week**.[325]

- **Nerve conduction studies / EMG** (subtype; may be normal early — repeat).
- **Serial bedside spirometry** — FVC **3–6 times a day** depending on severity, and **every 4 h while FVC is falling**, plus single-breath count and bulbar assessment. Act on **FVC ≤ 20 mL/kg**, a **> 30% fall** from baseline, single-breath count < 20, or MIP < 40 / MEP < 30 cmH_2O (EAN/PNS 2023).[325] The older "20/30/40" rule (FVC < 20 mL/kg, MIP < 30, MEP < 40 cmH_2O) comes from a mainly adult ICU cohort.[326]
- **Spirometry is unreliable under ~5–6 years** or with facial/bulbar weakness (poor mouth seal) — there, rely on **serial clinical assessment**: single-breath count, cough strength, paradoxical breathing, ability to lie flat, and the blood-gas/CO_2 trend (expert practice — not guideline-stated).
- **Continuous ECG/BP** for dysautonomia.[325]
- **Spinal MRI with contrast** (nerve-root enhancement; excludes a compressive cord lesion).

- Anti-ganglioside antibodies (GQ1b for Miller-Fisher).[325] **Stool for poliovirus/enterovirus** in acute flaccid paralysis — two specimens ≥ 24 h apart within 14 days of onset.[327]

IV immunoglobulin

DOSE

2 g/kg total — preferably 0.4 g/kg/day × 5 days (a 2-day course, 1 g/kg/day, gives more early relapses in children); for a child unable to walk unaided or with rapid progression, bulbar or respiratory involvement

NOTES

First-line; equivalent to plasma exchange — a **second course is not recommended** in non-responders (SID-GBS)[325]

Plasma exchange

DOSE

Per center protocol

NOTES

Alternative — not combined with IVIG[325]

Corticosteroids

DOSE

Not recommended

NOTES

No benefit in GBS[325]

ADMIT · REFER

- **Admit** all suspected cases for respiratory and cardiac monitoring.
- **Call** neurology; critical care early if bulbar/respiratory involvement or rapid progression. Acute flaccid paralysis is **notifiable** (polio surveillance) — send stool.

The Child with Neuromuscular Disease

MINUTES DMD Care 2018 · CHEST 2023

A known neuromuscular disease rewrites every emergency — the weak cough, the anesthetic that can kill, the heart, and the steroids.

RESPIRATORY — THE USUAL KILLER

- It is the **weak cough, not the lungs**: a “simple” chest infection tips into **hypercapnic respiratory failure**. Support ventilation with **NIV (bilevel)** and clear secretions with **mechanical insufflation–exsufflation (cough assist)** — not oxygen alone.[328,329]

- **The oxygen saturation lies** — it can be normal while CO_2 climbs. Track **capnography / blood-gas pCO_2**, not SpO_2.

⚠ ANESTHETIC / RSI HAZARD — FLAG BEFORE ANY SEDATION

- **Succinylcholine is contraindicated** in dystrophinopathies and many myopathies (hyperkalemic cardiac arrest), and **volatile agents** (sevoflurane, isoflurane, desflurane) risk **anesthesia-induced rhabdomyolysis / hyperkalemia** (see Rhabdomyolysis). **Safe approach:** total IV anesthesia (propofol, opioid, benzodiazepine) + a **non-depolarizing** blocker (rocuronium) reversible with sugammadex.[330]
- Obtain a baseline CK and an ECG before any procedure, and recheck K^+ and CK if perioperative rhabdomyolysis is suspected.[330]

⚠ DO NOT GIVE UNCONTROLLED OXYGEN

- High-flow O_2 masks a rising CO_2 and can abolish respiratory drive[328] → **CO_2 narcosis and arrest**.
- Titrate O_2 only **with** ventilatory support and CO_2 monitoring — correct the hypoventilation, not the number.[328]

CARDIAC

- **Duchenne / Becker** → dilated cardiomyopathy and arrhythmia (may be silent — reduced mobility hides symptoms). **Emery-Dreifuss / LGMD1B** → progressive **AV / conduction block** and sudden death (may need pacing).[328,331]
- Any acute deterioration: **12-lead ECG + echocardiogram**; troponin and BNP/NT-proBNP if acute myocardial injury or heart failure is suspected.[328]

ADRENAL — STRESS-DOSE STEROIDS

- A child on **chronic daily steroids** (prednisone/deflazacort for Duchenne) **cannot mount a stress**

response. Acute illness, vomiting, trauma, surgery or shock needs **stress-dose steroids** to prevent adrenal crisis — **never stop steroids abruptly**[332] (see **Adrenal Crisis**).

FRACTURE / FALL

- A Duchenne boy with a **long-bone fracture or leg trauma** (even a minor fall) who becomes confused, breathless/hypoxemic or tachycardic has **fat embolism syndrome** until proven otherwise → respiratory support, PICU, orthopedics, and stress-dose steroids.[328]

MYASTHENIC CRISIS

- Worsening bulbar/respiratory weakness → treat with **IVIG or plasma exchange** and support the airway.[333] Follow **FVC and NIF**, not SpO_2.
- **Avoid drugs that worsen myasthenia:** aminoglycosides, macrolides, fluoroquinolones, **IV magnesium**, beta-blockers, and procainamide.[334]

✦ TWO NUMBERS THAT MISLEAD, ONE THAT DOESN'T

- In neuromuscular weakness a normal **SpO_2** and a normal **respiratory rate** are falsely reassuring — the child fails from **CO_2 retention and a failing cough**.
- The honest bedside numbers are **pCO_2 (capnography/gas)** and **FVC / NIF**.
- A metabolic/mitochondrial myopathy adds a fourth: start **IV dextrose (D10) early** — fasting and catabolic stress precipitate metabolic decompensation (limit or avoid dextrose in pyruvate-metabolism disorders or on a ketogenic diet).[335]

◣ WORKUP

- **VBG/ABG with pCO_2 + continuous capnography** — the key respiratory measure; **FVC and NIF** where the child can cooperate.
- Electrolytes incl. **potassium, magnesium, calcium**; **creatine kinase**; renal function; **glucose**; lactate.

- **12-lead ECG**; troponin + BNP/NT-proBNP; echocardiogram if cardiac concern.
- Chest X-ray ± sputum culture if infective; swallow/bulbar assessment.[328]

Stress steroids — tolerating oral (moderate illness/injury)

DOSE

Never omit the usual daily steroid. Add oral hydrocortisone ≈ 30–50 mg/m²/day in 3–4 divided doses (≈ 3 × physiologic replacement — not 3 × the Duchenne treatment dose)

ROUTE & NOTES

PO; per the child's written stress plan / PJ Nicholoff protocol. If on prednisone/prednisolone the usual daily dose may instead be split twice daily; do not rely on extra deflazacort and **never use vamorolone** for stress cover. Vomiting, cannot take oral, severe illness, major trauma or surgery → IM/IV hydrocortisone (next row)

Stress steroids — unwell / vomiting / shock

DOSE

Hydrocortisone ≈ 2 mg/kg (or 50 mg/m²) IV, then continued

ROUTE & NOTES

IV/IM; treat as adrenal crisis — do not wait. DMD care considerations: emergency IM hydrocortisone 50 mg (< 2 yr) or 100 mg (≥ 2 yr); stress dosing 50–100 mg/m²/day in severe illness, major trauma or surgery.[332]

Myasthenic crisis

DOSE

IVIG 2 g/kg over 2–5 days *or* plasma exchange

ROUTE & NOTES

Plus airway support; treat the trigger/infection

Metabolic myopathy — catabolic stress

DOSE

IV dextrose (D10) early

ROUTE & NOTES

Prevents fasting-driven decompensation / rhabdomyolysis

◈ LOCAL & ANTICIPATORY

- Ask for the child's **EMERGENCY / ANESTHESIA ALERT CARD** and neuromuscular care plan on arrival, and involve the **NEUROMUSCULAR TEAM** early.
- Keep succinylcholine and volatile agents off the plan for dystrophinopathies, and flag the diagnosis to anesthesia/critical care before any transfer, sedation or intubation.[328]

◣ ADMIT · REFER

- **Admit** — any respiratory decompensation, myasthenic/adrenal crisis, new

cardiac signs, or a child who needs assisted airway clearance.

- **Refer — now** — call neuromuscular/neurology, cardiology and critical care/anesthesia; new acute flaccid weakness without a known diagnosis → see **Guillain–Barré / Acute Flaccid Paralysis**.

12 Orthopedic & Musculoskeletal

The limping child · fractures & NAI · SCFE · compartment syndrome · bone & joint infection

Orthopedic Emergencies — Call Now

MINUTES

Immediate orthopedic (± vascular/spinal) consultation — do not wait for imaging.

⚠ IMMEDIATE ORTHOPEDIC CONSULTATION

- Septic arthritis
- Compartment syndrome
- Open fracture

- SCFE
- Joint dislocation
- Fracture with pulseless limb
- Unstable pelvic injury
- Spine injury with neurological deficit

Osteoarticular Infections HOURS

RECOGNIZE

Acute hematogenous osteomyelitis (AHO) and septic arthritis (SA) — consider in any limp, refusal to use a limb, or pseudoparalysis.

CLINICAL PRESENTATION

- **Pseudoparalysis / limp / refusal to weight-bear**, or focal limb pain — often the only symptom. Fever supports diagnosis but may be absent.[93]
- **Osteomyelitis:** point tenderness over the **metaphysis** of a long bone ± localized swelling/erythema; fluctuance suggests a periosteal abscess.[93]
- **Septic arthritis:** joint effusion, swelling, and pain on any movement of the isolated joint; the limb is held

in a position of comfort.[336]

- *S. aureus* → acute, rapidly progressive, higher CRP (MRSA more severe). *Kingella kingae* (young children) → milder, indolent, lower markers.[93]
- **Chronic recurrent multifocal osteomyelitis (CRMO/CNO)** — consider with recurrent bone pain, multifocal lesions, sterile cultures, and poor response to antibiotics.[93]

MOST COMMON SITES & PATHOGENS

- **Bone:** metaphysis of long bones — **femur, tibia, humerus**. Pelvic bones are easily missed (vague pain, mimics abdomen).[93]
- **Joint: hip and knee** most common, then ankle, elbow, shoulder. SA + adjacent osteomyelitis is common (≈ 32% of SA), especially with *S. aureus* and longer symptom duration.[336]
- **Pathogens:** *S. aureus* overall most common; *K. kingae* dominates under ~4 yr (inoculate fluid into blood-culture bottles). Add

Salmonella in sickle cell disease; *H. influenzae* type b if under-immunized.[93]

◈ KOCHER CRITERIA — HIP SA VS TRANSIENT SYNOVITIS

- Four predictors, one point each: **NON-WEIGHT-BEARING**; **HISTORY OF FEVER (> 38.5 °C)**; **ESR ≥ 40 MM/H**; **WHITE-CELL COUNT > 12,000/ML**.
- Many add **CRP > 20 MG/L** as a strong independent predictor.[337]
- A risk-stratification aid for the hip, not a rule-out.[338]
- More positive criteria substantially raise septic-arthritis probability, but always interpret alongside CRP, ultrasound, and clinical judgment.[338]

KOCHER — PROBABILITY OF SEPTIC ARTHRITIS

0 of 4

APPROX. PROBABILITY OF SA
< 0.2 %

1 of 4

APPROX. PROBABILITY OF SA
~ 3 %

2 of 4

APPROX. PROBABILITY OF SA

~ 40 %

3 of 4

APPROX. PROBABILITY OF SA

~ 93 %

4 of 4

APPROX. PROBABILITY OF SA

~ 99 %

⚠ WORK-UP

- Blood cultures **before** antibiotics. **CRP** at baseline (sensitive, falls fast — best for monitoring; ESR less useful).[93]
- Plain films to exclude mimics; **ultrasound** for hip/shoulder effusion; **MRI is the imaging modality of choice** (add contrast if abscess or soft-tissue extension is suspected); **MRI with gadolinium** is the most sensitive/specific test, defining abscess, adjacent osteomyelitis, and soft-tissue extent.[93]

ADMIT · DISCHARGE · REFER

- **Admit** — all suspected septic arthritis/osteomyelitis → IV antibiotics after cultures/aspiration. **Ill-appearing child or rapidly progressive infection: start empiric IV antibiotics immediately after blood cultures — do not wait for joint aspiration.** Child who is not clinically ill: antibiotics may be withheld under close observation until the joint aspirate is obtained, provided aspiration is prompt (PIDS/IDSA 2023).
- **Home from the ward** — not acutely; step down to oral with monitoring and orthopedic follow-up.
- **Refer — now** — orthopedics (aspiration/washout) and infectious diseases.

Osteoarticular Infections — Management

HOURS CULTURES FIRST

Cultures first, then empiric IV cefazolin; involve orthopedics early for any septic joint or bony abscess.

DECISION

Osteomyelitis or septic arthritis?

OSTEOMYELITIS (AHO)

Most respond to **antibiotics alone**. Surgery (drainage/debridement) for a **subperiosteal/intraosseous abscess**, or if not improving in the first few days — repeat imaging and reconsider debridement.[93]

SEPTIC ARTHRITIS

Orthopedic emergency — urgent **aspiration ± arthroscopic/open drainage & irrigation**; send synovial fluid for cell count/differential, Gram stain and culture, with molecular (PCR) testing if no pathogen is identified, especially in preschool children (*K. kingae*).[336] Hip and shoulder are especially time-critical (avascular-necrosis risk; expert consensus).

Empiric therapy after cultures: IV cefazolin — covers MSSA and *K. kingae*.[93]

ANTIBIOTIC THERAPY

Empiric — first-line IV

DRUG & DOSE

Cefazolin 33–50 mg/kg/dose IV q8h (100–150 mg/kg/day; max 2 g/dose; upper end for serious invasive infection)

NOTES

Covers MSSA **and** *K. kingae* — the two commonest pathogens. Start after blood cultures.[93]

Under 4 yr / unimmunized

DRUG & DOSE

Cefuroxime 50 mg/kg/dose IV q8h (max 1.5 g/dose)

NOTES

Broadens to cover *H. influenzae* in unimmunized young children.[93]

MSSA — confirmed

DRUG & DOSE

Continue cefazolin, or cloxacillin 37.5–50 mg/kg/dose IV q6h (cloxacillin max 2 g/dose)

NOTES

Cloxacillin narrows further but irritates veins.[93]

MRSA — suspected/confirmed

DRUG & DOSE

Add/use vancomycin 15 mg/kg/dose IV q6h (max 1 g/dose; level-guided)

NOTES

Where MRSA prevalent or known carrier. Note: *K. kingae* is resistant to vancomycin and clindamycin but typically susceptible to cephalosporins.[93]

Oral step-down — MSSA / culture-neg

DRUG & DOSE

Cephalexin 25–33 mg/kg/dose PO TID (75–100 mg/kg/day; max 4 g/day — some experts give up to 6 g/day in 4 doses)

NOTES

First-line oral. Cloxacillin 25 mg/kg/dose QID is an alternative (poor taste). Formulary dosing.[42]

Oral step-down — MRSA

DRUG & DOSE

Clindamycin, TMP-SMX, or linezolid

NOTES

Per susceptibilities, with infectious-diseases input; MRSA usually needs longer before switching (expert practice).

◈ **IV → ORAL SWITCH & DURATION**

- Switch to oral when **CLINICALLY IMPROVED** (afebrile, using the limb) and **CRP FALLING**, with an active, well-tolerated oral option and assured adherence.[336,339] **DURATION (CRP-GUIDED):** AHO **3–4 WEEKS**
- uncomplicated SA as short as **10–14 DAYS** total (IV + oral) when improving rapidly with a progressively falling CRP by the end of week 1
- SA with adjacent osteomyelitis, a slow response, or the hip/shoulder: longer, individualized course with infectious-diseases input.[336]

- Randomized data (Peltola) support short courses once response is good and CRP normalizes early.[340]

⚠ **FOLLOW-UP**

- Confirm clinical resolution and a **normal/normalizing CRP** before stopping.
- End-of-therapy radiographs mainly if the **growth plate** was involved or a large lytic lesion present — these and any physeal involvement need **orthopedic follow-up**.
- Routine follow-up MRI/CT is not needed — reserve for complications or non-improvement.[93]

◈ **DIFFICULT IV ACCESS?** Reassess for an early IV→oral switch at every line failure rather than re-sticking — see **IV → Oral Switch & the DIVA Patient** (Quick Reference).

The Limping Child

ASSESS APPROACH

A limp is a symptom — use age and red flags to separate the benign from septic joint, SCFE, malignancy, and abuse.

DEFINE

- A **limp** is any deviation from normal age-appropriate gait; pain present in ~80%. Broad differential — separate benign causes from the **can't-miss** ones: septic joint, osteomyelitis, SCFE, malignancy, and inflicted injury.[341]

APPROACH — AGE NARROWS THE DIFFERENTIAL

- **Toddler (1–3 y):** toddler's fracture, transient synovitis, developmental dysplasia of the hip, inflicted injury.
- **Child (4–10 y):** transient synovitis, Legg-Calvé-Perthes, septic arthritis, reactive/juvenile idiopathic arthritis.
- **Adolescent (> 10 y): SCFE**, apophysitis/overuse, sports injury.[341]
- **Spinal:** consider discitis, vertebral osteomyelitis, or a spinal tumor in a child refusing to walk with a **normal**

hip exam — especially with back pain or spinal tenderness.[341]

- **Malignancy:** persistent night pain, pain out of proportion to the exam, constitutional symptoms, or failure to improve[341] → **urgent investigation**.
- History: pain, trauma, fever, systemic or night symptoms. Examine gait (antalgic vs Trendelenburg), hip, knee, spine, neurology — **knee pain often means hip disease**.[341]
- **Any age — look beyond the hip:** consider a **first presentation of juvenile idiopathic arthritis (JIA)**, which occurs across **all age groups**, and **examine every joint** — not only the painful one (a commonly missed step that reveals oligo- or polyarticular disease).[341]

⚠ **WORK-UP**

Plain radiographs of the involved site — **both hips (add a frog-leg view for SCFE)** if the exam does not localize. **FBC, CRP/ESR, blood culture** if febrile or systemically unwell; ultrasound for a hip effusion; MRI if osteomyelitis or malignancy is suspected.[341]

RED FLAGS

- **Fever + refusal to weight-bear + raised inflammatory markers** → septic joint/osteomyelitis. Normal early CRP/ESR/white count do **not** exclude osteoarticular infection — reassess if symptoms persist or worsen.[341]
- **Night pain, weight loss, pallor, bruising, or hepatosplenomegaly**[341] → malignancy/leukemia.
- **Multiple or unexplained fractures, or a fracture in a non-ambulatory infant**[342] → inflicted injury.
- **Adolescent hip or knee pain with a limp**[133] → SCFE until excluded.

PEARL — POINT TO THE HIP

Isolated knee or thigh pain in a child is hip pathology until proven otherwise — SCFE and Perthes both refer pain to the knee.[341]

ADMIT · DISCHARGE · REFER

- **Admit** — septic arthritis, osteomyelitis, fracture, or systemic illness; unable to weight-bear with red flags.

- **Home from the emergency department** — transient synovitis in a well child with safety-net advice and review.
- **Refer — now** — orthopedics for red flags.
- **Refer — clinic** — oncology/rheumatology as indicated.

Transient Synovitis vs Septic Arthritis

HOURS KOCHER

The commonest atraumatic limp — but rule out the septic joint first; fever + non-weight-bearing + high CRP means aspirate.

DEFINE

- **Transient synovitis** — a benign, self-limited, often post-viral hip inflammation and the commonest cause of an atraumatic limp.[343] Typically 3–8 years; symptoms usually resolve within **7–10 days**

(expert consensus). Must be separated from **septic arthritis**, a surgical emergency.[338]

APPROACH — READ THE CHILD

- **Transient synovitis:** a well child, low-grade or no fever, **weight-bears with discomfort**, mildly raised markers, often a recent upper-respiratory infection.
- **Septic arthritis:** an unwell/febrile child who **refuses to move the joint**, severe pain on any movement, the limb held in flexion/abduction/external rotation.[338]

KOCHER CRITERIA — HIP: SEPTIC ARTHRITIS VS TRANSIENT SYNOVITIS

- One point each: **NON-WEIGHT-BEARING**; **HISTORY OF FEVER (> 38.5 °C)**; **ESR ≥ 40 MM/H**; **WBC > 12,000/ML**.
- Many add **CRP > 20 MG/L** as a strong independent predictor.
- Probability of septic arthritis: 0/4 < 0.2%
- 1/4 ≈ 3%
- 2/4 ≈ 40%
- 3/4 ≈ 93%

- 4/4 ≈ 99%.
- A risk aid, not a rule-out.[338]

⚠ **WORK-UP**

- FBC, **CRP**, ESR, blood culture; hip **ultrasound** (an effusion is seen in both and does not distinguish).[338]
- If septic arthritis is suspected → **urgent ultrasound-guided aspiration** (cell count, Gram stain, culture into a blood-culture bottle).[341]

MANAGEMENT

- **Septic arthritis** — orthopedic emergency: urgent joint drainage plus IV antibiotics after cultures (see **Osteoarticular Infections**).
- **Transient synovitis** — rest, NSAIDs, review in 24–48 h; settles over days. Re-evaluate promptly if it does not improve or markers rise (expert consensus — not guideline-stated).

✦ **PEARL — WHEN IN DOUBT, ASPIRATE**

Fever + refusal to weight-bear + a raised CRP is a septic joint until an aspirate

proves otherwise — do not label it transient synovitis by default.[338]

ADMIT · DISCHARGE · REFER

- **Admit** — any suspicion of septic arthritis (Kocher criteria, raised markers) → aspiration.
- **Home from the emergency department** — transient synovitis, afebrile, mobilizing, with review.
- **Refer — now** — orthopedics for aspiration/washout if septic.

Nursemaid's Elbow

ASSESS · 1–4 YR

A pulled, pronated arm the child will not use — reduce by hyperpronation; no film needed if the story is classic.

DEFINE

- **Nursemaid's elbow (radial head subluxation, 'pulled elbow')** — the annular ligament slips over the radial head after axial traction on an extended, pronated arm.[344] Commonest elbow injury in children aged 1–4 years.

APPROACH & WORK-UP

- Typical story: sudden **pull or lift** on the arm. Child holds the arm slightly flexed and **pronated**, refuses to use it, with **no swelling, bruising, or deformity** and minimal tenderness.[344]
- **No imaging needed** with a classic history and a normal-looking arm. Image if the story is atypical, or there is swelling, focal bony tenderness, or deformity.[344]

⚠ RED FLAGS

- Swelling, bruising, point bony tenderness, or deformity → suspect a fracture and radiograph.
- An inconsistent or implausible history should prompt consideration of inflicted injury.

MANAGEMENT — REDUCE IT

- **Hyperpronation** (support the elbow, firmly pronate the forearm) — a Cochrane review and a meta-analysis show **fewer first-attempt failures** than supination-flexion (≈ 9% vs 26%;

low-certainty evidence); it may also be less painful, but the pain evidence is very uncertain — do it first.[344]

- Alternative: **supination-flexion** (supinate the forearm, then fully flex the elbow). A palpable click often signals success.[344]
- Child usually resumes normal use within 5–30 minutes. If reduction fails, try the other maneuver; if still unsuccessful, immobilize, image, reassess.[344]

✦ **PEARL — NO FILM NEEDED IF IT WORKS**

- With a classic pull mechanism and no swelling, reduce without imaging — if the child uses the arm normally afterwards, diagnosis is confirmed and no radiograph is required.[344]
- Do not attempt repeated reductions if there is swelling, bruising, focal tenderness, or an atypical history — image and consider safeguarding.[344]

◣ **ADMIT · DISCHARGE · REFER**

- **Admit** — not required.

- **Home from the emergency department** — after successful reduction and return of normal arm use.
- **Refer — now** — orthopedics only if reduction fails, or for swelling/deformity suggesting fracture (image first).

Slipped Capital Femoral Epiphysis (SCFE)

HOURS CAN'T MISS

Peri-pubertal limp with hip or knee pain — stop weight-bearing and get frog-leg views of both hips.

DEFINE

- **Slipped capital femoral epiphysis (SCFE)** — the proximal femoral epiphysis slips through the physis. Peri-pubertal; **obesity is the strongest risk factor**; up to ⅓ bilateral. Consider endocrinopathy if the child is young (< 10 years), underweight, or atypical.[133]

APPROACH & WORK-UP

- Limp with **hip, groin, thigh, or knee pain**; the leg lies **externally rotated** with limited internal rotation and **obligate external rotation on hip flexion** (Drehmann sign).[345]
- **Stable** (able to weight-bear, with or without walking aids) vs **unstable** (cannot bear weight — high avascular-necrosis risk).[346]
- **AP + frog-leg lateral radiographs of BOTH hips**.[345] For an **unstable** slip avoid forced frog-leg positioning and use AP + **cross-table lateral** to prevent further displacement; Klein's line may fail to intersect the epiphysis on the affected side but is insensitive on the AP view alone (expert practice).

⚠ RED FLAGS

- An **unstable slip** (non-weight-bearing) carries high avascular-necrosis risk.
- Missed or delayed diagnosis → progression and permanent deformity.[345]
- Assess both hips.

MANAGEMENT

- **Make the child non-weight-bearing immediately** and refer urgently to orthopedics for **in-situ screw fixation**.[345]
- **Do not attempt reduction** — forceful manipulation increases avascular-necrosis risk (expert consensus — not guideline-stated).
- Consider prophylactic contralateral fixation in high-risk patients (young age, obesity, endocrinopathy) — a specialist decision (expert consensus).

✦ PEARL — FROG-LEG BOTH HIPS

Any obese adolescent with a limp or knee pain gets frog-leg views of both hips and is kept off the leg until SCFE is excluded — knee pain is the classic decoy.[133,345]

ADMIT · DISCHARGE · REFER

- **Admit** — all → non-weight-bearing, urgent surgery.
- **Home from the ward** — post-operative.
- **Refer — now** — orthopedics urgently (surgical fixation).

- **Refer — clinic** — endocrinology if bilateral or atypical.

Fractures — Patterns & Non-Accidental Red Flags

ASSESS SAFEGUARDING

Know the common breaks — and the fractures that mandate a child-protection assessment.

DEFINE

- Common pediatric fracture patterns and — critically — the fractures that trigger a **child-protection** assessment. Children's growing bone breaks differently from adults'.[342]

APPROACH — COMMON ACCIDENTAL PATTERNS

- **Buckle/torus** (distal radius, stable) and **greenstick** fractures[347], and the **toddler's fracture** (spiral distal tibia in an ambulant toddler).

- **Physeal (Salter-Harris)** fractures cross the growth plate and risk growth arrest — always classify and follow up.[347]
- Radiograph the **joint above and below**; obtain comparison views when needed (standard radiographic practice).
- **Supracondylar humeral fractures** need careful neurovascular assessment — document radial pulse, capillary refill, and **median (including anterior interosseous), radial, and ulnar** nerve function before and after splinting/reduction. A pulseless or poorly perfused hand needs **immediate orthopedic consultation**.[348]

⚠ RED FLAGS — INFLICTED INJURY

- Escalate to safeguarding when the **injury is inconsistent** with the stated mechanism or the child's development — especially a **long-bone (femur/tibia) fracture in a non-ambulatory infant**, delayed presentation, multiple fractures of different ages, or **rib, metaphyseal 'corner', scapular, or spinous-process** fractures.[342]

- In children < 2 years with a suspicious fracture, obtain a **skeletal survey**.[342]
- Associated **bruising, patterned burns, retinal hemorrhage**, or other unexplained injuries further raise suspicion of abuse.[342]

MANAGEMENT

- Immobilize, provide analgesia, and refer to orthopedics for displaced, physeal, or unstable fractures.
- Where abuse is suspected, follow the mandatory **child-protection pathway** — evaluation and reporting are not optional.[342]

KUWAIT — REPORTING IS MANDATORY

- Under the **CHILD RIGHTS LAW NO. 21 OF 2015**, children are protected from all forms of violence, abuse, exploitation, and neglect, and **PHYSICIANS ARE LEGALLY OBLIGED TO REPORT** suspected child maltreatment.[2]
- Refer through the **KUWAIT NATIONAL CHILD PROTECTION PROGRAM (KNCPP), MINISTRY OF HEALTH**, via the national **CHILD PROTECTION HOTLINE 147**.

- Ensure the child's immediate safety, document findings objectively, and involve the hospital child-protection team.

✦ PEARL — IF THEY CAN'T WALK, BE SUSPICIOUS

A fracture in a child who is not yet walking is highly suspicious for abuse until proven otherwise — do the skeletal survey and involve safeguarding.[342]

✦ PEARL — DOCUMENT THE NEUROVASCULAR EXAM

Every **supracondylar fracture** needs documented radial pulse, capillary refill, and median (including anterior interosseous), radial, and ulnar nerve function **before and after** splinting or reduction. **A pulseless hand is an orthopedic emergency, even if it remains pink.**[348]

Compartment Syndrome MINUTES

LIMB-THREATENING

Rising compartment pressure starves muscle and nerve — in children the 3 A's beat the 5 P's; fasciotomy is the fix.

DEFINE

- **Acute compartment syndrome** — rising pressure in a fascial compartment cuts perfusion → muscle/nerve ischemia. Limb-threatening; **clinical** diagnosis. Most follow fractures (tibia, forearm), tight casts, crush, or reperfusion.[349]

⚠ RED FLAGS — THE 3 A'S IN CHILDREN

- The adult '5 Ps' (pain out of proportion, pain on passive stretch, paresthesia, pallor, pulselessness) are **unreliable in children**.[349]
- Suspect from the **3 A's — rising Analgesia requirement, Anxiety, and Agitation** — in the one series that measured it, a rising analgesic need preceded neurovascular change by more than 7 hours (Bae

2001; Lin & Samora 2020 meta-analysis).[349,350,351]

- Tensely swollen compartment = most consistent sign. **Pulselessness and paralysis are late.**[349]

⚠ **WORK-UP**

- Clinical diagnosis.
- Reserve compartment-pressure measurement for the obtunded or equivocal patient (ΔP < 30 mmHg from diastolic is concerning). **Do not delay fasciotomy to obtain pressures.**[349]

MANAGEMENT

- **Remove or split all constricting casts and dressings down to skin**; keep the limb at heart level (do not elevate).[349]
- Analgesia, oxygen, correct hypotension. Dense regional/nerve blocks can mask ischemic pain — in high-risk limb injuries prefer low-concentration blocks and stay vigilant (breakthrough or escalating pain, rising analgesic needs).[349]

- **Emergency surgical fasciotomy without delay** — the definitive treatment.[349]

✦ **PEARL — ESCALATING PAIN = CALL SURGERY**

A child with a limb injury whose analgesia needs keep climbing has compartment syndrome until proven otherwise — split the cast and call surgery.[349]

ADMIT · DISCHARGE · REFER

- **Admit** — all suspected → emergency.
- **Home from the ward** — post-operative.
- **Refer — now** — orthopedic (lower limb) / plastic surgery (upper limb) IMMEDIATELY (fasciotomy); do not delay for pressure measurement in a clear case.

Open Fracture HOURS

ANTIBIOTICS EARLY

Skin breach over bone — early IV antibiotics, tetanus cover, saline dressing, and urgent orthopedics.

DEFINE

- **Open (compound) fracture** — fracture with an overlying skin breach communicating with bone; high infection risk. Graded Gustilo-Anderson I–III by wound size, contamination, and soft-tissue injury.[352]

APPROACH & WORK-UP

- Visible wound/bleeding over the fracture, exposed bone, or gross deformity. **Assess neurovascular status distal to the injury.**[352]
- Remove gross contamination, photograph the wound once, then **cover with a saline-soaked sterile dressing**; radiograph; check **tetanus** status.[352]

⚠ **RED FLAGS**

- A **pulseless, pale, cold limb** needs urgent reduction/vascular assessment.
- Gross contamination, type-III wounds, and evolving **compartment syndrome** raise the stakes.[352]

MANAGEMENT

Antibiotics — timing

DOSE

First IV dose as soon as possible (ideally < 1 h, at latest < 3 h)

ROUTE & NOTES

The clock starts at injury, not arrival.[352]

Type I–II

DOSE

Cefazolin 30 mg/kg/dose IV (max 2 g) every 8 h

ROUTE & NOTES

First-generation cephalosporin — gram-positive cover (regimen adult-derived; pediatric weight-based dose per formulary).[42,352]

Type III

DOSE

Add gentamicin 5–7 mg/kg/dose IV once daily add benzylpenicillin for farm/soil contamination (anti-clostridial cover)

ROUTE & NOTES

Add gram-negative cover for high-grade/contaminated wounds (adult-derived; pediatric dose per formulary).[42,352]

Farm / soil contamination

DOSE

Add penicillin

ROUTE & NOTES

Anti-clostridial cover.

THEN

- **Tetanus prophylaxis** per immunization status; analgesia; realign and splint the limb.[352]
- **Urgent orthopedic referral** for formal debridement, irrigation, and stabilization in the operating room.[352]

✦ PEARL — ANTIBIOTICS ON THE CLOCK

Give the first cephalosporin within an hour of injury, update tetanus, cover with a saline dressing, call orthopedics — early antibiotics drive the infection rate down.[352]

ADMIT · DISCHARGE · REFER

- **Admit** — all open fractures and significant limb injuries.
- **Home from the ward** — not acutely; post-operative/reduction.
- **Refer — now** — orthopedics (early antibiotics, tetanus, debridement); vascular surgery if perfusion is threatened.

Fracture with Pulseless Limb

MINUTES LIMB-THREATENING

An absent pulse needs urgent assessment; a pale, cool, poorly perfused limb needs emergent restoration of circulation.

DEFINE

- A fracture with an absent distal pulse may indicate arterial compression, entrapment, or injury.[348,353]

APPROACH

- Obtain urgent radiographs.

- Record injury time, pulses, capillary refill, skin temperature and color, and individual peripheral-nerve function; compare with the opposite limb.
- Reassess and document after realignment, splinting, reduction, and surgery.
- Persistent suspected arterial injury requires consultant-directed vascular imaging, usually **CT angiography**, coordinated so that emergency revascularization is not delayed.[353]

⚠ **RED FLAGS**

- Pallor, coolness, delayed refill, worsening pain, progressive sensory or motor deficit, or deteriorating perfusion → **immediate orthopedic and vascular escalation**.
- Increasing pain or swelling also warrants reassessment for **compartment syndrome**.

MANAGEMENT

- **Pulseless deformed limb** (any fracture/dislocation other than a supracondylar humeral fracture): urgently realign with gentle in-line

traction under analgesia, splint, then re-check and document pulses and perfusion; if still pulseless → immediate orthopedic + vascular escalation (CT angiography must not delay revascularization).
Supracondylar humeral fracture: do not manipulate repeatedly in the emergency room — splint in a position of comfort (elbow ~20–40° flexion, never forced flexion) and proceed to emergent reduction and pinning in the operating room.

- Emergent reduction and pinning in the operating room.
- Reassess circulation immediately post-reduction; vascular exploration if the limb remains cold and pulseless.[348]
- **Supracondylar fracture with a pink, warm hand** — arrange urgent reduction and fixation. If the hand remains well perfused afterwards, an absent radial pulse alone does not mandate brachial-artery exploration; the orthopedic consultant documents the decision and arranges close inpatient neurovascular observation.[348]

✦ PEARL — THE PINK HAND IS STILL AN EMERGENCY

A pink pulseless hand remains an orthopedic emergency; its perfusion after reduction determines the need for immediate vascular exploration.[348]

◣ ADMIT · DISCHARGE · REFER

- **Admit** — all fractures presenting with a pulseless limb.
- **Home from the ward** — only after definitive management and consultant confirmation that perfusion is restored.
- **Refer — now** — orthopedics immediately; vascular surgery immediately for ischemia or suspected persistent arterial injury.

Joint Dislocation MINUTES

LIMB-THREATENING

Reduce traumatic dislocations promptly; compromised perfusion or threatened skin needs immediate intervention.

DEFINE

- Traumatic loss of joint alignment, with or without an associated fracture.

APPROACH

- Assess the mechanism, associated injuries, deformity, skin condition, and distal neurovascular function; document findings before and after reduction.
- Obtain joint radiographs to identify associated fractures — unless imaging would delay treatment of vascular compromise or threatened skin.
- Obtain post-reduction imaging and repeat the neurovascular examination.

⚠ **RED FLAGS**

- Absent or diminished pulses, impaired perfusion, neurological deficit, an open injury, or threatened skin → **immediate orthopedic assessment**.

MANAGEMENT

- Analgesia, then prompt reduction by an orthopedic surgeon under appropriate sedation or anesthesia with monitoring — emergency room or operating room depending on hospital capability.
- Immobilize after reduction and obtain post-reduction radiographs.
- Definitive management depends on the joint, injury pattern, and any associated fracture.

✦ **PEARL — THE HIP CLOCK**

A delay in reduction > 6 hours greatly increases the risk of avascular necrosis in traumatic hip dislocation.[354]

ADMIT · DISCHARGE · REFER

- **Admit** — hip or true knee (not patellar) dislocations; open, irreducible, unstable, or neurovascularly compromised injuries; associated fractures needing inpatient treatment.
- **Home from the emergency department** — selected uncomplicated injuries after stable reduction, satisfactory imaging, normal neurovascular findings, and arranged follow-up; advise return for increasing pain, swelling, or numbness.
- **Refer — now** — orthopedics immediately; vascular surgery immediately for ischemia or suspected persistent arterial injury.

Unstable Pelvic Injury MINUTES

LIFE-THREATENING

Treat a suspected unstable pelvic injury as major trauma — stabilization and hemorrhage control begin before radiological confirmation.

DEFINE

- A pelvic-ring injury with mechanical instability, usually anterior and posterior ring disruption. Mechanical and hemodynamic instability are distinct: a child may initially maintain circulation despite an unstable fracture.[355]

APPROACH

- Pediatric trauma primary survey (see **Major Trauma — Primary Survey**).
- Look for pelvic pain, deformity, limb-length asymmetry, and shock.
- Avoid pelvic springing and repeated stability testing; minimize unnecessary movement.

- Apply a pelvic binder as soon as possible; arrange targeted CT once sufficiently stable, with the trauma team — imaging must not delay stabilization or hemorrhage control.

⚠ RED FLAGS

- Persistent tachycardia, poor perfusion, hypotension, altered consciousness, or deterioration despite resuscitation → major hemorrhage.
- Open injury, blood at the urethral meatus, or lower-limb neurological abnormality → immediate specialist assessment.

◣ MANAGEMENT

- Activate the pediatric trauma and major-hemorrhage pathways; resuscitate while arranging urgent orthopedic, pediatric-surgical, anesthetic, and intensive-care support.
- A sheet applied over the greater trochanters serves as a pelvic binder when an unstable pelvic fracture is suspected — do not delay application for imaging.

- Ongoing hemodynamic instability despite resuscitation and binding needs immediate hemorrhage control — operative intervention or angioembolization; orthopedics determines temporary and definitive pelvic stabilization.
- Seek urological or pediatric-surgical advice before urethral catheterization if urethral injury is suspected.
- Open injuries require antibiotics and tetanus assessment.

✦ PEARLS

- An apparently reduced pelvis on imaging obtained with a binder on does not establish fracture stability.
- A negative FAST (Focused Assessment with Sonography for Trauma) examination does not exclude pelvic bleeding.

◣ ADMIT · DISCHARGE · REFER

- **Admit** — all suspected or confirmed unstable pelvic injuries; may need intensive care.

- **Home from the ward** — only after definitive stabilization, mobility, and a follow-up plan.
- **Refer — now** — triage to a pediatric-capable major trauma service; coordinate transfer and hemorrhage control with orthopedics and pediatric surgery.

Spine Fracture with Neurological Deficit

MINUTES

Protect spinal alignment, support oxygenation and circulation, and obtain immediate spinal-surgical advice.

DEFINE

- Traumatic cervical, thoracic, or lumbar fracture or dislocation with new motor, sensory, or sphincter dysfunction suggesting spinal cord, conus medullaris, or cauda equina injury. The same emergency pathway applies when neurological findings occur without a visible

fracture (SCIWORA — spinal cord injury without radiographic abnormality).

APPROACH

- Pediatric trauma primary survey with strict cervical-spine immobilization and log-roll precautions (see **Major Trauma — Primary Survey**).
- Document the time and evolution of weakness, sensory loss, and bladder or bowel symptoms; repeat the neurological assessment after transfers and any deterioration.
- Urgent radiographs and/or CT for injury characterization; urgent MRI for suspected cord or ligamentous injury.
- Do not delay referral to pediatric orthopedic spine or neurosurgery in order to complete imaging.

⚠ RED FLAGS

- Progressive weakness, a sensory level, saddle sensory loss, new urinary retention or incontinence, or respiratory compromise → immediate escalation.

- Hypotension with bradycardia may be neurogenic shock — but hemorrhage must also be excluded.

MANAGEMENT

- Maintain age-appropriate spine immobilization and minimize unnecessary movement.
- Analgesia and monitored resuscitation; correct hypoxemia and hypotension promptly.
- Involve intensive care early for mean arterial pressure support — in older children a lower limit of **75–80 mmHg** and upper limit of **90–95 mmHg**, maintained for **3–7 days** according to injury severity and neurological recovery; there is no established MAP target for young children.[356]
- The spine surgeon urgently determines the role of surgical decompression and stabilization, aiming for intervention **within 24 hours** of injury when clinically feasible to optimize neurological recovery (adult-derived: STASCIS enrolled ages 16–80).[357]

- Do not give high-dose methylprednisolone routinely for traumatic spinal cord injury; adult AOSpine guidance offers a 24-h infusion only as an option when started within 8 h of injury (not after 8 h, and never a 48-h infusion) — a specialist decision.[358]

ADMIT · DISCHARGE · REFER

- **Admit** — all; PICU for cord injury, neurogenic shock, or respiratory compromise.
- **Home from the ward** — not acutely.
- **Refer — now** — pediatric orthopedic spine or neurosurgery immediately; pediatric-capable major trauma service.

13

Pediatric Trauma & TBI

Primary survey & resuscitation · secondary survey & decisions · traumatic brain injury

Trauma Team & Roles MINUTES

Know who leads before the patient arrives — role confusion costs the golden hour.

WHO LEADS — SET LOCALLY

- **Trauma team leader (TTL)** — identified by each hospital's own trauma pathway; the designation differs between hospitals and this guide does not prescribe it. Whoever leads runs the primary survey and resuscitation and keeps the overview; the airway is managed by the most skilled airway operator present.[359]
- **Pediatric surgery** (where available; otherwise general surgery) — the surgical survey, hemorrhage source control, and performance of any operation. **The decision to operate, to image first, or to transfer is a team decision**, based on shared

situational awareness of the child's physiology and trajectory — not a single-specialty call.[15,359]

- **No trauma team on site (private hospital, peripheral facility):** stabilize with the primary survey (cABCDE), control hemorrhage, secure oxygenation and access, keep the child warm, and **transfer to the nearest trauma-capable center while resuscitating** — call the receiving team early. Do not delay transfer for imaging or specialist review that cannot change management locally.[16,359]

⚠ AGREE THE PATHWAY IN ADVANCE

Confirm the trauma call, role allocation, and transfer route locally before the patient arrives — front-door role confusion costs time in the golden hour.

Major Trauma – Primary Survey & Resuscitation

MINUTES

Stop the bleeding, protect the brain, keep them warm — and read the physiology, because children compensate then crash.

HOW CHILDREN DIFFER – ANTICIPATE IT

- **Large head, thin scalp:** head injury is common; scalp-wound blood loss can be significant in a small child.[16]
- **Compliant chest wall:** serious lung injury (pulmonary contusion) occurs **without** rib fractures — a normal-looking chest wall does not exclude it.[16]
- **Less-protected solid organs:** liver and spleen injure easily in blunt abdominal trauma.[16]
- **Great reserve, then sudden collapse:** children hold blood pressure by tachycardia and vasoconstriction, so **hypotension is a late, pre-terminal sign** — act on tachycardia, cool peripheries, and prolonged capillary refill long before the BP falls.[15]

- **High surface-area-to-mass:** they cool fast — hypothermia drives coagulopathy. In traumatic arrest treat the reversible causes at once: hemorrhage, tension pneumothorax and pericardial tamponade.[3]

<C> CATASTROPHIC HEMORRHAGE

Control visible bleeding first: direct pressure, wound packing, a **limb tourniquet** (**record the exact time applied**) for uncontrolled extremity bleeding, and a **pelvic binder** for a suspected pelvic fracture.[360]

A — AIRWAY + C-SPINE

- Manual in-line stabilization; open (using a **jaw-thrust maneuver**) and clear the airway.
- Anticipate a difficult airway (large occiput flexes the neck; large tongue). In younger children — especially **< 2 yr** — a **shoulder roll** helps: maintain C-spine precautions and avoid over-extension or flexion.
- Secure the airway if GCS ≤ 8 or it is not protected.[16]

B — BREATHING

- Oxygen 10–15 L/min via non-rebreather mask. **Tension pneumothorax is a clinical diagnosis — treat before imaging.** Needle decompression at the **5th intercostal space, mid-axillary line**, or the **2nd intercostal space (over the top of the 3rd rib), mid-clavicular line**. Then finger thoracostomy/chest drain — see **Pneumothorax**.[16]
- Seal an open pneumothorax; suspect massive hemothorax and pulmonary contusion.[16]

C — CIRCULATION

- Two large-bore IV lines; go early to **intraosseous** if access fails.
- Find the bleeding — **chest, abdomen, pelvis, long bones, and the floor**. Resuscitate with **blood, not repeated crystalloid**; give tranexamic acid as early as possible, within 3 h of injury — do not start it more than 3 h after injury.[362,827] **Activate the massive transfusion protocol when required.**[15]

D — DISABILITY

GCS or AVPU (alert / voice / pain / unresponsive), pupils, and a **glucose** (do not miss hypoglycemia). Manage raised ICP with **urgent neurosurgery consult** — see the Traumatic Brain Injury card.[217]

E — EXPOSURE / ENVIRONMENT

Fully undress to examine and log-roll, then **cover and actively warm** — every degree of cooling worsens clotting.[360]

RESUSCITATION — BLOOD, NOT CRYSTALLOID

Packed red cells

DOSE

10 mL/kg boluses, reassess after each[16,363]

NOTES

First-line for hemorrhagic shock; balanced 1:1:1 (RBC:plasma:platelets) in massive hemorrhage; activate the hospital massive transfusion protocol (pre-agreed with the blood bank)[15]; 1:1:1 ratio evidence is adult-derived (PROPPR)[364]

Crystalloid (warmed)

DOSE

≤ one 20 mL/kg bolus, only if blood not yet available

NOTES

Each further crystalloid bolus → more coagulopathy, ventilator and ICU days[15]

Tranexamic acid (TXA)

DOSE

15 mg/kg (max 1 g) IV over 10 min, then 2 mg/kg/h for at least 8 h or until bleeding stops (not above the adult rate of 125 mg/h) ≥ 12 years / adult-sized: 1 g over 10 min, then 1 g over 8 h

NOTES

Within 3 h of injury; weight-based pediatric regimen per BSH 2016[363]; ≥ 12 y adult regimen per RCPCH 2012; CRASH-2 was an adult trial[362]; pediatric evidence is observational (PED-TRAX)[365]

◈ **RESUSCITATION REASONING**

- Estimated blood volume ~70–80 mL/kg in a child (up to ~90 mL/kg in a term infant), so small losses matter.[363]
- Move early to blood products and minimize crystalloid. **DURING ACTIVE HEMORRHAGE, TRANSFUSE ACCORDING TO HEMORRHAGIC-SHOCK AND HEMOSTATIC-RESUSCITATION NEEDS — NOT TO A FIXED HEMOGLOBIN TARGET.** Once bleeding is controlled and the child is hemodynamically stable, use a restrictive red-cell strategy, generally around **HB 7 G/DL**; with acute brain injury (TBI) a higher threshold may be appropriate — TAXI: consider transfusion at Hb 7–10 g/dL.[15,220] **TARGET A SYSTOLIC BP NO LESS THAN 70 + 2 × AGE (YR) MMHG** (1–10 yr band; use the age-specific

systolic thresholds in the Shock card for other ages).[24] **ADDRESS ONGOING LOSSES. AVOID HYPOTENSION.**[15,217]

⚠ THE LETHAL TRIAD — AND REASSESS

- Hypothermia, acidosis, and coagulopathy feed each other: keep the child warm, give blood early, correct coagulopathy.[360]
- If the patient deteriorates at any point, **go back to A** and work through again.[16,359]

Major Trauma — Secondary Survey & Decisions

MINUTES

Once the primary survey is controlled — find the injuries and make the calls.

◢ SECONDARY SURVEY — HEAD-TO-TOE + AMPLE HISTORY (ALLERGIES, MEDICATIONS, PAST HISTORY, LAST MEAL, EVENTS)

- Start **only after <C>ABCDE is controlled** and resuscitation underway. Examine front and back (log-roll): scalp and face, neck,

chest, abdomen, pelvis and perineum, back, limbs, and a focused neurological exam.[16]

- **AMPLE** history: **A**llergies, **M**edications, **P**ast history, **L**ast meal, **E**vents/mechanism. Mechanism predicts the injuries — ask for it explicitly.[16]

DECISION

Abdomen — does this child need a CT?

PECARN (Pediatric Emergency Care Applied Research Network) intra-abdominal injury rule — 7 features:
abdominal wall trauma / seatbelt sign
GCS < 14 (i.e. 13 or less)
abdominal tenderness
chest-wall trauma
abdominal pain
decreased breath sounds
vomiting.[366]

NONE present

Very low risk for injury needing intervention — CT can usually be safely avoided; observe with serial examination.[366]

ANY present / unstable

ANY present → not very-low-risk; **CT is not automatic**. Decide with the surgical team by the number and type of predictors (strongest first: abdominal-wall trauma/seat-belt sign, GCS < 14, abdominal tenderness): CT if hemodynamically stable and the risk is appreciable; a stable child with an isolated lower-risk predictor (e.g. vomiting or abdominal pain alone) can usually be observed with serial examination ± laboratory tests/ultrasound. Unstable → resuscitate and urgent surgical decision, not CT.[366] A **negative FAST does not exclude** intra-abdominal injury in children (FAST = Focused Assessment with Sonography for Trauma — bedside ultrasound for free fluid in the abdomen and pericardium).[367]

CHEST

CXR for hemo/pneumothorax and pulmonary contusion; place a **chest drain** for a hemothorax or significant pneumothorax. *(Tension pneumothorax is already decompressed in the primary survey.)*[16]

PELVIS

Confirm the binder is correctly positioned and **image** (pelvic X-ray ± CT); do **not** distract or repeatedly spring the pelvis — it can increase bleeding.[16] *(The binder is applied in the primary survey.)*

C-SPINE

- **PECARN C-spine rule** (blunt trauma, < 18 y) — 3 tiers:
  CT if ANY high-risk factor — GCS 3–8 or unresponsive (AVPU = U); abnormal airway, breathing or circulation; focal neurological deficit (paresthesia, numbness or weakness).
  Plain radiographs if none of these but ANY of — neck pain; altered mental status (GCS 9–14, AVPU = V or P, or other signs); substantial head injury; substantial torso injury; posterior midline neck tenderness ("substantial" = needing inpatient observation or surgery).
  None of the nine → clinical clearance without imaging (NPV 99.9%). Derived and validated in pediatric trauma centers; not yet validated in community EDs.[368]
- **SCIWORA** (spinal cord injury without radiographic abnormality) is commoner in children — a normal X-ray does not exclude cord injury; keep the spine immobilized and call neurosurgery/spine urgently if there is any neurological deficit

(weakness, sensory change, or bladder/bowel dysfunction), even with normal imaging.[369]

LIMBS & ANALGESIA

Splint long-bone fractures and check distal pulses. Give **timely analgesia** (intranasal or IV opioid) — pain is routinely undertreated in injured children.[16,359]

⚠ ALWAYS CONSIDER INFLICTED INJURY

- Be alert when the history is inconsistent with the injury or the child's development, presentation is delayed, or the pattern is suspicious (bruising or fracture in a non-mobile infant, torn frenulum, multiple injuries of different ages).
- Document carefully and escalate through local safeguarding.[342]

◦ ESCALATE & TRANSFER EARLY

- With no in-house pediatric surgery, involve the trauma team, anesthesia, intensive care and the receiving **trauma center early** — do not wait for the patient to deteriorate.[16,359]

- Package for transfer: airway secured, hemorrhage controlled, the child warm, and blood en route.
- Do **not** delay transfer for a CT that will not change what you do before the child leaves.[16,359]

Traumatic Brain Injury MINUTES

Decide who needs a CT; in severe injury, stop the second insult.

IMAGING DECISION — PECARN

- Use the **PECARN** rule to select children for CT after blunt head trauma and safely avoid imaging in the very-low-risk group. It is **age-stratified** — use the correct **age column** below. PECARN was not derived or validated for suspected **abusive (inflicted)** head trauma — keep a low threshold to image regardless of the rule when abuse is suspected.[370]

PECARN HEAD-CT — BY AGE GROUP

CT recommended (high risk)

< 2 YEARS

Any of: **GCS ≤ 14**, altered mental status / agitation / slow response, or a **palpable skull fracture**.[370]

≥ 2 YEARS

Any of: **GCS ≤ 14**, altered mental status, or signs of a **basilar skull fracture**.[370]

CT vs observe (intermediate)

< 2 YEARS

Any of: **occipital / parietal / temporal scalp hematoma**, **LOC (loss of consciousness) ≥ 5 s**, **severe mechanism**, or **not acting normally** per the parent[370] — **shared decision-making + observation**.

≥ 2 YEARS

Any of: **LOC**, **vomiting**, **severe mechanism**, or **severe headache** —[370] **shared decision-making + observation**.

No CT (low risk)

< 2 YEARS

None of the above.

≥ 2 YEARS

None of the above.

◈ **DECISION TOOLS**

- PECARN pediatric head-CT rule — mdcalc.com.
- Severe-TBI management — Brain Trauma Foundation pediatric guideline, 3rd ed — doi.org.

SEVERE TBI (GCS ≤ 8)

- Secure the airway.
- Keep **SpO_2 ≥ 94%** and normocapnia ($PaCO_2$ 35–40 mmHg).
- Avoid hypotension[217] — **target SBP no less than 70 + 2 × age** mmHg (**1–10 yr** band; age-specific thresholds otherwise; PALS hypotension definition).[24,371] Higher blood-pressure targets may be beneficial in isolated severe TBI, but the threshold, and whether to target SBP or MAP, are not established — set targets with neurosurgery and the receiving intensive care unit (PICU or ICU, per hospital policy).[371]
- Head midline, **elevate the head of the bed 30°**; treat pain, agitation, glucose, and temperature.[217]

IMPENDING HERNIATION — BRIDGE TO DEFINITIVE CARE

- **Recognize:** new pupil asymmetry or a fixed dilated pupil, Cushing response (bradycardia + hypertension + irregular breathing), extensor posturing, or a falling GCS.
- **Bridge:** head up 30° and midline; secure oxygenation and normocapnia; avoid hypotension; give **one hyperosmolar bolus** (3% saline 2–5 mL/kg, or mannitol 0.5–1 g/kg if not hypovolemic); brief hyperventilation **only** for signs of herniation, as a temporizing measure.[217]
- **Hand over** for urgent CT and neurosurgical review; ongoing intracranial-pressure and perfusion management is intensive-care therapy (PICU or ICU, per hospital policy) and is beyond the scope of this guide.

Hypertonic saline 3%

DOSE

2–5 mL/kg IV over 10–20 min (impending herniation)

NOTES

First-line hyperosmolar bridge; infusion regimens are intensive-care therapy[217]

Mannitol

DOSE

0.5–1 g/kg over 10–15 min

NOTES

Alternative; caution if hypovolemic or hypotensive — formulary dosing[42] (the Brain Trauma Foundation guideline gives no evidence-based mannitol dose)

Levetiracetam

DOSE

20–55 mg/kg IV (max 4.5 g), then 10 mg/kg BID (local formulary dosing — not guideline-stated)

NOTES

Prophylaxis to reduce **early** post-traumatic seizures in severe TBI — a short course (~7 days); phenytoin / fosphenytoin an alternative[217]

⚠ PREVENT THE SECOND INSULT

- Hypoxia and hypotension each independently worsen outcome — avoid both.
- Do **not** routinely hyperventilate (vasoconstriction lowers cerebral

blood flow).

- Avoid hyperthermia and treat seizures promptly.[217]

ADMIT · DISCHARGE · REFER

- **Admit** — all moderate/severe TBI and any abnormal CT to intensive care (PICU or ICU, according to each hospital's internal policy) with neurosurgical review. Until the child leaves the department, care is led by the consultant responsible at the patient's location — in the emergency department, the trauma team leader.
- **Home from the emergency department** — minor head injury meeting a validated low-risk rule, observed, with head-injury advice.
- **Refer — now** — neurosurgery for surgical lesions or deterioration; safeguarding if abuse is suspected.

Child Protection & Safeguarding

ASSESS AAP · ACR 2025

The injury that doesn't fit the history — recognizing it once may prevent a fatal second event.

RECOGNIZE (RED-FLAG PATTERNS)

- **Any bruise in a not-yet-mobile infant** is a sentinel injury until proven otherwise. Use **TEN-4-FACESp** (children < 4 years): bruising of the **T**orso, **E**ar or **N**eck; **ANY** bruise in an infant **4** months or younger (up to 4.99 months); bruising of the **F**renulum, **A**ngle of jaw, **C**heek (fleshy) or **E**yelid, or **S**ubconjunctival hemorrhage; or **p**atterned bruising.[372]
- History that is **absent, inconsistent, or doesn't match the developmental stage or the injury**; delayed presentation; injuries of different ages.[342]

⚠ ABUSIVE HEAD TRAUMA

- An infant with unexplained irritability, vomiting, apnea, seizures or reduced

consciousness may have **abusive head trauma**. Typical findings include subdural hemorrhage, complex **retinal hemorrhages**, encephalopathy and other intracranial or spinal injury, often with rib and other fractures — but **no single finding or "triad" makes or excludes the diagnosis**, which is reached by multidisciplinary evaluation of the history, examination, imaging and laboratory results.[373,374]

- Image the brain and arrange a dilated fundoscopy; it is easily mistaken for sepsis or a feeding problem.[200,373]

✦ EXAMINE, DOCUMENT, ESCALATE

- Fully undress and examine; document injuries factually with sizes and a body map (photograph per policy).
- In children < 2 years with suspected physical abuse, arrange a **skeletal survey** and consider coagulation studies to exclude mimics.[342]

- Care for the child first; you do not need to be certain to refer.[342]

◈ **LOCAL & LEGAL** Follow Kuwait MOH child-protection procedures — involve the hospital child-protection team/social work and make the mandatory report; ensure the child is in a safe place and that siblings are considered.[375]

WORKUP

- **Skeletal survey** — all children **< 24 months**; **2–5 years selectively** (radiographs of areas of concern; full survey if multiple or occult injuries are suspected); not useful > 5 years. **Repeat limited survey at ~2 weeks** when the first is negative or equivocal — it reveals healing rib and metaphyseal fractures.[342,376]
- **Neuroimaging — immediate non-contrast head CT** for any neurological symptom or sign, scalp swelling, or a low hemoglobin (the strongest predictors of an abnormal CT: head swelling OR 46.7, neurological impairment OR 20.6, low hemoglobin OR 11.8).[377] **Neurologically normal: CT head is still usually appropriate < 24**

months — occult head injury (skull fracture and/or intracranial injury) is found in up to 37% of high-risk children < 2 years (rib or multiple fractures, facial injury, age < 6 months).[376,378,379] Where rapid non-sedated MRI is available and expertly reported, **MRI may replace CT as first-line** in a stable infant whose injuries are unrelated to the head.[377] **MRI brain ± whole spine at day 2–5** whenever CT shows hemorrhage, parenchymal injury or skull fracture, or neurology persists.[376,378]

- **Dilated indirect ophthalmoscopy by ophthalmology — within 24 h, no later than 72 h** (hemorrhages fade): for intracranial hemorrhage or injury on imaging, unexplained coma, seizures or altered consciousness in a child < 5 years, visible eye injury, or coagulopathy. **Not a screening test** in the neurologically normal infant — image the brain first.[200]
- **Bleeding-disorder evaluation** when bruising or intracranial hemorrhage is what raises the concern. **Bruising: PT, aPTT, CBC with platelets, von Willebrand antigen and activity, factor VIII and IX activity**.

Intracranial hemorrhage: PT, aPTT, CBC with platelets; add factor VIII and IX activity if there is a history of trauma, and d-dimer and fibrinogen if there is neurologic compromise. Any abnormal result → pediatric hematology. Unnecessary when injuries are patterned (hand marks; ear, neck or genital bruising) or clearly non-hemorrhagic (fractures, burns). After transfusion, delay testing until transfused products have cleared; viscoelastic tests (TEG/ROTEM) are not acceptable for this purpose.[380]

- **Occult abdominal injury — screen every child < 5 years: AST, ALT, lipase, urinalysis.**
  Contrast-enhanced abdominal CT if AST or ALT > 80 IU/L or abdominal bruising, tenderness or distension — a quarter of injuries with raised transaminases have no abdominal signs.[376,381]

ADMIT · REFER

- **Admit** — for safety and investigation whenever abuse is a realistic concern.

- **Refer — now** — child-protection team, social work, and safeguarding lead; police per local law.

Massive Transfusion & Blood Products

MINUTES Eur. trauma guideline 2023

Balanced-ratio resuscitation with the per-kg doses — and the two silent killers, ionized hypocalcemia and the cold, acidotic child.

ACTIVATE EARLY — ON CLINICAL GROUNDS

- **Activate on clinical grounds** — uncontrolled hemorrhage with shock/instability, an elevated SIPA, or ongoing bleeding despite initial red cells; **do not wait for a volume threshold**.[15]
- Definitions (recognition/audit): blood loss of **40 mL/kg in 3 h** or **2–3 mL/kg/min**, or **80 mL/kg** (≈ 1 blood volume) in 24 h[363]; ≥ 40 mL/kg of all blood products in 24 h (Neff 2015).
- Uncontrolled hemorrhage with instability, a high **pediatric age-adjusted shock index (SIPA)**, or

clinical judgment — **activate the protocol early, not late**.[15]

Packed red cells

DOSE

20 mL/kg (max 4 adult units)

NOTES

BSH major-hemorrhage aliquot[363]. Emergency (blood group unknown): group **O** red cells — **RhD-negative for girls** — and group **AB** plasma, until type-specific and crossmatched products are ready[16]

Fresh frozen plasma

DOSE

20 mL/kg (max 4 adult units)

NOTES

Give in a **1:1:1** ratio with red cells & platelets (pediatric consensus; adult RCT evidence)[15,364]; BSH major-hemorrhage aliquot[363] (ATLS gives 10–20 mL/kg[16])

Platelets

DOSE

15–20 mL/kg (max 1 adult therapeutic dose)

NOTES

BSH major-hemorrhage aliquot[363] (ATLS gives 10–20 mL/kg[16])

Cryoprecipitate

DOSE

`10 mL/kg (max 2 pools)`

NOTES

BSH major-hemorrhage aliquot[363]. For fibrinogen < 1.5 g/L (or give fibrinogen concentrate)[360,363]

⚠ THE TWO SILENT KILLERS

Ionized hypocalcemia — citrate in stored products chelates calcium, worsening coagulopathy and cardiac contractility; keep **ionized Ca ≥ ~1.1 mmol/L** and recheck it with every blood gas during transfusion.[360,363] **The lethal triad** — hypothermia + acidosis + coagulopathy: **warm every product and the child**, correct acidosis, and treat coagulopathy early.[360]

Tranexamic acid (TXA)

DOSE

15 mg/kg (max 1 g) IV over 10 min, then 2 mg/kg/h for at least 8 h or until bleeding stops (not above the adult rate of 125 mg/h) ≥ 12 years / adult-sized: 1 g over 10 min, then 1 g over 8 h

NOTES

Give as early as possible, **within 3 h** of injury — do not start it more than 3 h after injury (treatment started after 3 h increased death from bleeding in CRASH-2)[362,363,827]; consider in TBI with GCS ≤ 12 or intracranial bleeding on CT (adult trial, CRASH-3)[382]

Calcium gluconate

DOSE

50–100 mg/kg IV (max 2–3 g) — local practice US label initial bolus: 29–60 mg/kg (> 1 mo to < 17 yr); 100–200 mg/kg (neonate); 1–2 g (≥ 17 yr)[383]

NOTES

Slow IV via a secure IV line; extravasation can cause calcinosis cutis and tissue necrosis[383]

TARGETS

- **Fibrinogen > 1.5 g/L**[15,360,363] · **platelets > 75 ×10⁹/L** during major hemorrhage (BSH pediatric)[363] — > 100 ×10⁹/L with TBI (adult European guideline)[360] · **PT ratio < 1.5**.[360,363]

✦ DON'T DROP THE PRESSURE

- In children, and especially with TBI or threatened perfusion, maintain age-appropriate blood pressure throughout resuscitation — **target SBP no less than 70 + 2 × age (yr) mmHg**[24], address ongoing losses, avoid hypotension.[15,217]
- Use **viscoelastic testing (TEG — thromboelastography / ROTEM — rotational thromboelastometry; bedside whole-blood clotting tests)** to guide which component to give, where available[15,360], and watch for **hyperkalemia** with large-volume or irradiated red cells.[363]

◣ WORKUP — SEND AT ACTIVATION, REPEAT EVERY 30–60 MIN

- CBC (hemoglobin, platelets), **fibrinogen**, PT/INR ± aPTT, **ionized calcium**, blood gas with lactate / base deficit, type & crossmatch; **point-of-care viscoelastic coagulation testing**

(thromboelastography, TEG/ROTEM) if available; monitor temperature and potassium.[360]

◈ **LOCAL & EVIDENCE**

- Activate your hospital massive-hemorrhage protocol and follow its ratios and dosing.[15,360,363]
- Pediatric ratios and thresholds are largely **EXTRAPOLATED FROM ADULT RCTS** (PROPPR, CRASH-2/CRASH-3); the pediatric TXA signal (PED-TRAX) is observational.[362,364,365,382]
- Verify every dose against local protocol.[363]

14

Renal & Urology

AKI · HUS · hypertensive emergency · acute scrotum · foreskin emergencies · priapism · hematuria

Acute Kidney Injury HOURS

Abrupt fall in kidney function — rising creatinine and/or falling urine output.

RECOGNIZE & DEFINE

- Suspect in any child with oliguria/anuria, rising creatinine, edema or fluid overload, or unexplained electrolyte disturbance.[384]
- **KDIGO (Kidney Disease: Improving Global Outcomes) stages AKI 1–3** — Stage 1 is the threshold that diagnoses AKI (see the table below).[384]

KDIGO STAGING — GRADE BY THE WORSE OF CREATININE OR URINE OUTPUT[384]

1

SERUM CREATININE

1.5–1.9× baseline (within the prior 7 days), or a rise ≥ 26.5 µmol/L (≥ 0.3 mg/dL) within 48 h

URINE OUTPUT

< 0.5 mL/kg/h for 6–12 h

2

SERUM CREATININE

2.0–2.9× baseline

URINE OUTPUT

< 0.5 mL/kg/h for ≥ 12 h

3

SERUM CREATININE

≥ 3.0× baseline, or ≥ 353.6 µmol/L (≥ 4.0 mg/dL), or dialysis started, or — if age < 18 y — eGFR < 35 mL/min/1.73 m²

URINE OUTPUT

< 0.3 mL/kg/h for ≥ 24 h, or anuria ≥ 12 h

FIND THE CATEGORY — IT DRIVES TREATMENT

PRE-RENAL · impaired perfusion (commonest)

Hypovolemia, shock, sepsis — poor perfusion. → **Restore perfusion:** if volume loss, give fluid; if another cause, treat that cause. Reversible if treated early.[384]

RENAL · intrinsic

HUS (see **Hemolytic Uremic Syndrome**), glomerulonephritis, acute tubular necrosis, nephrotoxins. → **Supportive care; treat the cause.**[384]

POST-RENAL · obstruction

Posterior urethral valves, stones, neurogenic bladder. → **Insert a urinary catheter first**, then image. After relief, watch for **post-obstructive diuresis** (urine > 3.5–5 mL/kg/h — local practice threshold, not guideline-stated) — replace fluid/electrolytes with nephrology.

⚑ MANAGE — VOLUME STATUS DRIVES FLUID THERAPY

Assess volume status first, then treat by category:

- **Hypovolemic / intravascularly deplete** (cool peripheries, tachycardia, prolonged capillary refill, low BP, weight loss) — resuscitate with **isotonic crystalloid**.
- **Euvolemic** (well-perfused, no edema, no fluid-overload signs) — match intake to **insensible losses (300–400 mL/m² per 24 h) plus measured urine output**[183]; do **not** apply routine

4-2-1 (Holliday–Segar) maintenance during established AKI (expert consensus — not guideline-stated).

- **Hypervolemic / overloaded** (edema, hypertension, raised JVP, pulmonary crackles or a gallop, weight gain) — **restrict fluids**; diuretics do not aid recovery but may be used for established hypervolemia.[384]

Stop nephrotoxins (NSAIDs, aminoglycosides, contrast) and adjust drug doses. Watch potassium, sodium, acid–base; **avoid potassium in maintenance fluids unless treating hypokalemia**.[384] Involve nephrology for KDIGO stage 2–3 or worsening AKI; arrange structured follow-up (stage 2–3, AKI ≥ 7 days, incomplete recovery, pre-existing CKD, or recurrent AKI).[384]

⚑ WHEN TO CALL NEPHROLOGY / PICU FOR DIALYSIS — THE "AEIOU" TRIGGERS

Refer urgently for dialysis / CRRT when any of these will **not** correct with medical treatment:

- **A — Acidosis:** severe metabolic acidosis (pH < 7.1) despite bicarbonate / ventilation.[384]
- **E — Electrolytes:** hyperkalemia that keeps rising or recurs despite full medical therapy.

- **I — Intoxication:** a dialyzable poison / drug (salicylate, methanol, ethylene glycol, lithium, theophylline).[385]
- **O — Overload:** fluid overload / pulmonary edema — **or severe hypertension driven by volume overload** — not responding to fluid restriction + diuretics (especially if it limits feeding or ventilation).
- **U — Uremia:** symptomatic — encephalopathy, pericarditis, or bleeding.[384]

The clinical picture — not the creatinine or urea number — decides. Recognize early and call; the specialist chooses the modality (hemodialysis, CRRT, or peritoneal dialysis).[384]

⚠ **CROSS-REFERENCE**

Treat life-threatening hyperkalemia immediately — see **Acute Electrolyte Emergencies** (Endocrine & Metabolic).

ADMIT · DISCHARGE · REFER

- **Admit** — all but mild pre-renal AKI; oliguria, hyperkalemia, fluid overload, or acidosis → high-dependency.
- **Home** — resolving pre-renal AKI with normalizing function and follow-up.

- **Refer — now** — nephrology for KDIGO stage 2–3, no clear cause, or need for dialysis.

Hemolytic Uremic Syndrome HOURS

Triad: microangiopathic hemolytic anemia + thrombocytopenia + acute kidney injury.

RECOGNIZE

- **Typical (STEC):** preceded by bloody diarrhea; pallor, reduced urine, edema, petechiae, irritability.[386]
- Blood film: fragmented red cells (schistocytes), low platelets, negative direct antiglobulin test, high lactate dehydrogenase.[386]
- **Atypical (non-diarrheal) HUS:** STEC-negative; any age. **Primary** — inherited or antibody-mediated complement dysregulation (low C3, family history, relapsing course). **Secondary** — invasive *S. pneumoniae* (pneumonia/empyema, meningitis, bacteremia; **direct antiglobulin test positive**; **avoid plasma-containing products** — use washed red cells and platelets; treat the infection), HIV, drugs

(chemotherapy, calcineurin inhibitors, ionizing radiation), systemic disease (lupus, antiphospholipid syndrome, scleroderma), and cobalamin C defect (methylmalonic aciduria with homocystinuria — check homocysteine and methylmalonic acid in infants). The underlying condition is usually already known; this guide details the complement-mediated form.[386]

WORKUP

- CBC + film, U&E/creatinine, LDH, haptoglobin, direct Coombs (negative).
- **Send C3, C4, CH50 and ADAMTS13** (ADAMTS13 = the von Willebrand factor–cleaving enzyme; **severely low confirms TTP (thrombotic thrombocytopenic purpura), normal points to HUS**)[386] **before** any plasma therapy or eculizumab. **If available, also send anti–factor-H antibodies and complement-gene screening** (*CFH, CD46/MCP, CFI, C3, CFB, THBD* and *DGKE*) to confirm complement dysregulation, guide prognosis and estimate recurrence risk, including after transplantation

— results take weeks and must not delay treatment. Not currently available in Kuwait: store samples and send out.[386,387]

- Stool culture for *E. coli* O157 and Shiga-toxin PCR/antigen when diarrhea is present.[386]

SUPPORTIVE CARE IS THE MAINSTAY

- Careful fluid and electrolyte management — in suspected STEC-HUS, early isotonic volume expansion before oligo-anuria may reduce kidney injury; once oliguric or fluid-overloaded, restrict fluids and involve nephrology.[386]
- Manage the acute kidney injury (see **Acute Kidney Injury**); transfuse packed red cells for symptomatic anemia or Hb < 6–7 g/dL (platelets only for active bleeding or a procedure); dialysis as needed — dialysis does not change STEC-HUS prognosis.[386]
- Monitor closely through the **5–14-day peak period**: daily CBC, creatinine, electrolytes and LDH, plus urine output, blood pressure and weight.[386]

DECISION

Typical (STEC) or atypical (complement-mediated)?

TYPICAL · STEC

Supportive care only. Benefit of eculizumab in STEC-HUS is unproven — not routine. The only placebo-controlled RCT (100 children) showed no improvement in the acute course, dialysis or extrarenal disease; use, if any, is a nephrology decision in severe neurological involvement.[386,388]

ATYPICAL · aHUS

Complement inhibition (eculizumab/ravulizumab) — nephrology directed. **Meningococcal risk is > 1,000-fold and vaccination alone does not prevent it:** give **MenACWY + MenB ≥ 2 weeks before the first dose**; if treatment cannot wait, vaccinate and start **antibiotic prophylaxis (e.g., penicillin V) for the duration of therapy**. Boosters: MenACWY every 5 years (if the primary series was given before age 7, the first booster at 3 years, then every 5 years); MenB 1 year after the series, then every 2–3 years while on treatment. **Any fever = emergency blood cultures and IV ceftriaxone** — 14 of 16 US cases occurred in vaccinated patients, most from non-groupable strains.[389,390]

⚠ AVOID

- Antibiotics in STEC (may increase toxin release — generally avoided), antimotility agents (loperamide), and NSAIDs.[386]
- Do not transfuse platelets unless active bleeding or a procedure is planned.[386]

ADMIT · DISCHARGE · REFER

- **Admit** — all → monitoring and supportive care; anuria/severe → high-dependency. **PICU** for neurologic symptoms or hemodynamic instability; involve **nephrology** early for atypical HUS.
- **Home from the ward** — not acutely; after hematologic and renal recovery.
- **Refer — now — nephrology** (dialysis); atypical HUS → a **nephrology specialist** for complement inhibition / eculizumab.

Hypertensive Emergency MINUTES

Severe hypertension **with** new or progressing end-organ damage (encephalopathy, seizures, facial palsy, severe headache; heart failure or chest pain; acute kidney injury; retinopathy or blurred vision).

ASSESS FOR END-ORGAN DAMAGE

- **Brain:** headache, vomiting, altered mental status, seizures, visual symptoms, focal deficits.

- **Heart:** tachycardia, gallop, pulmonary edema, heart failure, chest pain (older children).
- **Kidney:** AKI, oliguria, hematuria, proteinuria.
- **Eyes:** blurred vision, retinal hemorrhages, papilledema.[391]

WORKUP

- CBC, electrolytes, urea, creatinine.
- Urinalysis ± urine protein.
- ECG.
- Chest radiograph if heart failure suspected.
- Echocardiography if LV dysfunction suspected.
- Fundoscopy if available.
- Renal ultrasound ± Doppler when a renal cause is suspected.
- CT/MRI brain only if neurological symptoms or concern for intracranial pathology.[391]

PEARL

In children, severe hypertension is **secondary until proven otherwise** — renal disease is the commonest cause.[391]

LOWER GRADUALLY — CONTROLLED DESCENT

- A true hypertensive emergency needs PICU/high-dependency monitoring with a titratable IV infusion under specialist guidance.
- Reduce blood pressure by no more than **25% of the planned reduction** (presenting BP minus target, ≈ 95th percentile) in the first 8 hours, then the remainder gradually over the next 12–24 hours (AAP 2017).
- Abrupt drops risk cerebral, renal, and retinal ischemia.[391]



TREAT COMPLICATIONS

Seizures → benzodiazepine. Fluid overload (e.g., acute glomerulonephritis) → furosemide. Monitor in PICU.[391]

MEDICATIONS — TITRATABLE IV AGENTS PREFERRED

Labetalol

DOSE

bolus 0.2–1 mg/kg (max 40 mg); infusion 0.25–3 mg/kg/h

ROUTE & NOTES

IV; **preferred first-line (best option) in Kuwait**; avoid in asthma, heart failure[391]

Hydralazine

DOSE

0.1–0.2 mg/kg/dose, up to 0.4 mg/kg/dose (usual adult max 20 mg)

ROUTE & NOTES

IV/IM every 4 h; **second-line**; may cause reflex tachycardia[391]

Sodium nitroprusside

DOSE

start 0–3 mcg/kg/min; max 10 mcg/kg/min

ROUTE & NOTES

IV; reserve — cyanide risk with prolonged use/renal impairment[391]

Esmolol

DOSE

100–500 mcg/kg/min infusion

ROUTE & NOTES

IV; short-acting, constant infusion preferred; may cause profound bradycardia or bronchospasm[391]

Nicardipine

DOSE

bolus 30 mcg/kg (max 2 mg); infusion 0.5–4 mcg/kg/min

ROUTE & NOTES

IV; where available (titratable alternative); reflex tachycardia; raises cyclosporine and tacrolimus levels[391]

Furosemide

DOSE

1–2 mg/kg (max 40–80 mg)

ROUTE & NOTES

IV; if fluid overloaded (e.g., post-streptococcal glomerulonephritis)

◈ **NOTE** Oral or sublingual nifedipine can cause a precipitous, uncontrolled fall and is **NOT** recommended for a true hypertensive emergency.[391]

ADMIT · DISCHARGE · REFER

- **Admit** — all true emergencies → PICU with a titratable infusion.
- **Home from the ward** — not from the emergency; controlled blood pressure with a plan.
- **Refer — now** — nephrology/cardiology for cause.

- **Refer — clinic** — nephrology/cardiology for long-term control.

Nephrotic Syndrome HOURS

IPNA 2023

Heavy proteinuria, low albumin, and edema — usually steroid-responsive, but watch the complications. Doses follow the International Pediatric Nephrology Association (IPNA) 2023 guideline.

RECOGNIZE

- **The triad:** nephrotic-range proteinuria (urine protein/creatinine > 200 mg/mmol, or ≥ 3+ on dipstick), **hypoalbuminemia < 30 g/L (< 3.0 g/dL)**, and edema (periorbital → generalized, ascites, scrotal/labial); usually with hyperlipidemia.[392]
- In a child **1–10 years** without the atypical features below, it is almost always steroid-responsive minimal-change disease — treat without a biopsy.[392]

CONFIRM & ASSESS

- Confirm proteinuria (first-morning-void protein/creatinine ratio preferred over a 24-hour collection); send albumin, renal function and electrolytes, lipids; weigh, record blood pressure, assess volume status.
- Assess clinically for active infection before commencing high-dose corticosteroids; investigate according to symptoms and risk factors rather than performing routine infection screening in an otherwise well child.[392]

FIRST PRESENTATION

- Oral **prednisolone 60 mg/m²/dose (≈ 2 mg/kg/dose, max 60 mg)** once daily for 4–6 weeks, then 40 mg/m² (max 40 mg) on alternate days for a further 4–6 weeks (total 8–12 weeks)
- Add a no-added-salt diet (no fluid or protein restriction) and ensure pneumococcal vaccination; routine antibiotic prophylaxis is not recommended — instead treat suspected infection promptly, including spontaneous bacterial peritonitis.[392]

⚠ COMPLICATIONS TO PRE-EMPT

- **Hypovolemia** can hide behind gross edema — abdominal pain, cool peripheries, tachycardia, prolonged capillary refill, oliguria; needs urgent senior/nephrology input. **Withhold diuretics (and ACE inhibitors/ARBs) while hypovolemic.** Shock or hypotension: 4–5% albumin (or isotonic crystalloid if unavailable) without furosemide. Hypovolemia without shock: **20–25% albumin 0.5–1 g/kg IV over 4–6 h**; add furosemide 1–2 mg/kg IV mid- or

end-infusion only once volume is restored and urine output remains poor. Monitor closely during albumin (pulmonary edema, hypertension). **Hypervolemia** presents differently — edema with **strong peripheral pulses and warm peripheries**; treat with diuretics and close reassessment.[392]

- Watch for **spontaneous bacterial peritonitis** (pneumococcal) and other sepsis, **venous or arterial thromboembolism** (these children are hypercoagulable), and **acute kidney injury (AKI)**.[392]

ADMIT · DISCHARGE · REFER

- **Admit** — first presentation, hypovolemia, peritonitis or sepsis, thromboembolism, severe edema with respiratory compromise, AKI, or a relapse not responding to oral steroid.
- **Home** — steroid responsiveness is not required before discharge, provided close OPD follow-up is arranged: a well child with no complications, able to tolerate oral

steroids, with the family able to monitor first-morning urine and act on a written plan.

- **Refer — now** — Nephrology for any atypical feature (age < 1 or > 12 years, persistent hypertension, gross hematuria, low complement (C3), renal impairment) — these may need a biopsy or second-line therapy.[392]
- **Refer — clinic** — Nephrology for steroid resistance or frequent relapse — these may need a biopsy or second-line therapy.[392]

Circumcision — Kuwait Practice

ASSESS ≥ 1 WK · Ped SURGERY

Near-universal in Kuwait — screen first, always give analgesia, and know the complications.

BEFORE YOU CIRCUMCISE — CHECKLIST

- **Examine the genitalia first. Do NOT circumcise** if hypospadias, epispadias, chordee, ambiguous genitalia / suspected DSD, micropenis, or buried / webbed penis

— the foreskin may be needed for repair → refer to pediatric surgery / urology.[393]

- Contraindicated in an **unstable or sick infant** — confirm normal feeding, elimination and thermoregulation; ensure vitamin K given.[393]
- Family history of a bleeding disorder → coagulation studies / defer.[393]
- Informed parental consent. In Kuwait usually performed by **pediatric (or general) surgery from ~1 week of age** (and later in infancy / childhood).

◈ **ANALGESIA — NEVER OMIT**

- **Dorsal penile nerve block** or subcutaneous **ring block** (lidocaine 1% without epinephrine: nerve block 0.4 mL each side, or ring block 0.8 mL in total — AAP 2012; stay within 3–4 mg/kg) — the most effective analgesia studied for newborn circumcision; minor bleeding, swelling or hematoma can occur.[393,394]
- Add topical EMLA, oral sucrose, non-nutritive sucking and

acetaminophen.

- Sucrose or EMLA **alone are not enough**; combination analgesia is best.[395]

METHODS

Gomco clamp, Mogen clamp, or Plastibell (ring) device — each with its own technique and complication profile.[393]

WOUND CARE

- Clean gently with warm water at each diaper change; avoid soap and wipes (they sting).
- **Gomco / Mogen:** apply petroleum jelly (or antibiotic ointment) to the glans and on the diaper for ~5–7 days to stop the wound sticking. A moist **yellow coating** (granulation) on the glans is **normal healing**, not infection.[393]
- **Plastibell:** the ring falls off by itself in ~5–10 days — **do not pull it**; sponge-bathe until it separates[393]; seek review if it slips onto the shaft or has not fallen by 10–14 days.

- Heals in ~7–10 days. After healing, gently retract the skin at the groove to prevent adhesions / skin bridges.[396]

⚠ COMPLICATIONS — WHEN TO SEEK URGENT REVIEW

- **Bleeding** more than a few drops (commonest — direct pressure and a compressive dressing around the penis, then pediatric surgery review + coagulation workup)
- spreading redness up the shaft, pus or fever = **wound infection**
- no urine for ~8 h = **retention**[396]
- Plastibell ring migrated with a **dusky glans** = constriction (emergency)
- trapped / concealed penis, adhesions, skin bridges, or late **meatal stenosis** (deflected stream)[396] → pediatric surgery / urology.

Acute Scrotum

MINUTES

6-HOUR WINDOW

Sudden scrotal pain is testicular torsion until proven otherwise — a clinical diagnosis; do not wait for imaging.

DEFINE

- **Acute scrotum** = sudden scrotal pain/swelling. **Testicular torsion until proven otherwise** — a time-critical surgical emergency. Bimodal peaks: the neonate and the peri-pubertal boy.[397]
- Differential: **torsion of the appendix testis** (blue-dot sign, gradual, milder), **epididymo-orchitis** (dysuria, gradual, older/sexually active), trauma, idiopathic scrotal edema, incarcerated inguinal hernia.[398]

APPROACH — FAVORS TORSION

- **Sudden severe pain** ± nausea/vomiting, **high-riding testis, horizontal lie, absent cremasteric reflex**, diffuse tenderness.[397]
- The **TWIST score** (hard testis, swelling, nausea/vomiting, absent cremasteric reflex, high-riding testis)

risk-stratifies but does not replace surgical judgment.[397]

⚠ WORK-UP

- **Torsion is a clinical diagnosis — do not delay surgical exploration for imaging.** Color Doppler ultrasound (absent intratesticular flow) is useful only when the diagnosis is equivocal **and** will not delay surgery.[397]
- Urinalysis: pyuria or bacteriuria supports bacterial epididymitis — but a **normal urinalysis does not exclude epididymitis, and an abnormal one does not exclude torsion**; send a culture.[398]

⚠ RED FLAGS — THE CLOCK

- Testicular salvage is **time-dependent**: near-universal (≈ 97%) if detorsion occurs within ~6 hours of onset, falling progressively thereafter (≈ 79% at 7–12 h, ≈ 42% at 19–24 h).[399]
- Neonatal torsion and any delayed presentation need urgent senior/urology input.

MANAGEMENT

- **Immediate urology/surgical referral** for scrotal exploration, detorsion, and **bilateral orchidopexy**.[398]
- If surgery is delayed, a trained clinician may attempt **manual detorsion** (usually 'opening a book' — medial-to-lateral) **only if experienced** as a temporizing measure while immediate exploration is arranged, guided by pain relief; success does not remove the need for surgery and orchidopexy.[398]
- **Consult surgery/urology at once and confirm the diagnosis.** Torsion → surgery. Once torsion is excluded: **appendix-testis torsion** → NSAID analgesia and rest; **epididymo-orchitis** → NSAIDs, rest and scrotal support. **Prepubertal boys: antibiotics only if urinalysis or urine culture shows bacterial infection** (send the culture before treating — prepubertal epididymitis is usually non-bacterial). **Sexually active adolescents:** send urine NAAT for chlamydia/gonorrhea and treat presumptively at the visit (e.g.,

ceftriaxone 500 mg IM once [1 g if ≥ 150 kg] + doxycycline 100 mg PO twice daily for 10 days; CDC).[398]

✦ PEARL — ABDOMINAL PAIN CAN BE A TORSION

Examine the testes in every boy with acute lower-abdominal or groin pain — torsion frequently refers pain to the abdomen and is missed when the scrotum is not examined.[400]

◣ ADMIT · DISCHARGE · REFER

- **Admit** — torsion (confirmed or not excluded) → emergency exploration; incarcerated hernia; epididymo-orchitis only if systemically unwell, an infant, or unable to take oral analgesia.[398]
- **Home from the emergency department** — once the surgical/urology team has excluded torsion: appendix-testis torsion and epididymo-orchitis go home on NSAIDs ± antibiotics per urine results, review in 48–72 h.[398]
- **Refer — now** — surgery/urology IMMEDIATELY to confirm the diagnosis (torsion → exploration within 6 h).[397]

- **Refer — clinic** — consider outpatient renal-tract ultrasound after prepubertal epididymitis, particularly if recurrent, culture-positive or in an infant (underlying urogenital anomaly reported in ~25–30%; routine full urological evaluation of every case is debated).[398]

◈ SEE ALSO Testicular Torsion — the time-critical diagnosis to exclude first.

Testicular Torsion MINUTES

ADOLESCENT & NEONATE

Salvage window ~6 hours. A boy's abdominal pain → examine the scrotum.

◣ RECOGNIZE

- Sudden severe scrotal/lower-abdominal pain, nausea/vomiting, swelling. High-riding/horizontal testis, **absent cremasteric reflex**, negative Prehn sign.[397]

Clinical suspicion = urgent exploration. Don't delay for imaging.

ACT

- **Immediate urology / pediatric surgery** → exploration, detorsion + bilateral orchidopexy.[398]
- Color Doppler ultrasound **only if it will not delay** surgery.
- Manual detorsion may temporize **only in experienced hands** — do not attempt if untrained (can worsen the torsion), and never let it delay surgical exploration.[398]

ADMIT · DISCHARGE · REFER

- **Admit** — all → emergency exploration.
- **Home from the ward** — post-operative.
- **Refer — now** — pediatric surgery/urology IMMEDIATELY (explore within 6 h); do not delay for imaging.

◈ SEE ALSO Acute Scrotum for the full differential.

Paraphimosis HOURS REDUCE PROMPTLY

A retracted foreskin trapped behind the glans — edema then ischemia; reduce promptly.

DEFINE

- **Paraphimosis** — a retracted foreskin trapped behind the glans, cannot be reduced. The constricting band causes progressive glans and distal-foreskin edema, then venous → arterial compromise. A urological emergency.[396]
- Commonly **iatrogenic** — the foreskin is left retracted after catheterization, cleaning, or examination.[396]

APPROACH & WORK-UP

- Painful, swollen glans with an edematous 'collar' of foreskin proximal to it. Diagnosis is clinical.
- Distinguish from balanoposthitis (foreskin/glans inflammation without a trapped retracted ring).

⚠ RED FLAGS

Increasing edema, dusky glans, or pain out of proportion signal arterial

compromise and impending necrosis — **reduce promptly; escalate to urology if reduction fails.**[396]

MANAGEMENT

REDUCE IT

- **Analgesia first** — penile block with plain lidocaine 1% (no epinephrine; see **Maximum Local Anesthetic Doses**) or procedural analgesia (expert practice).
- **Reduce edema** — sustained manual compression of the glans (± a wrap such as saline-soaked gauze squeezed gently but firmly for 5–10 min, ice, or an osmotic agent such as granulated sugar); multiple punctures of the edematous foreskin or hyaluronidase under the constricting band are described for difficult cases.[396]
- **Reduce the foreskin** — push the glans back with the thumbs while drawing the foreskin forward over it with the fingers.
- **If manual reduction fails** — urology for a dorsal-slit or emergency reduction.[396]

✦ PEARL — PREVENTION IS THE CURE

Always return the foreskin to its natural forward position after any catheterization, cleaning, or examination, and teach carers never to force-retract a child's foreskin.[396]

◣ ADMIT · DISCHARGE · REFER

- **Admit** — if reduction fails or there is tissue compromise.
- **Home from the emergency department** — after successful reduction with follow-up.
- **Refer — now** — urology for failed reduction.
- **Refer — clinic** — urology for recurrent episodes.

Balanitis / Balanoposthitis & Phimosis

ASSESS COMMON

Glans/foreskin inflammation and non-retractile foreskin; physiologic phimosis is normal, needs no treatment.

DEFINE

- **Balanitis** = inflammation of the glans; **balanoposthitis** = glans + foreskin. **Phimosis** = non-retractile foreskin — **physiologic** (normal in young boys) or **pathologic** (scarred).
- **Physiologic phimosis is normal**: non-retractile in most infants, becomes retractile with age (≈ 99% by 17 years). Needs no treatment.[396]

APPROACH & WORK-UP

- Balanitis: red, swollen, tender glans/foreskin ± discharge, dysuria. Usually hygiene-related or candidal; consider sexually transmitted causes in adolescents.
- Distinguish physiologic phimosis (soft, healthy, pink opening) from **pathologic** (scarred white fibrotic

ring — balanitis xerotica obliterans/lichen sclerosus).[396]

- Clinical diagnosis; swab if recurrent/purulent; urinalysis if voiding symptoms.

⚠ RED FLAGS

Pathologic phimosis (white scarred ring / BXO), recurrent balanoposthitis, **ballooning or difficulty voiding**[396], or **urinary retention** — refer to urology.

MANAGEMENT

Balanitis — general

DOSE

Hygiene, warm saline soaks

ROUTE & NOTES

Retract gently only as far as comfortable; avoid irritants.

Balanitis — bacterial/candidal

DOSE

Topical/oral antibiotic or topical antifungal

ROUTE & NOTES

Guided by likely organism; treat/screen for STI in adolescents.

Physiologic phimosis

DOSE

No treatment; do not force-retract

ROUTE & NOTES

Reassure; resolves with age.

Symptomatic / early pathologic phimosis

DOSE

Topical betamethasone 0.05% applied twice daily for 4–8 weeks (expert practice; the review gives no regimen)

ROUTE & NOTES

Success 67–95% with betamethasone (about 80% overall); avoids or defers circumcision.[396]

Pathologic phimosis / BXO / recurrent

DOSE

Refer for circumcision

ROUTE & NOTES

Definitive for scarred foreskin or lichen sclerosus.[396]

✦ PEARL — HANDS OFF THE YOUNG FORESKIN

Never forcibly retract a young boy's foreskin — it tears, bleeds, and scars, converting harmless physiologic phimosis into pathologic phimosis.[396]

◣ ADMIT · DISCHARGE · REFER

- **Admit** — rarely — severe infection or urinary retention.

- **Home from the emergency department** — most, with hygiene and topical treatment.
- **Refer — clinic** — urology for pathological phimosis, recurrent balanitis, or balanitis xerotica obliterans.

Priapism

MINUTES

> 4 H = EMERGENCY

Painful rigid erection > 4 hours; ischemic priapism is a penile compartment syndrome — relieve fast.

DEFINE

- **Priapism** — persistent erection > 4 hours unrelated to stimulation. **Ischemic** (low-flow, painful, rigid corpora — penile compartment syndrome, a true emergency) versus **non-ischemic** (high-flow, usually post-traumatic, not urgent).[401]
- Most pediatric priapism is **ischemic and associated with sickle cell disease** (the cause in about two-thirds of childhood cases); short

self-limiting 'stuttering' episodes are common in SCD and can progress to a prolonged ischemic event.[402]

APPROACH & WORK-UP

- Rigid, painful corpora cavernosa with a **soft glans and corpus spongiosum** → ischemic. Ask about sickle cell disease and drugs.
- **Cavernosal blood gas** distinguishes: ischemic = dark, hypoxic, acidotic blood. **Color Doppler ultrasound** also separates the two (ischemic = absent/low cavernosal flow; non-ischemic = normal/high flow). **Do not delay treatment for imaging.**[401]

⚠ RED FLAGS — THE CLOCK

- Smooth-muscle edema and atrophy begin as early as ~6 hours; risk of permanent erectile dysfunction rises with duration.[401]
- Ischemic priapism > 4 hours is a time-sensitive emergency needing immediate urology (and hematology in sickle cell disease) — do not delay urologic

intervention for sickle-cell measures.[401]

MANAGEMENT

RELIEVE THE ERECTION FIRST

- **In sickle cell disease, do not delay penile intervention for exchange transfusion** — urologic relief comes first; sickle measures (hydration, oxygen, analgesia) run concurrently.[403]
- **Corporal aspiration ± saline irrigation** plus **intracavernosal phenylephrine** (urology-directed), repeated as needed, with blood-pressure and heart-rate monitoring.[401]
- Surgical shunting only after aspiration + sympathomimetic have failed.[401]

Phenylephrine (intracavernosal)

DOSE

Adult/post-pubertal: 100–200 mcg per injection every 3–5 min, diluted in 0.9% saline to 100–500 mcg/mL; maximum cumulative dose 1 mg within the first hour

NOTES

Urology-directed. Children and patients with cardiovascular disease: lower doses/lower concentration in smaller volumes. Monitor BP and HR (e.g., every 15 min for 1 h after injection).[401,402]

✦ PEARL — CALL UROLOGY NOW

Acute ischemic priapism is an emergency; in sickle cell disease relieve the erection first and give sickle-specific care alongside — not instead.

◣ ADMIT · DISCHARGE · REFER

- **Admit** — ischemic priapism → urgent intervention.
- **Home** — after detumescence with follow-up.
- **Refer — now** — urology (aspiration/irrigation) and hematology in sickle cell disease; do not delay urology.

Gross Hematuria ASSESS APPROACH

Confirm true hematuria, then sort glomerular from non-glomerular — that split directs the entire work-up.

DEFINE

- **Gross hematuria** — visibly bloody or tea/cola-colored urine. Confirm **true hematuria** (dipstick positive **and** ≥ 5 RBC/high-power field on microscopy) — exclude mimics: foods (beetroot), drugs (rifampin), myoglobin, urate, menstrual contamination.[404]

APPROACH — GLOMERULAR VS NON-GLOMERULAR

- **Glomerular** — brown/cola-colored, dysmorphic RBCs or RBC casts, proteinuria, hypertension, edema → glomerulonephritis (post-infectious, IgA nephropathy, Alport). **Recurrent painless gross hematuria** with a fever, viral illness or exercise → most likely **IgA nephropathy**; hematuria with **hearing impairment** (or a family history of kidney failure) → **Alport syndrome** — send genetics first.[404]

- **Non-glomerular** — bright red ± clots → urologic: UTI, hypercalciuria/stones, trauma, benign urethrorrhagia, rarely tumor. **Timing helps:** blood at the **start** of the stream → urethra; at the **end** → bladder. **Benign urethrorrhagia** — prepubertal boys, spots of blood at the end of or between voids, resolves spontaneously.[405]
- Commonest causes overall: UTI and hypercalciuria; gross hematuria without glomerular features is **usually benign**.[405]

⚠ **WORK-UP**

- Urinalysis with **microscopy** (casts, dysmorphic RBCs), urine culture, **blood pressure**; urine protein:creatinine and calcium:creatinine ratios; serum creatinine/electrolytes; **C3/C4 and anti-DNase B** if glomerulonephritis is suspected; **renal-bladder ultrasound** — stones, polycystic kidney disease, trauma.[404]
- Image for trauma or obstructing clot as indicated.

RED FLAGS

- Hypertension, edema, oliguria, or rising creatinine → glomerulonephritis with acute kidney injury.[404]
- Flank pain with clots (stones), significant trauma, a palpable mass, or systemic symptoms.

MANAGEMENT

- Treat the underlying cause. **Nephrology referral** for glomerular features (hypertension, proteinuria, casts, reduced GFR); **urology** for structural/urologic causes.[404]
- Isolated gross hematuria with normal blood pressure, no proteinuria, and normal ultrasound can usually be observed.[405]

✦ PEARL — DIPSTICK + MICROSCOPY + BLOOD PRESSURE

Those three bedside steps triage most children — color and RBC morphology sort glomerular from non-glomerular and direct the whole work-up.[404]

ADMIT · DISCHARGE · REFER

- **Admit** — clot retention, significant bleeding, hypertension, or acute nephritis with impairment.
- **Home from the emergency department** — well child with a benign cause and outpatient workup.
- **Refer — clinic** — nephrology (glomerular) or urology (structural, stones, or mass).

Acute Post-infectious Glomerulonephritis (PIGN)

ASSESS 2–12 YR

The commonest acute nephritis in children — cola urine, puffy eyes and a high blood pressure 1–6 weeks after an infection, classically streptococcal.

RECOGNIZE

- **Acute nephritic syndrome** — cola/tea-colored urine, periorbital/leg edema, **hypertension**, oliguria; onset **1–3 weeks after pharyngitis** or **3–6 weeks after impetigo** (skin infection is the commoner trigger in hot

climates). Group A streptococcus is the classic cause, but other bacteria, viruses, fungi and parasites cause the same immune-mediated nephritis — hence **post-infectious** (infection-related) GN.[406,407]

- Ask about recent sore throat, skin sores or scabies; examine the skin, blood pressure and volume status.

WORK-UP

- Urinalysis and microscopy — dysmorphic RBCs, **RBC casts**, proteinuria (usually sub-nephrotic); urine protein:creatinine ratio.
- Creatinine, urea, electrolytes (potassium), albumin, CBC.
- **Low C3 with normal C4** supports the diagnosis; **anti-DNase B** confirms recent streptococcal infection (positive in nearly all; ASO titer adds little); throat or skin swab if there is a current infection.[406,407]
- Chest X-ray if breathless or overloaded; renal ultrasound only if the picture is atypical.

MANAGE — SUPPORTIVE CARE

- **Manage fluid balance** (strict input/output, daily weight, fluid restriction if oliguric or overloaded) and a **no-added-salt diet**.
- **Treat hypertension** — furosemide 1–2 mg/kg IV/oral[42] for edema, overload or hypertension is usually enough[408]; add a calcium-channel blocker if still hypertensive[407]. Severe hypertension with headache, seizures or visual change → Hypertensive Emergency.
- **Penicillin for every patient** (benzathine penicillin G preferred; amoxicillin, or a macrolide if allergic) to eradicate any remaining group A streptococci and limit spread to household contacts (CDC)[409] — it does not alter the course of the nephritis.[406]
- **No corticosteroids or immunosuppression** for uncomplicated disease.[406]

⚠ RED FLAGS

- **Hypertensive encephalopathy** (headache, vomiting, seizures, altered consciousness) — about 1 in 10 admissions.[407]

- **Pulmonary edema**, hyperkalemia, or a **rapidly rising creatinine** → possible crescentic glomerulonephritis — nephrology the same day (see **Acute Kidney Injury**).[406,407]

✦ EXPECTED COURSE

Diuresis and normal blood pressure within 1–2 weeks; C3 normalizes by 8 weeks; microscopic hematuria may persist up to a year; recurrence is rare (course timelines: expert consensus — not guideline-stated). Long-term prognosis is good.[408]

◣ ADMIT · DISCHARGE · REFER

- **Admit** — hypertension, oliguria, edema/overload, raised creatinine or hyperkalemia.
- **Home** — normal blood pressure and urine output; check blood pressure and urinalysis at 1–2 weeks, C3 at 6–8 weeks.[407]
- **Refer — now** — nephrology if creatinine keeps rising or nephrotic-range proteinuria — these may need a biopsy.[406]

- **Refer — clinic** — nephrology if C3 still low at **12 weeks** (consider C3 glomerulopathy), or hematuria/proteinuria beyond 1 year — these may need a biopsy.[406]

Rhabdomyolysis MINUTES

DASAIM/DSIT 2019 · Mannix 2006

Muscle breakdown → tea-colored urine, a very high CK, and the twin threats of hyperkalemia and AKI.

RECOGNIZE

- Myalgia, weakness and **dark (tea-/cola-colored) urine** that is **dipstick-positive for blood but shows few red cells** (myoglobin), with **creatine kinase > 5× the upper limit**. Triggers: viral myositis (influenza), trauma/crush, extreme exertion or heat, seizures, toxins/drugs, and metabolic myopathies.[410]

⚠ TWO IMMEDIATE DANGERS

- **Hyperkalemia** — get an ECG and treat at once (see **Acute**

Electrolyte Emergencies). **Acute kidney injury** — start **early, generous IV fluids** to maintain a good urine output.[410]

- Also watch calcium/phosphate and for **compartment syndrome** in a swollen, painful limb.[410] **Routine urinary alkalinization and mannitol are not recommended** (adult guidance).[411]

✦ CHASE THE CAUSE

Recurrent or exertion-out-of-proportion rhabdomyolysis, or a family history, suggests an **underlying metabolic myopathy** — refer for metabolic work-up once the acute episode is controlled.[410]

◣ WORKUP

- **Creatine kinase** (diagnostic > 5× the upper limit of normal (ULN); **serial** to track the trend)[410]; AKI risk climbs > 5000 U/L (adult trauma data).[412]
- **Potassium + ECG**, calcium, phosphate.
- Renal function, venous blood gas/bicarbonate; urinalysis (**heme-positive with few RBCs** = myoglobinuria) + urine myoglobin.[410]

- Uric acid, LDH, AST; metabolic/genetic screen if recurrent or exertion-disproportionate.[410]

ADMIT · REFER

- **Admit** — significant CK elevation, any renal impairment or hyperkalemia.
- **Refer — now** — nephrology if AKI; surgery for compartment syndrome.

15 Respiratory, Allergy & Immunology

Airway, breathing, anaphylaxis, allergy & immunology

Anaphylaxis MINUTES

Acute multisystem allergic reaction — epinephrine first, always.

RECOGNIZE & DIAGNOSE

- **Diagnose anaphylaxis (GA²LEN 2024 criteria) when any one applies:**

1 · No known allergen — acute skin/mucosal signs **plus** respiratory **or** cardiovascular involvement.
2 · Likely or known allergen exposure — any **two** of: skin/mucosa · respiratory · cardiovascular · severe GI symptoms (severe crampy pain, repeated vomiting).
3 · Known allergen exposure — respiratory involvement **alone** (non-inhaled allergen) **or** cardiovascular involvement **alone** (hypotension, poor perfusion, collapse) — skin signs may be absent.[413]

- **If in doubt, give epinephrine.** Epinephrine is given immediately for suspected anaphylaxis and may be given on clinical judgment before the criteria are fully met — the risk of a missed dose exceeds the risk of an unnecessary one.[413,414]
- Skin: urticaria, flushing, angioedema, pruritus (absent in up to 20%).[414]
- Breathing: stridor, wheeze, hoarseness, falling SpO_2, cyanosis, increased work of breathing, signs of respiratory distress, persistent cough.

- Circulation: poor perfusion, hypotension, collapse — **reduced BP = low systolic for age or > 30% drop from baseline**. Infants: floppiness, drooling, pallor, sudden behavior change.[414]
- GI: severe crampy abdominal pain or repeated vomiting — counts toward the diagnosis, especially after a likely allergen.[414]
- **Not anaphylaxis:** repeated vomiting 1–4 h after a food **without** skin, respiratory or cardiovascular signs → think food protein-induced enterocolitis syndrome (FPIES) — fluids and ondansetron, not epinephrine (see **Acute FPIES**). **If the infant is lethargic or hypotensive, treat shock immediately** (20 mL/kg bolus) **and give epinephrine if anaphylaxis cannot be excluded.**[415]

1ST LINE · IM EPINEPHRINE **IM epinephrine now — 0.01 mg/kg of 1 mg/mL (max 0.3 mg before puberty, 0.5 mg in adolescents) into the anterolateral thigh; there is no contraindication**[414,416]

THEN

- **Remove the allergen if possible** — stop the infusion or drug, remove the stinger.[414]
- Lay supine, legs up (sit if breathing is hard; never stand suddenly).
- Oxygen 10–15 L/min via non-rebreather mask.
- Stridor, voice change, or tongue/uvula swelling = impending airway obstruction → call anesthesia/ENT now for early, controlled intubation (see **Difficult Airway**).
- Fluid bolus for hypotension.
- Repeat epinephrine every 5–15 min if needed.[416]

refractory after ≥2 IM doses

2ND–3RD LINE **Refractory after repeated IM epinephrine → urgent PICU/anesthesia support; IV epinephrine infusion only by an experienced team with monitoring · IV fluids · glucagon if on a beta-blocker.**[414,416]

MEDICATIONS — EACH GIVEN SEPARATELY

Epinephrine (adrenaline) — 1st line

DOSE

0.01 mg/kg (max 0.3 mg before puberty; 0.5 mg in adolescents)

ROUTE & NOTES

IM, 1 mg/mL (1:1000), anterolateral thigh; repeat every 5–15 min[414,416]

Epinephrine autoinjector (limited availability)

DOSE

0.1 / 0.15 / 0.3 mg

ROUTE & NOTES

Dispensed from the emergency department or the general pediatric clinic to cover the child until the allergy clinic review. 0.1 mg (7.5 to < 15 kg) · 0.15 mg (15 to < 25 kg) · 0.3 mg (≥ 25 kg; US label ≥ 30 kg). If the 0.1 mg device is unavailable, the 0.15 mg device may be used down to 7.5 kg.

Epinephrine infusion (refractory)

DOSE

0.1–1 mcg/kg/min (max 10 mcg/min — local practice)

ROUTE & NOTES

IV infusion via an infusion pump; titrate to effect under PICU supervision with continuous cardiac monitoring[416]; dose range = PALS epinephrine-infusion range[24]

Balanced crystalloid

DOSE

20 mL/kg

ROUTE & NOTES

IV bolus for hypotension, repeat

Salbutamol (for wheeze)

DOSE

2.5–5 mg nebulized

ROUTE & NOTES

Adjunct only — does not replace epinephrine

Diphenhydramine (for skin symptoms)

DOSE

1 mg/kg/dose (max 50 mg/dose)

ROUTE & NOTES

IV/IM; adjunct only, not first-line. A second-generation antihistamine (e.g., cetirizine, age-appropriate dose) avoids sedation[416]

Glucagon

DOSE

20–30 mcg/kg (max 1 mg)

ROUTE & NOTES

IV over 5 min, only if on a beta-blocker and refractory

Corticosteroids

DOSE

Not routine

ROUTE & NOTES

Consider only for persistent bronchospasm, or severe reactions needing more than 2 IM epinephrine doses or an IV epinephrine infusion; never delay epinephrine

⚠ OBSERVE EVERY CHILD BEFORE ANY DISCHARGE DECISION — NO EARLY DISCHARGE FROM THE EMERGENCY DEPARTMENT

- **Admit** — usually, for the 12-h tier: minimum 12 h if more than two doses were needed, **history of severe asthma**, anaphylaxis with **severe respiratory compromise**, possible continuing allergen absorption, presentation at night/out of hours, difficult access to emergency care, or the family cannot recognize and respond to deterioration.[417]
- **Home from the emergency department** — 2-h tier: minimum 2 h after full resolution, only when every criterion is met — good response within 5–10 min to a single IM dose given within 30 min of symptom onset, symptoms completely resolved, the child leaves with **two in-date**

autoinjectors dispensed and demonstrated, and a trained adult supervising.[414,417]

- **Home from the emergency department** — longer tiers: observe 4–6 h whenever possible, and always when any criterion is unmet or the department cannot dispense autoinjectors; minimum 6 h if two IM doses were needed or there is a history of a biphasic reaction.[414,417]

ADMIT · OBSERVE · DISCHARGE · REFER

- **Admit** — more than two epinephrine doses or an epinephrine infusion; ongoing or biphasic symptoms; **moderate–severe respiratory distress** or hypotension at any point; airway involvement; history of severe asthma; any child in the 12-h observation tier.[414,417]
- **Home from the emergency department** — after observation (emergency department / short stay): resolution after one or two IM doses, the observation tier above completed, no respiratory distress at review.

- **Home from the emergency department** — checklist (Kuwait pathway) — **Home epinephrine:** dispense an epinephrine autoinjector from the emergency department or the general pediatric clinic, **with hands-on training**, to cover the child until the allergy clinic review. If none can be dispensed, give **clear written instructions**: strict avoidance of the suspected trigger, the warning signs, and to come straight to the emergency department (call emergency services) at the first sign. Written action plan; allergen-avoidance advice; non-sedating antihistamine for residual urticaria only; no routine steroid.[414,416]
- **Refer — now** — **PICU** for refractory anaphylactic shock despite repeated IM epinephrine requiring an epinephrine infusion, or airway compromise requiring definitive airway management.
- **Refer — clinic** — Allergy/Immunology for every case.

Anaphylaxis — epinephrine first

Recognize (GA²LEN criteria) → IM epinephrine immediately → fluids & repeat → refractory (PICU).

IM EPINEPHRINE FIRST, ALWAYS
There is no contraindication — give it before antihistamine or steroid.

1 **RECOGNIZE — GA²LEN CRITERIA** — recognize

1 No known allergen: skin/mucosa + respiratory or cardiovascular
2 Likely allergen: any 2 of skin/mucosa · respiratory · cardiovascular · severe GI
3 Known allergen: respiratory alone or cardiovascular alone

If in doubt, give epinephrine.

2 **IM EPINEPHRINE** — now

0.01 mg/kg (max 0.3 mg; teen 0.5 mg) of 1:1000 IM, anterolateral thigh. Supine, legs up; O_2 10–15 L/min.

3 **FLUIDS · REPEAT** — 5–15 min

Fluid bolus for hypotension. Repeat IM epinephrine every 5–15 min as needed.

4 **REFRACTORY — PICU** — ≥ 2 doses

Urgent PICU/anesthesia. IV epinephrine infusion by experts only; glucagon if on a beta-blocker.

Acute Asthma MINUTES GINA 2026

Grade severity continuously: speech, work of breathing, SpO_2, silent chest. Doses follow the Global Initiative for Asthma (GINA) 2026 strategy; PICU-level therapies are beyond GINA's scope and follow critical-care practice.

GRADE SEVERITY FIRST

- Use a validated score — the **PRAM (Pediatric Respiratory Assessment Measure)** (validated 2–17 yr) or **PASS (Pediatric Asthma Severity Score)** — with SpO_2 on room air, work of breathing, and ability to speak or feed; reassess and re-score after each step.[418,419]
- **PRAM bands:** 0–3 mild · 4–7 moderate · 8–12 severe (Canadian Paediatric Society); re-score after each step. **Life-threatening** = drowsy/confused or silent chest (GINA 2026).

PEARL — WHEN IT ISN'T ASTHMA

- Doubt the diagnosis and look for a mimicker when wheeze is present from the **first weeks of life**, is **monophonic or focal**, fails to

respond to adequate bronchodilator and steroid, or comes with faltering growth, clubbing, or chronic wet cough.

- Think: inhaled **foreign body**, tracheo-/bronchomalacia or a **vascular ring**, **cystic fibrosis** or primary ciliary dyskinesia, bronchiolitis in the infant, a **cardiac** cause (heart failure), aspiration/gastroesophageal reflux disease (GERD), and — in adolescents — inducible laryngeal obstruction (vocal cord dysfunction).[420]

1ST LINE

- **Oxygen** — start it when SpO_2 is **below 92%**. Then titrate: children **6 years and older** — keep SpO_2 **92 to 95%**; children **under 6 years** — keep SpO_2 **at or above 92%**. Do not push saturations higher (avoid over-oxygenation).[420]
- **Inhaled salbutamol** by spacer every 20 min × 3 in the first hour, reassessing before each repeat, then titrate to response (dose by age in the table).[420]
- **Systemic corticosteroid** for a **moderate–severe** exacerbation or inadequate response to salbutamol (oral — prednisolone or dexamethasone — as effective as IV). **Not routine for mild**; avoid routine oral steroids for mild viral wheeze in preschoolers.[420]

↓

2ND LINE MODERATE–SEVERE

- Add **ipratropium × 3**.
- Severe or poor response → **IV magnesium sulfate**.
- **Call PICU**.

life-threatening / not responding

↓

3RD LINE · PICU **Not responding / life-threatening → call PICU urgently. Continuous nebulized salbutamol, IV salbutamol, non-invasive ventilation and intubation are PICU-directed (see "Beyond GINA" below).**[420]

BRONCHODILATORS

Salbutamol (inhaler + spacer)

DOSE

< 6 yr: mild 2–4 · moderate 4 · severe 6 puffs
≥ 6 yr: mild 4 · moderate 4–6 · severe 6–10 puffs

ROUTE & NOTES

100 mcg/puff; **shake before each puff**, one puff at a time (4–5 breaths each); every 20 min × 3 in the first hour, then **titrate to response** (hourly → every 1–4 h). GINA sets no fixed cap[420]

Salbutamol (nebulized)

DOSE

< 6 yr: 2.5 mg (any severity)
≥ 6 yr: mild 2.5 mg · moderate 2.5–5 mg · severe 5 mg

ROUTE & NOTES

Every 20 min × 3, then titrate to response; spacer is preferred when the child can use it[420]. Not responding → PICU: continuous nebulized or IV salbutamol — see **Beyond GINA**.

Ipratropium bromide

DOSE

< 6 yr: 80 mcg by spacer (4 puffs of 20 mcg) or 250 mcg nebulized
≥ 6 yr: 4–8 puffs (80–160 mcg) or 250–500 mcg nebulized

ROUTE & NOTES

Moderate–severe: give with each salbutamol dose, every 20 min × 3 in the first hour only[420]

Magnesium sulfate

DOSE

40–50 mg/kg (max 2 g)

ROUTE & NOTES

IV over 20 min, age ≥ 2 yr

BEYOND GINA — CRITICAL-CARE THERAPIES (PICU-DIRECTED)

Salbutamol — continuous nebulization

DOSE

0.5 mg/kg/h, maximum 20 mg/h (many units use 10–15 mg/h)

NOTES

NAEPP dose.[421] GINA accepts continuous nebulized salbutamol for severe exacerbations in the emergency department; the mg/kg/h regimen and the high-output nebulizer are critical-care practice. Cardiac + K^+ monitoring[420]

Salbutamol IV

DOSE

bolus then infusion

NOTES

Not routine (no GINA recommendation); PICU only, cardiac monitoring; watch for hypokalemia and lactic acidosis[420]

Aminophylline

DOSE

5 mg/kg load, then infusion

NOTES

Not recommended (GINA 2026) — poor efficacy, narrow safety margin, potentially fatal toxicity (especially with prior oral theophylline); no reduction in symptoms or length of stay in children. **PICU rescue only**, after IV salbutamol and magnesium; monitor levels[420,422]

Heliox (helium–oxygen ≥ 70:30)

DOSE

driving / breathing gas

NOTES

No proven benefit in routine exacerbations (Cochrane); may be considered in severe exacerbations in an ICU setting. Needs ≥ 70% helium, so unsuitable when a high FiO_2 is required[423,424,425]

CORTICOSTEROIDS — CHOOSE ONE; ORAL BEFORE IV (IV DOSES ARE NOT GINA DOSES)

Prednisolone

DOSE

< 2 yr: 1–2 mg/kg (max 20 mg)
2–5 yr: 1–2 mg/kg (max 30 mg)
6–11 yr: 1–2 mg/kg (max 40 mg)
≥ 12 yr: 1–2 mg/kg (max 50 mg)
once daily

ROUTE & NOTES

PO; 3–5 days (≤ 11 yr) · 5–7 days (≥ 12 yr — GINA adult/adolescent regimen 40–50 mg/day); age-specific maxima per GINA[420]

Dexamethasone

DOSE

0.3–0.6 mg/kg once daily (max 12–16 mg)

ROUTE & NOTES

PO/IV, 1–2 days.[420]

Methylprednisolone

DOSE

1–2 mg/kg/day IV in 2 divided doses (max 60 mg/day)

ROUTE & NOTES

IV drug of choice when oral is not tolerated[834]. Not a GINA dose — NAEPP EPR-3[421]; confirm with clinical pharmacy.

Hydrocortisone

DOSE

4 mg/kg/dose every 6 h on day 1 (max 100 mg/dose), then every 12 h on day 2 and once daily on day 3 — or switch to oral prednisolone

ROUTE & NOTES

Only if methylprednisolone is unavailable[834]. Not a GINA dose — Australian Asthma Handbook[839]. Not equivalent to the row above: about 3 mg/kg/day of methylprednisolone on day 1; higher steroid doses add no benefit.[421]

◈ STEROID CHOICE & AVAILABILITY

- Oral prednisolone and oral dexamethasone are equally effective[426], and oral steroid is as effective as IV[427]; reserve IV steroid for the child who cannot take oral.
- When IV is needed, methylprednisolone is the drug of choice; use hydrocortisone only if it is unavailable.[834]
- Note that hydrocortisone's mineralocorticoid effect can add to

the hypokalemia caused by high-dose salbutamol, and all systemic steroids can raise blood pressure and glucose.

- All four are widely stocked.[420]

⚠ CLINICAL PEARLS & RED FLAGS

A **silent chest**, a falling respiratory rate with rising drowsiness, or a normal/rising $PaCO_2$ in a tiring child is **pre-arrest** — not improvement. **Call PICU urgently**: decisions on sedation (e.g., ketamine), non-invasive ventilation, imaging, and intubation are made by the critical-care team, aiming to maximize urgent treatment before any intubation decision.[420]

◣ ADMIT · DISCHARGE · REFER

- **Admit** — ongoing oxygen requirement, incomplete response after first-hour therapy, salbutamol needed more often than every 3–4 h, or prior PICU admission/intubation.
- **Home** — when all are met:
  - $SpO_2 \geq 92\%$ on room air.
  - Salbutamol needed no more often than every 4 h.
  - Feeding and talking.

    - Inhaler and spacer technique checked.
- **Discharge prescription**
    - **Salbutamol by inhaler and spacer** (face mask under 3 years): 2–6 puffs every 4 h, weaning over days.[420]
    - **Nebulized salbutamol** only for a child who cannot use an inhaler and spacer with face mask — e.g. too young or too weak to breathe effectively through the spacer (dose as in the table above, every 4 h, weaning).[421,839] A home nebulizer must not delay care: if salbutamol is needed more often than every 4 h, return at once. GINA links home nebulized salbutamol with a higher risk of asthma death; nebulizers can also spread respiratory viruses.[420,839]
    - **Oral steroid course** (table above).
    - **Inhaled corticosteroid (ICS):**
        - **≥ 6 years** — start or step up ICS-containing maintenance treatment; no child leaves on salbutamol alone.
        - **Under 6 years with asthma or recurrent wheeze** — a 2–3-month trial of daily low-dose

ICS when this episode needed oral steroids or urgent care, or symptoms occur between episodes more than twice a week; review the response at 2–3 months.[420,834]

- Written action plan; review within 1 week.[420]

- **Refer — now** — PICU for impending respiratory failure.
- **Refer — clinic** — Pulmonology for any PICU-level escalation, ≥ 2 admissions per year, or diagnostic doubt; Allergy/Immunology for difficult-to-control atopic disease.

✦ BEFORE DISCHARGE — SCREEN FOR WHAT KEEPS ASTHMA UNCONTROLLED (GINA 2026)

An exacerbation is the moment to look for the drivers. Ask and act on: **allergic rhinitis / rhinosinusitis** (intranasal corticosteroid — improves asthma control); **obesity** (harder to control; weight management in the plan — even 5–10% loss helps); **obstructive sleep apnea** (habitual snoring, witnessed apnea → sleep referral; see **OSA**); **gastro-esophageal reflux** (treat only if symptomatic — anti-reflux therapy does not improve asthma without reflux symptoms); **food allergy** (confirmed

food allergy is a risk factor for asthma death → allergy testing and an epinephrine plan); **anxiety or depression** in adolescents; **inducible laryngeal obstruction** when cough or "wheeze" does not respond to bronchodilator; and **exposures** — tobacco, vaping or shisha smoke at home or in the car (parents must never smoke or vape in rooms or cars the child uses), pets, mold, school triggers. Check **adherence and inhaler technique** last — they explain more exacerbations than any comorbidity. Refer to pulmonology/allergy when asthma stays uncontrolled despite treating these.[420]

Croup

HOURS

MINUTES if severe / impending failure

6 MO–6 YR

Barking cough, hoarse voice, inspiratory stridor; worse at night. Grade severity clinically — stridor at rest, indrawing, sustained agitation, lethargy or cyanosis (mild · moderate · severe · impending failure)[813] — or with the **Westley score** (0–17: ≤ 2 mild · 3–5 moderate · 6–11 severe · ≥ 12 impending

respiratory failure), summing level of consciousness, cyanosis, stridor, air entry, and retractions.[428]

KEEP CALM

Agitation worsens obstruction — examine on a parent's lap, minimal handling.

DECISION

Stridor at rest / respiratory distress?

MILD

Single steroid dose; discharge with clear return-precaution advice (safety-netting).[429,430]

MODERATE–SEVERE

Steroid + nebulized L-epinephrine; observe ≥ 2–4 hours for rebound; oxygen if hypoxic.[431]

Dexamethasone

DOSE

Mild: 0.15 mg/kg
Moderate–severe: 0.6 mg/kg
(max 16 mg)

ROUTE & NOTES

PO/IM/IV, single dose. 0.15 mg/kg may be as effective as 0.6 mg/kg in mild–moderate croup (Cochrane 2023; 0.6 scored better at 24 h). Dexamethasone probably reduces return visits compared with prednisolone (RR 0.55, 95% CI 0.28–1.11 — not statistically significant); prednisolone 1 mg/kg is an acceptable alternative when dexamethasone is unavailable (non-inferior in the largest RCT)[430]

Budesonide (nebulized)

DOSE

2 mg

ROUTE & NOTES

If oral steroid not tolerated (nebulized budesonide 2 mg performed similarly to oral dexamethasone)[430,432]

Epinephrine (nebulized)

DOSE

L-epinephrine (adrenaline) 1:1000 (1 mg/mL) 0.5 mL/kg nebulized (max 5 mL)

ROUTE & NOTES

Moderate–severe; observe for rebound[431]

◈ CONCENTRATION CHECK

Do not confuse 1:1000 (1 mg/mL) with 1:10 000 (0.1 mg/mL) epinephrine —

different concentrations.[431]

◈ **HELIOX IN SEVERE CROUP**

- In **SEVERE** croup with significant distress **NOT SETTLING** after dexamethasone and nebulized L-epinephrine, **HELIOX** (helium–oxygen) may temporize while the steroid takes effect or transfer/airway support is arranged — in small trials its effect was comparable to oxygen plus epinephrine.
- It is a **BRIDGE, NOT A SUBSTITUTE**, and the evidence is very limited (low certainty).
- Needs ≥ 70% helium, so it is unsuitable when a high oxygen requirement is present. **INVOLVE ICU/ANESTHESIA EARLY.**[433]

⚠ **DIFFERENTIALS**

- Drooling + toxic + no cough → epiglottitis (do not examine the throat).
- Sudden choking → inhaled foreign body.

ADMIT · DISCHARGE · REFER

- **Admit** — stridor at rest persisting after a steroid ± nebulized L-epinephrine, any oxygen requirement, or a repeat epinephrine dose needed.
- **Home from the emergency department** — mild croup (no stridor at rest, no distress) after a single steroid dose, feeding well, with reliable carers and safety-netting; if epinephrine was given, observe ≥ 2–4 h after the dose for rebound before the child goes home.
- **Refer — now — early ICU / anesthesia consult** for impending obstruction or failure to respond; ENT if an alternative airway diagnosis is suspected. If intubation is considered, do it in a controlled setting (PICU or operating room) with anesthesia and ENT present and difficult-airway equipment ready — see **Difficult Airway**.

◈ **SEE ALSO** **Pediatric ENT Emergencies** (epiglottitis, bacterial tracheitis) in Section 07.

Retropharyngeal Abscess HOURS

1–5 YR

Deep neck-space infection after recent upper-respiratory illness — fever, neck pain, refusal to move the neck, drooling; guard the airway.

RECOGNIZE

- Peak age 1–5 yr (median ~3 yr), usually after upper-respiratory infection.
- Symptoms: fever, sore throat, odynophagia/dysphagia, neck pain and swelling, muffled ("hot-potato") voice, trismus, and drooling.
- Signs: neck tenderness, limited neck extension or torticollis, and cervical lymphadenopathy. **Neck pain and refusal to move or extend the neck** are the most useful clues.[214]

⚠ GUARD THE AIRWAY

- Stridor, respiratory distress, tripod posture, or pooling of secretions signal an airway threat (it mimics epiglottitis).
- Keep the child calm and sitting upright, give oxygen, do **not**

examine the throat or lie the child flat, and involve ENT + anesthesia for a controlled airway before any manipulation.[214]

◈ IMAGING

- Lateral neck radiograph is a screening test when the diagnosis is equivocal and there is no airway obstruction (widened prevertebral soft tissue — > 7 mm at C2 or > 14 mm at C6). **Contrast-enhanced CT of the neck is the preferred, confirmatory test** — it separates a drainable abscess (rim-enhancing hypodensity) from retropharyngeal cellulitis/phlegmon and maps the extent.[214]
- No specific laboratory test is usually required.

DECISION

Airway compromise, or a large / loculated abscess? (large = CT cross-sectional area > 2 cm^2 or diameter > 2.5 cm; rim enhancement is the strongest predictor of pus at surgery)[434,435]

YES

Secure the airway with ENT / anesthesia, then **surgical incision & drainage**; send pus for culture.[434]

NO — cellulitis / small abscess

A **48-hour trial of IV antibiotics first** — many children resolve without surgery. Re-image and drain if not improving.[434]

Ceftriaxone + clindamycin — first line

DOSE

Ceftriaxone 50 mg/kg once daily (max 2 g) clindamycin 10 mg/kg/dose every 8 h (max 900 mg/dose)

ROUTE & NOTES

IV; together cover group A streptococcus, oral anaerobes, Gram-negatives and MRSA (methicillin-resistant *Staphylococcus aureus*) — Kuwait Pediatric Council antibiotic policy.[27,214]

Amoxicillin- clavulanate — second line

DOSE

30 mg/kg/dose of co-amoxiclav (= amoxicillin 25 mg/kg + clavulanate 5 mg/kg) every 8 h IV (max 1.2 g/dose = amoxicillin 1 g + clavulanate 200 mg)

ROUTE & NOTES

IV alternative when the first line is unsuitable. No oral amoxicillin-clavulanate step-down at standard dose — it does not cover *S. pneumoniae* adequately; choose the oral step-down agent with infectious diseases/ENT per the Council policy.[27]

ADMIT · DISCHARGE · REFER

- **Admit** — all suspected retropharyngeal abscess for IV antibiotics and observation; a monitored bed if there is any airway concern.
- **Home from the ward** — not from the acute phase; step to an oral agent chosen with infectious diseases/ENT (per the Council policy) once afebrile, improving and swallowing, with ENT follow-up.
- **Refer — now** — ENT for drainage and **anesthesia** for airway control; a screening lateral neck film only if it will not delay a needed CT or airway management.

Difficult Airway MINUTES

Oxygenate first, then work the three zones — optimize (yellow) → intubate (green) → front-of-neck (red); change one thing with every attempt.

ANTICIPATE & PREPARE

- **Predictors:** craniofacial anomaly / syndrome (Pierre Robin, Treacher Collins, Goldenhar, Down), limited mouth opening or neck movement, deep-neck infection or airway swelling (retropharyngeal abscess, epiglottitis, angioedema, burns), stridor, a large tongue, or a previously documented difficult airway.[436]
- **Anticipated** — manage in a **controlled setting (PICU / OR)** with **ENT + anesthesia back-up available**. **Unanticipated** (ineffective bag-mask ventilation, or a failed first direct / video laryngoscopy (DL / VL) attempt) — **call for help now**.[436,437]
- **Muscle relaxants** at the discretion of anesthesia / PICU. **Keep spontaneous breathing** (minimal sedation or inhalational anesthesia) where muscle tone is holding the airway open — anterior mediastinal

mass, epiglottitis, large tongue, deep-neck abscess, or known impossible mask ventilation.[438,439]

- **Prepare:** assign the team (1st + 2nd airway managers, assistant, respiratory therapist, drug nurse, circulating nurse); a **time-out** to agree **Plan A + B + C** (1st / 2nd intubator and technique, and the surgical-airway option, with personnel and equipment ready); check equipment and drugs; full monitoring; assess the airway (history + exam).[439]

⚠ OXYGENATION IS THE GOAL — NOT THE TUBE

- Pre-oxygenate fully and keep **apneic oxygenation** (nasal cannula / high-flow nasal cannula (HFNC)) running through every attempt.
- Change **one variable** with each attempt — operator, device, blade, position, or adjunct — rather than repeating the same one. **If in doubt, take it out** and oxygenate.[437,438]

THE THREE-ZONES APPROACH (KUWAIT ALGORITHM)[440]

✦ FOR THE GENERAL PEDIATRICIAN

Recognize the predictors, keep the child oxygenated (yellow zone) and **call anesthesia/ENT early**. The green and red zones below are the airway team's work — shown so you can anticipate and assist, not to lead.

● **YELLOW ZONE · OPTIMIZE** — make bag-mask ventilation effective: **position** (head tilt / chin lift, jaw thrust; **shoulder roll if < 2 yr**), suction, **100% FiO_2**, change mask size / adjust the seal, **two-person bag-mask ventilation (BMV)**, insert a nasogastric tube (NGT). Add an **oropharyngeal / nasopharyngeal airway (OPA / NPA)**. Add a **supraglottic airway (laryngeal mask airway, LMA)** if ventilation is still ineffective.[437,438]

`saturated & stable`

● **GREEN ZONE · INTUBATE** — intubate when **this is the best saturation you can get and the child is as stable as possible**. **Videolaryngoscopy** with an **age-adapted standard blade** is the first choice (use a stylet with a hyperangulated blade);[438,441] **max 4 attempts total (DL + VL)**. Between attempts change **operator** or **blade** (straight / curved / hyperangulated), add a **bougie** or a **flexible intubation scope (FIS)** — through a supraglottic airway, via the nasal route, or by a hybrid technique (FIS guided by the videolaryngoscope view) — or try a **smaller endotracheal tube (ETT)**. Keep **apneic O_2** (NC / HFNC) running and **treat laryngospasm**. **If oxygenation falls or the patient deteriorates → go back to the yellow zone** and re-optimize.[437,439]

`can't intubate, can't ventilate`

● **RED ZONE · CAN'T INTUBATE, CAN'T VENTILATE (CICV)** — declare it early. **ENT available:** rigid bronchoscopy ventilation or tracheostomy. **ENT not available: child ≥ 1 yr — needle (cannula) cricothyrotomy / cricotracheal puncture** with pressure-limited oxygen; percutaneous cricothyrotomy, or a surgical "slash" cricothyrotomy (scalpel technique), in the older child (usually from about 12 years, when the cricothyroid membrane is easily felt) by trained hands[16]. **Neonate or infant < 1 yr** — needle and surgical cricothyrotomy are unreliable (ESAIC/BJA 2024): the most competent operator available performs an **emergency surgical tracheostomy**; consider ECMO where it exists. **Call for help if it has not arrived.**[437,439]

✦ **CONFIRM PLACEMENT**

On successful intubation, confirm the tube **primarily with continuous waveform capnography ($EtCO_2$)**; support with equal chest rise, rising SpO_2, bilateral air entry on auscultation, misting of the tube, and a chest X-ray with the tip in the mid-trachea — midway

between the inferior clavicular border and the carina (too shallow above the clavicle, too deep at or below the carina; malposition is found in about one in five children despite normal clinical signs); in extremely preterm infants keep the tip at T1–T2.[438,828,829,830]

HAVE READY (DIFFICULT-AIRWAY CART)

Videolaryngoscope (standard + hyperangulated blades), a range of tubes, bougie and stylets, supraglottic airways (LMA) in graded sizes, a **flexible intubation scope (FIS)**, and a **front-of-neck-access / cricothyrotomy kit** — checked and immediately available before induction.[439]

Bronchiolitis

HOURS · < 2 YR

Viral (e.g., RSV): coryza → cough, fast breathing, wheeze/crackles, feeding difficulty.

SUPPORTIVE CARE IS THE TREATMENT

- Superficial nasal suction when secretions impair breathing or feeding (avoid routine deep suction);

small frequent feeds; NG or IV fluids if intake under 50–75% or dehydrated.[442]

- Give oxygen for persistent SpO_2 < 90% (consider < 92% in young infants, prematurity, cardiac/lung disease, or severe work of breathing).[442,443]

Mild

CLINICAL FEATURES

Normal behavior; normal or mildly fast breathing; no or mild chest recession; no apnea; feeding normally[840]

SUPPORT AND SETTING

No oxygen; emergency department or primary care[442]

Moderate

CLINICAL FEATURES

Intermittent irritability; fast breathing; moderate chest recession, tracheal tug or nasal flaring; may have brief apneas; reduced or difficult feeding[840]

SUPPORT AND SETTING

Fluid support (NG or IV) and/or oxygen — low-flow nasal cannula first, **high-flow only after low-flow fails**; ward (or PICU per local pathway)[442,444,445]

Severe

CLINICAL FEATURES

Increasing irritability, lethargy or fatigue; marked increase or decrease in breathing rate; marked recession, tracheal tug or nasal flaring; frequent or prolonged apneas; hypoxemia that may not correct with oxygen; reluctant or unable to feed[840]

SUPPORT AND SETTING

High-flow before CPAP; HDU/PICU[442]

- Oxygen follows the SpO_2 threshold above, not the severity grade.[442]

✦ PEARL — FIRST WHEEZE VS THE MIMICKERS

A **first** episode of wheeze with coryza in a child under 12 months in the bronchiolitis season is bronchiolitis. **Recurrent or episodic** wheeze, a strong atopic or family history, or wheeze that responds well to a bronchodilator points instead to viral-induced wheeze or pre-school asthma; **persistent focal signs** raise a retained foreign body or a structural airway lesion; and an infant who is failing to feed with hepatomegaly or a murmur may have **heart failure**, not bronchiolitis.[443]

✕ NOT ROUTINELY RECOMMENDED

Bronchodilators (salbutamol, epinephrine), corticosteroids, nebulized

hypertonic saline, antibiotics, chest physiotherapy, routine chest X-ray or viral testing.[442,443] **Red flags:** apnea, grunting, severe recession, SpO_2 < 90%, dehydration, age < 3 months (highest risk < 10 weeks), comorbidity.

◈ RSV IMMUNOPROPHYLAXIS — WHO QUALIFIES (AAP 2026)

- **First season, all infants < 8 months** born during or entering the RSV season: one dose of a long-acting monoclonal antibody (nirsevimab or clesrovimab), unless the birthing parent received the RSV vaccine (RSVpreF) **≥ 14 days before delivery**. Infants born in season: give **within the first week of life, ideally before discharge** from the birth hospital.[844]
- **Second season, 8–19 months, high-risk only:** born < 32 weeks; chronic lung disease of prematurity (or other significant neonatal lung disease) needing steroids, diuretics or oxygen in the previous 6 months; hemodynamically significant congenital heart disease; anatomic pulmonary abnormality or neuromuscular disorder;

severe immunocompromise; Down syndrome or other chromosomal difference raising RSV risk; cystic fibrosis with severe lung disease or weight-for-length < 10th centile.[844]

- **Doses per label:** nirsevimab 50 mg (< 5 kg) or 100 mg (≥ 5 kg) IM in the first season, 200 mg in the second; clesrovimab 105 mg IM in the first season — a single 210 mg dose before the second season was well tolerated in high-risk children (RSV lower respiratory infection 7.3% through day 180).[844,845]

ADMIT · DISCHARGE · REFER

- **Admit** — SpO_2 persistently < 90% (< 92% in high-risk infants), apnea, intake under 50–75% or dehydration, marked work of breathing — especially if high-risk (age < 3 months — risk highest in the youngest; the Australasian guideline flags < 10 weeks — prematurity, or cardiopulmonary disease).
- **Home** — (NICE NG9, 2021) clinically stable; taking adequate oral fluids; SpO_2 in room air maintained **for 4**

hours including a period of sleep: **> 90% if ≥ 6 weeks old**, **> 92% if < 6 weeks or any underlying health condition**; work of breathing settling; carers confident, with written safety-netting (worsening work of breathing, intake 50–75% of normal or no wet diaper for 12 h, apnea or cyanosis, exhaustion) and a clear route back.[442,446,447]

- **Refer — now** — PICU (for escalation to high-flow nasal cannula or continuous positive airway pressure (CPAP)) for rising work of breathing, recurrent apnea, or hypoxia despite oxygen.

◈ SEE ALSO **Community-Acquired Pneumonia**, **Complicated Pneumonia / Empyema**, **Pertussis** and **BRUE** in Section 04.

Community-Acquired Pneumonia

HOURS CPS 2024

The healthy, immunized child with fever, cough, and tachypnea — treat *S. pneumoniae*, mostly orally, and keep it short.

RECOGNIZE & ASSESS SEVERITY

- Acute fever + cough + **tachypnea** (the most useful sign; respiratory rate for age — see **Normal Vital Signs by Age**) ± increased work of breathing, chest or abdominal pain, poor feeding. Wheeze + hypoxia points to bronchiolitis or asthma, not bacterial CAP.[448]
- Check SpO_2 in everyone — hypoxemia may not be clinically obvious; **give oxygen for sustained SpO_2 < 90%** (PIDS/IDSA).[448]
- **Likely cause by age:** infants/preschool — mostly **viral** (RSV, influenza, human metapneumovirus); *Streptococcus pneumoniae* is the leading bacterial cause at all ages; school-age — add atypicals (*Mycoplasma*, *Chlamydophila*).[448]

◈ **KEEP INVESTIGATIONS TARGETED**

- A chest radiograph is not essential for a non-severe outpatient with a typical picture; obtain posteroanterior + lateral when the diagnosis is uncertain or the child is admitted (extent, effusion, abscess).[449]
- Do not image typical bronchiolitis or asthma.
- In hospitalized children: complete blood count (CBC)/C-reactive protein (CRP) + blood culture before antibiotics; consider respiratory viral testing in influenza season. If influenza is suspected or confirmed in moderate–severe or hospitalized CAP, **START OSELTAMIVIR AT ONCE — DO NOT WAIT FOR THE RESULT** (most benefit within 48 h; still treat later if severe): age ≥ 1 yr — ≤ 15 kg 30 mg, > 15–23 kg 45 mg, > 23–40 kg 60 mg, > 40 kg 75 mg; infant 2 wk to < 1 yr — 3 mg/kg/dose; all PO twice daily for 5 days.[448,449]

DECISION

Outpatient or admit?

OUTPATIENT · NON-SEVERE

Well-hydrated, tolerating oral intake, no respiratory compromise. **Oral amoxicillin** is the mainstay — high-dose covers *S. pneumoniae*. Most do not need a chest radiograph.

ADMIT

Inadequate oral intake or intolerance, **hypoxemia / grunting / nasal flaring / apnea**, severe or complicated pneumonia, or **age < 6 months**. Start **IV ampicillin**.

Amoxicillin (oral) or ampicillin (IV) is first-line — cover *S. pneumoniae*.

EMPIRIC THERAPY

Amoxicillin — outpatient, first-line

DOSE

25–30 mg/kg/dose PO q8h (max 4 g/day)

NOTES

Drug of choice for non-severe CAP. **TID** dosing (not BID). 5 days is enough if responding.[449]

Ampicillin — admitted, first-line

DOSE

50 mg/kg/dose IV q6h (max 12 g/day)

NOTES

IV first-line for hospitalized, non–life-threatening CAP. Step down to oral amoxicillin on improvement.[449]

Ceftriaxone — severe / respiratory failure

DOSE

50 mg/kg/dose IV q12–24h (max 2 g/dose)

NOTES

For respiratory failure or septic shock (or cefotaxime 50 mg/kg/dose q6–8h). Broader cover incl. β-lactamase *H. influenzae*.

+ Vancomycin — if MRSA suspected

DOSE

15 mg/kg/dose IV q6h

NOTES

Add for rapidly progressing multilobar disease or pneumatoceles until cultures return; send nasal MRSA screen first; stop if MRSA excluded.

Azithromycin — atypical (*Mycoplasma*)

DOSE

10 mg/kg (max 500 mg) on day 1, then 5 mg/kg (max 250 mg) once daily on days 2–5

NOTES

School-age with atypical features. Macrolide resistance rising; doxycycline is an alternative from 8 years (CPS).[449]

⚠ DURATION, COURSE & FOLLOW-UP

- **5 days** for non-severe CAP (ambulatory, or admitted and responding within 24–36 h); **7–10 days** for more significant disease.[449]
- Expect improvement (appetite, fever, tachypnea, O_2 need) within **48 h**.[449]
- If **not improving by 48–72 h** → re-image (radiograph/ultrasound) for empyema or abscess and reconsider the diagnosis (foreign body, tuberculosis, atypical).[449]
- Routine end-of-therapy radiograph is not needed — radiographic clearance lags 4–6 weeks.[448]

ADMIT · DISCHARGE · REFER

- **Admit** — hypoxia (sustained SpO_2 < 90%)[448], respiratory distress, dehydration or feeding failure, a moderate-to-large effusion or empyema (a small effusion in a well child may be treated as CAP with early review — see **Complicated Pneumonia**), or failure of outpatient therapy.
- **Home** — well child maintaining saturations in air, feeding, on oral antibiotics with follow-up arranged.
- **Refer — now** — PICU for respiratory failure or sepsis; surgical or respiratory review for empyema or non-resolving disease.

◈ **DIFFICULT IV ACCESS?** Reassess for an early IV→oral switch at every line failure rather than re-sticking — see **IV → Oral Switch & the DIVA Patient** (Quick Reference).

Complicated Pneumonia — Empyema

HOURS IDSA/PIDS 2026 · CPS 2024

Pneumonia + pus or a moderate-to-large pleural effusion — antibiotics plus, when needed, drainage with a fibrinolytic.

◈ DEFINITION & STAGES

- Empyema = intrapleural pus, or a moderate-to-large exudative parapneumonic effusion.
- It evolves: **STAGE 1** exudative (free-flowing) → **STAGE 2** fibrinopurulent (loculated) → **STAGE 3** organized (thick fibrinous peel)[450].
- Small parapneumonic effusions are common in uncomplicated pneumonia and do **NOT** need drainage.[450]
- Lung abscess and necrotizing pneumonia are separate complications.

◣ RECOGNIZE & DIAGNOSE

- Suspect it when an initially uncomplicated pneumonia is **poorly responsive** — persistent fever after 48–72 h, worsening distress or

hypoxia, or new effusion signs (decreased breath sounds, dullness, reduced expansion).

- **Imaging:** chest radiograph first, then **chest ultrasound** (confirms effusion, estimates size, distinguishes free-flowing from loculated). Computed tomography (CT) is not routine — reserve for a suspected alternative diagnosis (e.g., malignancy).[450]
- **Pathogens:** *S. pneumoniae* (most common), *S. aureus* (incl. MRSA), *S. pyogenes* (group A streptococcus). Send drained fluid for **culture and Gram stain** (± pneumococcal PCR where available); blood cultures positive in only ~10%[450]. Labs often show high white-cell count/ESR/CRP, thrombocytosis, hypoalbuminemia — these normalize with recovery.

DECISION

How big is the effusion, and how sick is the child?

SMALL / MILD — ANTIBIOTICS ALONE

Small effusion, mild distress, no mediastinal shift → a trial of **antibiotics alone** is reasonable with close monitoring.

MODERATE–LARGE / COMPROMISE — DRAIN

Moderate-to-large effusion, significant respiratory distress, or mediastinal shift → **drainage plus antibiotics**, early. Consult thoracic surgery / interventional radiology promptly.

DRAIN WHEN

Moderate-to-large effusion or empyema causing respiratory compromise, or occupying much of the hemithorax ± **mediastinal shift**; **loculated (stage 2) or organized** collection on ultrasound, or frank **pus** on aspiration; or **failure of antibiotics alone** (not improving, or progressing, after an adequate trial).

FIBRINOLYTIC (ALTEPLASE / TPA)

- First-line, most cost-effective drainage = **SMALL-BORE (≤ 12 FR) PERCUTANEOUS CHEST TUBE + INTRAPLEURAL FIBRINOLYTIC**, preferred over surgical debridement (VATS) in

most cases — reserve VATS for refractory disease or extensive loculation. **ALTEPLASE 4 MG IN 30–50 ML OF 0.9% SALINE** (40 mL in the trials; use a smaller volume in small infants per local protocol) instilled via the chest tube, **CLAMP/DWELL 1 HOUR, THEN DRAIN — ONCE DAILY FOR UP TO 3 DOSES**. **TPA ALONE IS NOW PREFERRED OVER TPA + DNASE** (no added benefit, higher cost).[450,451]

- Prescribe and label as **ALTEPLASE**.

ANTIBIOTICS FOR EMPYEMA

Cefotaxime / ceftriaxone — first-line

DOSE

Cefotaxime 50 mg/kg/dose q6–8h; ceftriaxone 50 mg/kg/dose q12–24h

NOTES

Empiric IV cover for the usual pathogens; choose per local antibiogram.[449,450]

+ Vancomycin — MRSA

DOSE

15 mg/kg/dose IV q6h

NOTES

Reserve for culture-proven or strongly suspected MRSA / severe disease.

Oral step-down — culture-negative

DOSE

Amoxicillin (high-dose) or amoxicillin-clavulanate

NOTES

Switch once drainage complete, improving, and off oxygen.

⚠ DURATION, COURSE & FOLLOW-UP

- Total **3–4 weeks** is reasonable with adequate drainage and no further complication; transition to **oral** at or just before discharge once drained, improving, and off oxygen. **Persistent fever > 72 h is common** and — if the child is otherwise improving — usually **not** treatment failure; serial CRP can confirm improvement.[450]
- Outcome is excellent: lung function and radiograph normalize over weeks–months (a repeat film at 2–3 months is reasonable).
- Watch necrotizing pneumonia for **bronchopleural fistula** → involve surgery / respirology / infectious diseases.[450]

ADMIT · DISCHARGE · REFER

- **Admit** — every child with a parapneumonic effusion or empyema (BTS 2005)[452], for IV antibiotics ± drainage.
- **Home from the emergency department** — not for a parapneumonic effusion or empyema: BTS 2005 advises admission for all.[452] A **small effusion in a well child** usually needs antibiotics only, no drainage.
- **Home from the ward** — not acutely; complete therapy with follow-up imaging.
- **Refer — now** — respiratory/surgery for drainage (chest drain ± fibrinolytics or VATS).

Choking (Foreign-Body Obstruction)

MINUTES

Sudden cough/stridor/one-sided wheeze with a choking history.

DECISION

Mild or severe obstruction?

MILD — effective cough

Coughing effectively, can speak/cry, adequate air movement → **encourage coughing, stay, monitor closely**; no back blows or thrusts.[453]

SEVERE — responsive

Weak or silent cough, cannot speak or cry, cyanosis or color change, altered consciousness, apnea → start maneuvers now. **Infant < 1 yr:** 5 back blows → 5 chest thrusts, repeat (no abdominal thrusts). *Back blows:* infant face down along your forearm, resting on your thigh, head lower than the chest; 5 sharp blows between the shoulder blades. *Chest thrusts:* turn the infant face up, head still low; 5 thrusts on the lower half of the sternum — like compressions but sharper — with the heel of one hand (AHA/AAP 2025) or two thumbs encircling (ERC 2025).[453,835] **Child ≥ 1 yr:** 5 back blows → 5 abdominal thrusts, repeat (AHA/AAP 2025 and ERC sequence).[5,453]

becomes unconscious

Start CPR. Check the mouth before breaths; remove the object only if visible. No blind finger sweeps. [453]

⚠ REMOVE NOW

- Foreign body in the larynx or trachea (central airway), stridor at rest, severe distress or cyanosis, or complete obstruction.
- **Call anesthesia/ENT/PICU early** and keep managing the child until they arrive: oxygenate, continue the maneuvers above, prepare laryngoscope and Magill forceps, and bring the front-of-neck-access kit to the bedside (local airway practice).

⚠ AIRWAY TEAM — COMPLETE OBSTRUCTION NOT RELIEVED BY MANEUVERS

- **Recognize:** cannot speak, cry or cough; clutching the neck; silent chest; paradoxical chest/abdominal movement; loss of consciousness. Act after two cycles of maneuvers fail or as soon as the child becomes unresponsive.[5]

- **1 · Laryngoscopy** — remove a visible object with Magill forceps (experienced clinician).[5]
- **2 · Not removable and rigid bronchoscopy available →** operating room now: removal by ENT/thoracic surgery with anesthesia.[454]
- **3 · Unstable, no immediate rigid bronchoscopy — act by level. At or above the cords:** remove under direct laryngoscopy (step 1); if that fails and the child cannot be oxygenated → **front-of-neck access as the last resort — follow the red zone of the Difficult Airway card** (ENT: tracheostomy).[835] **Below the cords:** push the object distally into **one main bronchus** (tube or rigid bronchoscope) to ventilate the other lung.[454]
- **Anesthetic principle:** prefer spontaneous breathing while the obstruction is **partial** (positive pressure can complete it); neither technique has been shown superior.[455]

STABLE CHILD — SUSPECTED INHALED

FOREIGN BODY

- **A convincing choking history mandates bronchoscopy even when the chest X-ray is normal** — only about 11% of inhaled objects are radio-opaque and the film is normal in about 17% of children[455].
- **Chest X-ray** (add a lateral view if an object is seen). Look for a radio-opaque object, unilateral air trapping, atelectasis, mediastinal shift or infiltrate; **a normal film does not exclude an inhaled foreign body**. CT (virtual bronchoscopy) has a role only in a stable, cooperative child with low suspicion; with a convincing history, go to bronchoscopy.[454]
- **Removal is by rigid bronchoscopy** (the gold standard), **by ENT or thoracic surgery** with an experienced anesthesia team, promptly — a stable child may wait for daytime or transfer to a specialist unit. Flexible bronchoscopy can diagnose and, in experienced centers, retrieve; **the flexible scopes in our hospitals are not retrieval instruments.**[454,455]

ADMIT · DISCHARGE · REFER

- **Admit** — after removal, observe for airway injury/aspiration; any hypoxia, stridor, or incomplete relief → ED/PICU.
- **Home** — only when a **retained foreign body has been excluded** (by bronchoscopy, or by ENT/respiratory review with follow-up arranged); a child can be fully recovered with an effective cough, normal examination and normal SpO_2 and still have a retained object.[454]
- **Refer — now** — ENT/anesthesia for suspected retained foreign body → rigid bronchoscopy.

Obstructive Sleep Apnea ASSESS

AAP · ERS

Flagged here for its acute peri-operative airway risk (post-adenotonsillectomy compromise, opioid/sedation sensitivity). Habitual snoring and witnessed apnea; by day, hyperactivity in young children, sleepiness and falling school performance in older ones.

RECOGNIZE

- **Obstructive sleep apnea (OSA)** — habitual snoring (≥ 3 nights/week), witnessed apnea or gasping, restless sleep, mouth breathing, enuresis; by day — **hyperactivity and inattention in toddlers and preschoolers**; **daytime sleepiness** (in the car or class), poor concentration and **declining school performance** in older children. Peak 2–8 years (adenotonsillar hypertrophy).[456]
- **High-risk groups:** obesity, Down syndrome, craniofacial anomalies, neuromuscular disease, Prader-Willi, achondroplasia, mucopolysaccharidoses, sickle cell disease.[456,457]

- **Work-up is elective, not an emergency task:** refer to ENT and to pediatric pulmonology for a sleep study.[458,459] Chronic treatment is decided in clinic.[456,457]

RED FLAGS

- **Severe OSA** — AHI ≥ 10 obstructive events/h and/or nadir SpO_2 < 80% (the AAO-HNS definition used for peri-operative risk)[460]; nocturnal desaturations or hypoventilation.
- **Cor pulmonale / pulmonary hypertension**, failure to thrive — complex, high-risk: refer to a specialist.
- **Cardiorespiratory failure cannot await elective evaluation** — treat urgently.[456]

⚠ PERI-OPERATIVE & ACUTE CARE — THE BEDSIDE PRIORITY

- **Post-adenotonsillectomy respiratory compromise:** anesthesia to assess, and consult PICU for any need for respiratory support.
- **Admit overnight** after tonsillectomy if **< 3 years**, **severe**

OSA (AHI ≥ 10/h and/or SpO_2 nadir < 80%), or a comorbidity: obesity, craniofacial anomaly, neuromuscular disorder, cardiac complications of OSA, current respiratory infection, failure to thrive.[456,460] **Opioids: no codeine or tramadol after tonsillectomy/adenoidectomy under 18 years** (FDA); ibuprofen and/or acetaminophen are the first-line analgesics.[134,460]

- In moderate-to-severe OSA, minimize opioids and monitor closely — children with recurrent nocturnal hypoxemia (nadir SpO_2 < 85%) needed **about half the morphine dose** of children with a nadir ≥ 85% for the same analgesia in a small prospective blinded study (n = 22), so start low and titrate with monitoring.[456,461]
- Position ramped, keep airway adjuncts and CPAP ready.

✦ PEARL — SNORING AND BEHAVIOR

A snoring toddler or preschooler who is hyperactive and inattentive may have OSA, not just a behavior problem; in an older child, look for daytime sleepiness

and falling grades. Ask about snoring and witnessed apnea at every visit.

ADMIT · DISCHARGE · REFER

- **Admit** — from the emergency department: cardiorespiratory compromise, cor pulmonale or severe hypoventilation. After adenotonsillectomy: admit overnight if < 3 years, severe OSA or a comorbidity (above).[456,460]
- **Home from the emergency department** — all others, with an urgent outpatient sleep study and ENT referral (severe OSA alone is an urgent outpatient, not an admission).[456]
- **Home from the ward** — after adenotonsillectomy, when overnight admission is not indicated: discharge per anesthesia/ENT.[456,460]
- **Refer — clinic** — ENT (adenotonsillectomy) and pediatric pulmonology (sleep study); cardiology if pulmonary hypertension. OSA persists after adenotonsillectomy in up to 40% — re-refer to pediatric pulmonology/ENT if snoring or symptoms continue (options include

CPAP, weight management, sleep endoscopy-guided surgery and rapid maxillary expansion).[462]

Cow's Milk Protein Allergy ASSESS

INFANT · ESPGHAN 2024 · WAO DRACMA 2023–24 · CPS 1

The commonest infant food allergy — IgE-mediate (immediate) or non-IgE (delayed, cell-mediated). Over-diagnosis is common.

◈ SEE ALSO **Acute FPIES** (vomiting 1–4 h after a food — criteria and emergency treatment).

RECOGNIZE THE TWO PATTERNS

- **IgE-mediated (minutes–2 h):** urticaria, angioedema, vomiting, wheeze, anaphylaxis.[463] **Testing:** skin-prick test or specific IgE to cow's milk when the history suggests an immediate reaction — a positive result may indicate sensitization only; **allergy referral is indicated**.[464]
- **Non-IgE (hours–days):** blood or mucus in the stool, eczema flare, faltering growth, chronic diarrhea;

reflux, colic, loose stools or constipation — **these four are, on their own, common in healthy infants.**[464] Distinct from lactose intolerance (an enzymatic, non-immune condition).[465]

- **Confirming non-IgE disease:** a **2–4-week diagnostic elimination** (maternal cow's-milk-free diet if breastfed; extensively hydrolyzed formula if formula-fed) **followed by planned reintroduction** — improvement alone is not enough, because up to 20% of breastfed infants with blood in the stool settle with no change at all.[464] FPIES is the exception: a typical history with resolution on withdrawal is sufficient; a supervised challenge, in a medical facility and according to protocol, only if the history is unclear.[464]

⚠ WHEN TO START AN ELIMINATION – OBSERVE FIRST

- **Start a 2–4-week diagnostic elimination** for: severe or persistent bleeding; faltering growth; moderate–severe eczema not responding to treatment; or a strong overall picture of CMPA.[464]

- Unneeded maternal elimination shortens breastfeeding, and therapeutic formulas taste different and may shape later food preferences — both are reasons to hold the threshold.[464]

NON-IGE SUBTYPES — RECOGNIZE THE PATTERN

- **Food protein-induced allergic proctocolitis (FPIAP)** — a well-appearing infant with blood/mucus streaks in the stool, onset **2–8 weeks**; the most common subtype; up to 50% of affected infants are breastfed; mostly benign and self-limiting.[464,465]
- **Food protein-induced enteropathy (FPE)** — chronic diarrhea **with** faltering growth and malabsorption (steatorrhea, hypoalbuminemia, anemia); emesis and distension may accompany. A thriving infant with loose stools alone does not have FPE. Uncommon. If the picture fits and CMPA is likely, start the elimination and expect improvement within 1–4 weeks; refer to pediatric GI — endoscopy with biopsy (villous atrophy, crypt hyperplasia) confirms the diagnosis and is prioritized when

response is poor, features are severe or another cause is suspected. Exclude infection with stool studies and cystic fibrosis with a sweat test; celiac testing applies only once gluten is in the diet.[465,466,467]

- **Food protein-induced enterocolitis syndrome (FPIES)** — profuse **repetitive vomiting 1–4 h after the food**, pallor, lethargy ± diarrhea; ~15% develop hypovolemic shock. Rare; mimics sepsis. Criteria and acute treatment: **Acute FPIES**.[415]

MANAGEMENT — BY FEEDING & SUBTYPE (EVERY ELIMINATION IS A 2–4-WEEK DIAGNOSTIC TRIAL, THEN REINTRODUCE TO CONFIRM)

IgE-mediated — anaphylaxis

FIRST CHOICE

Amino acid formula (AAF)

NOTES

DRACMA XVI advises AAF for severe cow's milk allergy; this guide applies that to anaphylaxis and starts AAF from the outset.[468]

IgE-mediated — milder immediate reaction

FIRST CHOICE

Extensively hydrolyzed formula (EHF)

NOTES

Step up to AAF only per the rule in the Avoid box below.[464]

IgE-mediated, breastfed

FIRST CHOICE

`Continue breastfeeding`

NOTES

If the infant is symptom-free on breast milk, **no maternal elimination**; eliminate maternal cow's milk only if the infant reacts while exclusively breastfed.[469]

Mixed-fed (breast + formula)

FIRST CHOICE

`Change the formula; keep breastfeeding`

NOTES

If symptoms occur only with formula and the infant is well on breast milk, use EHF (or AAF per the rows above) and **do not restrict the mother's diet** — IgE-CMPA and FPIES.[415,469] For FPIAP/FPE the same approach is reasonable; add maternal elimination only if symptoms persist on breast milk alone.

FPIAP, breastfed — threshold met

FIRST CHOICE

`Maternal cow's-milk-free diet`

NOTES

Cow's milk (and other mammalian milks) first; **remove soy from the maternal diet only if no response** after 2–4 weeks (CPS removes both from the start; ESPGHAN cow's milk only).[464,465] Continue breastfeeding; dietitian for calcium and vitamin D.

FPIAP, formula-fed — threshold met

FIRST CHOICE

Extensively hydrolyzed formula (EHF); amino acid formula (AAF) if no response

NOTES

Whether to eliminate at all in formula-fed FPIAP is debated (a cohort linked it to later IgE-CMPA); if started, reintroduce afterwards.[464] Soy formula is an option > 6 months if tolerated.[465]

FPE, breastfed

FIRST CHOICE

Maternal cow's-milk-free diet, 2–4 wks

NOTES

Remove soy from the maternal diet if no response; monitor growth and nutrition — resolution takes weeks. No improvement → AAF and pediatric GI.[465,466]

FPE, formula-fed

FIRST CHOICE

Amino acid formula (AAF)

NOTES

First-line (not EHF) given the malabsorption; pediatric GI.[465]

FPIES, breastfed

FIRST CHOICE

Continue breastfeeding

NOTES

Rare in this group. If reacting to breast milk or faltering: maternal elimination of the trigger with allergy input; if unresolved, **consider** stopping breastfeeding → EHF/AAF.[415]

FPIES, formula-fed

FIRST CHOICE

`EHF first; AAF if no improvement in 2 wks`

NOTES

10–20% need AAF from the start; AAF preferred if faltering. Strictly avoid **all forms** (incl. heated/baked) of the trigger.[415]

⚠ AVOID & WHO DECIDES

- **Avoid:** goat's / sheep's milk (high cross-reactivity) and partially hydrolyzed / “comfort” or “HA” formulas.[464]
- **Step up:** EHF → AAF only after 2–4 weeks without response **and** after checking the diet for hidden milk and reconsidering the diagnosis; AAF is first-line only for anaphylaxis, FPIES with faltering growth, or FPE.[464,465]
- **Who decides:** the treating pediatrician may start EHF or a maternal trial; the step to AAF and any prolonged maternal elimination are confirmed with allergy/GI, with a dietitian monitoring calcium and growth.

✦ **RE-CHALLENGE**

After a confirmed diagnosis, the timing and setting of re-challenge are **planned by the specialist** (allergy or pediatric GI). FPIES: supervised challenge — see **Acute FPIES**.

◣ **ADMIT · DISCHARGE · REFER**

- **Admit** — from the emergency department: IgE-mediated reaction with anaphylaxis (manage, observe and admit per **Anaphylaxis**); acute FPIES with lethargy, dehydration or shock (see **Acute FPIES**).
- **Home from the emergency department** — after assessment: the well infant with blood-streaked stool, mild immediate symptoms that have resolved, or chronic symptoms — with the observe-first advice above, written warning signs, and clinic follow-up within 2–4 weeks; start a diagnostic elimination only if the threshold is met.
- **Home from the ward** — once feeding and growing, with the dietary plan, dietitian review and the reintroduction date written down.
- **Refer — now** — allergy for anaphylaxis (urgent).

- **Refer — clinic** — allergy: IgE-mediated disease for testing and challenge, FPIES, multiple food allergies; pediatric GI: FPE, faltering growth, no response to EHF, diagnostic doubt; dietitian for every infant on an elimination diet.

◈ **BASIS** ESPGHAN 2024 position paper[464]; WAO DRACMA VII (2023, elimination and reintroduction)[463], X (2023, breastfeeding)[469] and XVI (2024, nutritional management)[468]; Canadian Paediatric Society 2024 (non-IgE subtypes)[465]; international FPIES consensus 2017[415]. Where CPS and ESPGHAN differ (maternal soy; observation before elimination) the card follows ESPGHAN and says so.

Acute FPIES (Food Protein-Induced Enterocolitis Syndrome)

HOURS · INFANT · FPIES CONSENSUS 2017

Repetitive vomiting 1–4 h after a food, with pallor and lethargy — a non-IgE reaction that mimics sepsis; fluids and ondansetron, not epinephrine.

RECOGNIZE — 2017 INTERNATIONAL

CRITERIA

- **Major criterion (required):** vomiting 1–4 h after ingestion of the suspect food **and** no classic IgE-mediated skin or respiratory symptoms.[415]
- **Plus ≥ 3 minor criteria:** a second episode after the same food · repetitive vomiting 1–4 h after a different food · extreme lethargy · marked pallor · emergency-department visit · need for IV fluids · diarrhea within 24 h (usually 5–10 h) · hypotension · hypothermia.[415]
- **Triggers:** cow's milk and soy in infants; rice and oat are the commonest solids; also egg, fish, poultry, vegetables. Onset is usually with the first exposures to formula or solids, typically at **2–7 months**.[415,470]
- **Looks like:** sepsis, surgical abdomen, gastroenteritis, metabolic crisis. Clues: the timing after a new food, a well child an hour earlier, rapid recovery with fluids. Blood tests may show neutrophilia, thrombocytosis, acidosis and methemoglobinemia.[415,470]

ACUTE MANAGEMENT BY SEVERITY (FPIES CONSENSUS 2017)

Mild

FEATURES

1–2 vomits, no lethargy

TREATMENT

Oral rehydration — breastfeeding or clear fluids; if ≥ 6 months, ondansetron IM 0.15 mg/kg (FPIES consensus max 16 mg; this guide caps a single pediatric dose at 8 mg — see **Gastroenteritis**) may be considered. Can resolve at home.[415]

Moderate

FEATURES

≥ 3 vomits, mild lethargy

TREATMENT

Ondansetron IM/IV 0.15 mg/kg (FPIES consensus max 16 mg; this guide caps a single pediatric dose at 8 mg — see **Gastroenteritis**); consider IV access and **0.9% saline 20 mL/kg**, repeated as needed; monitor vital signs and observe for at least 4–6 h from onset, until tolerating fluids.[415]

Severe

FEATURES

≥ 3 vomits with severe lethargy, hypotonia, ashen or cyanotic appearance, hypotension

TREATMENT

IV access; **0.9% saline 20 mL/kg rapidly, repeat as needed**; **ondansetron IV 0.15 mg/kg** (FPIES consensus max 16 mg; this guide caps a single pediatric dose at 8 mg — see **Gastroenteritis**); consider **methylprednisolone IV 1 mg/kg** (max 60–80 mg); blood gas, electrolytes, glucose, CBC; correct acid–base and electrolyte abnormalities and methemoglobinemia; manage as shock (see **Shock**).[415]

⚠ PITFALLS

- **Epinephrine does not treat FPIES** (not IgE-mediated); give it only if anaphylaxis cannot be excluded — see **Anaphylaxis**.
- Do not label a sepsis-like infant as FPIES until the timing fits and infection has been considered; when in doubt treat for both.
- Ondansetron ≥ 6 months only; monitor the QT interval if repeated (QTc).

ADMIT · DISCHARGE · REFER

- **Admit** — severe reaction, hypotension, ongoing vomiting or lethargy, or dehydration.
- **Home from the emergency department** — mild reaction: tolerating oral fluids and well after about 4–6 h of observation from the onset of the reaction. Moderate reaction: observe in the emergency department for at least 4–6 h from onset, until drinking and lethargy has resolved, then home. Both with a written plan to avoid the trigger in **all forms** and to return for repetitive vomiting after any new food.
- **Refer — clinic** — allergy for every new diagnosis (trigger confirmation, written emergency plan, supervised re-challenge usually 12–18 months after the last reaction); dietitian when a staple food is removed. Chronic feeding choices: see **Cow's Milk Protein Allergy**.[415,465,470]

◈ **BASIS** International consensus guidelines for FPIES (Nowak-Węgrzyn 2017)[415]; ESPGHAN 2024 for the diagnostic approach.[464]

Antibiotic Allergy Assessment & Pretesting

ASSESS

Most allergy labels are false. Take a history, don't routinely skin-test, and de-label when you can.

THE LABEL IS USUALLY WRONG

- About **10% of people** carry a penicillin/beta-lactam allergy label, but **~90% are not truly allergic**: only **5–10%** of children with a “penicillin allergy label” have a true penicillin allergy.[471]
- Most labels accumulate from **non-allergic events** — GI upset, headache, family history, or a viral rash during treatment.
- In children, a **maculopapular rash is more often viral than allergic**.[471]
- Routine pre-dose intradermal **"test dosing" is not standard of care, not validated, and should be abandoned** — it delays therapy and misleads (a positive skin test over-diagnoses allergy — its positive

predictive value is below 100%; it misses dose-independent and enteral reactions).[472]

◈ WHY MISLABELING HARMS

A beta-lactam label drives **second-line agents** (vancomycin, clindamycin, fluoroquinolones) that are less effective, broader, and costlier — linked to more *C. difficile* (+23%), **MRSA** (+14%) and **vancomycin-resistant enterococci (VRE)** (+30%) infections and longer hospital stays (Macy & Contreras, J Allergy Clin Immunol 2014)[473], and to more surgical-site infections. **No reaction history — or a beta-lactam tolerated since — give the drug. No skin test required.**[472]

◣ RISK-STRATIFY THE HISTORY — SEVERITY, TIMING, DRUG CLASS, AND ANY BETA-LACTAM TOLERATED SINCE

◈ READING THE TIERS

- Assign the **highest** tier any feature reaches — one high-risk feature makes the patient high-risk.
- Risk rises with reaction **severity** (intolerance → hives → anaphylaxis / severe delayed),

immediacy (delayed benign → immediate IgE), and **recency** (remote → recent). **None / Low** → give the drug or refer for an allergist-supervised oral challenge; **Medium** → skin test ± challenge, pick a non-cross-reacting **oral** beta-lactam meanwhile; **High** → avoid the culprit, refer, do not challenge.

- The pediatric category method is preferred[471]; adult scores (e.g., the PEN-FAST penicillin-allergy score) are not robustly validated in children[474]. **The table below applies to a child with a reported penicillin allergy (cephalosporin allergy excluded).**[471]

History not consistent with allergy

HISTORY (ANY OF)

No previous allergic reaction; side effects / intolerance only (GI upset, headache); a reaction history but tolerated the antibiotic since the index event; family history only.

ACTION

De-label the record. Give penicillin if indicated.

Low

HISTORY (ANY OF)

Benign, non-severe delayed reaction — e.g., maculopapular rash starting ≥ 3 days into the course, with no mucosal, blistering, systemic or organ involvement.

ACTION

Oral amoxicillin challenge under allergist supervision (skin testing not required). Tolerated → **de-label** the record; give penicillin when indicated.[471]

Medium

HISTORY (ANY OF)

Urticaria (hives) or other immediate, IgE-type reaction **without anaphylaxis**; a "rash" where hives cannot be excluded.

ACTION

Refer to an allergist. Avoid penicillin. See **the side-chain chart below** for prescribing **oral** cephalosporins — **oral use only, not IV/IM**.[471]

High

HISTORY (ANY OF)

Anaphylaxis; recurrent reactions or reactions to **multiple** beta-lactams; prior positive skin test; any **severe delayed** reaction — Stevens-Johnson syndrome / toxic epidermal necrolysis (SJS/TEN), drug reaction with eosinophilia and systemic symptoms (DRESS), serum sickness, hemolytic anemia, nephritis, hepatitis.

ACTION

Do not test or challenge. Refer to an allergist. Anaphylaxis / immediate reactions: avoid penicillins and cephalosporins. **Severe delayed reactions** (SJS/TEN, DRESS, serum sickness, organ involvement): avoid all penicillins and cephalosporins.[471]

⚠ WHEN TO INVOLVE AN ALLERGIST

Any **type-1 (immediate / IgE-mediated)** reaction — urticaria, angioedema, wheeze, or anaphylaxis — prompts **allergist referral**; more nuanced than the table alone, which is a triage aid, not a substitute for specialist assessment.[472]

BETA-LACTAM CROSS-ALLERGY — BY SIDE-CHAIN STRUCTURE

◈ HOW TO USE THIS CHART

- **For oral use only — not IV/IM.** Prescribing an **oral** cephalosporin for a penicillin-allergic child: choose one that does **not** share a

similar side-chain structure with penicillins (a "✓" against the penicillin columns below).

- Cross-reactivity follows **side-chain similarity** — not the shared beta-lactam ring.[472] Use only for **immediate / IgE** histories (non-anaphylactic) — **never** after anaphylaxis and **never** for SJS/TEN/DRESS, where all beta-lactams are avoided.[472]

CHILDREN WITH A CEPHALOSPORIN ALLERGY

- **Immediate hypersensitivity to a cephalosporin** — avoid the culprit and cephalosporins sharing its side chain (see chart) and refer to allergy. **Non-anaphylactic reaction** (e.g., urticaria): a penicillin, or a cephalosporin with a dissimilar side chain, may be used. **Anaphylaxis:** use a carbapenem or non-beta-lactam alternative until allergist testing; penicillins/dissimilar cephalosporins only after allergist assessment.[472]
- **Inpatient / ICU** — avoid all cephalosporins and penicillins and use alternatives; consult **Allergy / ID** if a penicillin or cephalosporin is the recommended first-line treatment.

- **Severe cutaneous reaction** (SJS/TEN/DRESS) — **avoid all penicillins, cephalosporins, and carbapenems**; use an alternative and consult allergy or ID.[471]

◈ **BASIS** Kuwait Pediatric Council practice point on skin testing before antibiotic administration; risk table adapted from the Canadian Paediatric Society[471] and Devchand & Trubiano[475]; pathway aligned with the CHOP Penicillin Allergy Clinical Pathway[476] and the AAAAI/ACAAI 2022 drug-allergy practice parameter.[472] Apply to the local antibiogram; verify doses before use.

⚠ **NEVER TEST THESE**

Anaphylaxis, SJS/TEN, DRESS, acute generalized exanthematous pustulosis (AGEP), serum sickness, cytopenias, interstitial nephritis, or hepatitis — no skin test, no challenge; refer to an allergist.[472]

Hereditary Angioedema — Acute Attack

MINUTES

Bradykinin-mediated swelling that does **not** respond to epinephrine, antihistamine, or steroid.

RECOGNIZE

- Recurrent angioedema **without urticaria or itch**; laryngeal swelling, abdominal attacks; family history; known C1-esterase inhibitor deficiency.[477]
- If anaphylaxis cannot be excluded, give intramuscular epinephrine first (see **Anaphylaxis**) — failure to respond supports the diagnosis.[477]

Airway is the danger — early anesthetics/ENT for any laryngeal involvement[477]

SPECIFIC THERAPY

Give a hereditary angioedema (HAE)-specific agent early; earlier treatment means a milder, shorter attack. Every child with HAE should have on-demand therapy available at all times.[477,478]

C1-esterase inhibitor concentrate

DOSE

20 units/kg

ROUTE & NOTES

IV; best safety evidence in children — first-line[477]

Icatibant

DOSE

Weight-based (max 30 mg):
10 mg (12–25 kg)
15 mg (26–40 kg)
20 mg (41–50 kg)
25 mg (51–65 kg)
30 mg (>65 kg)

ROUTE & NOTES

SC (subcutaneous); bradykinin B2-receptor antagonist; ready-to-use prefilled syringe. **Not recommended < 2 years or < 12 kg** — no dose established (EMA label, licensed from 2 years; the US FDA label covers adults ≥ 18 years only)[477]

Sebetralstat (oral; ≥ 12 years — availability in Kuwait to confirm)

DOSE

600 mg (two 300 mg tablets) at the first sign
repeat once after ≥ 3 h if inadequate
max 1,200 mg/24 h
with a moderate CYP3A4 inhibitor (e.g., erythromycin, fluconazole): 300 mg, repeat once after ≥ 3 h

ROUTE & NOTES

Oral plasma kallikrein inhibitor; first-line on-demand option from 12 years in the 2026 international pediatric guideline; not approved < 12 years. **Avoid with strong CYP3A4 inhibitors** (e.g., clarithromycin, itraconazole) — use a parenteral agent. Severe laryngeal attacks were not studied — use a parenteral agent[478]

Fresh frozen plasma

DOSE

10 mL/kg

ROUTE & NOTES

IV; only if specific agents unavailable[477]

ADMIT · DISCHARGE · REFER

- **Admit** — laryngeal or severe attacks → a monitored bed.
- **Home** — after resolution with on-demand therapy and a written plan.

- **Refer — clinic** — immunology/allergy (diagnosis, prophylaxis).

When to Suspect Primary Immunodeficiency (IEI)

ASSESS

Inborn errors of immunity — think of it before the next live vaccine or transfusion.

WHEN TO SUSPECT — THE SPUR PATTERN

- **S**evere, **P**ersistent, **U**nusual (opportunistic organism or unusually severe course), or **R**ecurrent infection.[479]
- **Family history** of immunodeficiency or unexplained early infant death, **parental consanguinity**, **failure to thrive**, infections needing **intravenous antibiotics** or admission.[479]
- Classic thresholds: ≥ 2 pneumonias or **≥ 4 new ear infections** in a year, ≥ 2 deep-seated infections (abscess, osteomyelitis), persistent oral/skin thrush after age 1, or little response to ≥ 2 months of antibiotics.[479,480]

- **Non-infectious red flags** (increasingly recognized): autoimmune cytopenias — especially chronic, refractory, or multi-lineage — early or treatment-resistant inflammatory bowel disease (< 2 years), granulomas, lymphoproliferation, severe eczema.[481]

OVERVIEW — INFECTION PATTERN → LIKELY DEFECT

Recurrent sinopulmonary (encapsulated bacteria), onset mostly after 6 months

THINK

`Antibody deficiency`

TYPICAL CLUES

Agammaglobulinemia, common variable immunodeficiency (CVID), IgA deficiency; low immunoglobulins

Early severe viral/fungal/opportunistic infection, chronic diarrhea, failure to thrive

THINK

`Combined / T-cell`

TYPICAL CLUES

Severe combined immunodeficiency (SCID): lymphopenia, may have absent thymic shadow — a pediatric emergency (below)

Deep abscesses, unusual organisms (Serratia, Burkholderia, Aspergillus), poor wound healing

THINK

Phagocyte defect

TYPICAL CLUES

Chronic granulomatous disease; leukocyte adhesion deficiency (delayed cord separation)

Recurrent Neisseria (meningococcal) or encapsulated- organism infection, or lupus-like disease

THINK

Complement deficiency

TYPICAL CLUES

Early-onset, recurrent or familial meningococcal disease; lupus-like autoimmunity (early classical-pathway defects)[481]

⚠ SUSPECTED SCID IS A PEDIATRIC EMERGENCY

- Infant in the first months of life with severe or persistent infection, chronic diarrhea, failure to thrive, oral thrush, or an **absolute lymphocyte count < 2.5–3 ×10⁹/L** (or a positive newborn T-cell receptor excision circle (TREC) screen) may have severe combined immunodeficiency.[482]
- Diagnose **before** live vaccines, non-irradiated blood, or

overwhelming infection — allows a life-saving transplant.[482]

- Phone pediatric immunology the same day.[482]

✦ **FIRST-LINE SCREEN**

- Full blood count **with differential** (absolute lymphocyte and neutrophil counts), immunoglobulins (IgG, IgA, IgM, IgE), lymphocyte subsets (T/B/NK by flow cytometry), complement (CH50/AH50 — total classical / alternative-pathway complement activity), and specific antibody responses (vaccine titers, isohemagglutinins); **HIV test** — exclude secondary immunodeficiency before labeling an inborn error.[481]
- Add a neutrophil oxidative-burst test (dihydrorhodamine) if a phagocyte defect is suspected. **Save a pre-treatment serum sample before giving intravenous immunoglobulin (IVIG).**[481]
- **To diagnose infections do not rely on serology** — antibody production is impaired and IVIG

transfers donor antibody; use culture, PCR or antigen detection.

⚠ ACUTE DO / DON'T WHEN IEI IS SUSPECTED

- **Do not** give live vaccines (BCG, oral polio, rotavirus, MMR, varicella, yellow fever) — they can cause fatal vaccine-strain disease.[482]
- **If blood products are needed, use only irradiated, CMV-negative, leukoreduced products** (prevents transfusion-associated graft-versus-host disease).[483]
- Do not delay empiric antibiotics for fever — treat any infection promptly and aggressively; avoid non-essential steroids/immunosuppression before a diagnosis.[481]

⚠ SUSPECTED SCID — EMERGENCY MANAGEMENT, UNDER PEDIATRIC IMMUNOLOGY DIRECTION

- **A medical emergency:** immunology the same day; confirmatory testing (lymphocyte subsets ± TREC) at a center able to interpret it.[483,484]

- **Strict protective isolation** from the moment of suspicion — **at home or in hospital, at the treating immunologist's discretion** (centers differ; infection rates were similar at home and in hospital).[833] **At home:** caregivers are counselled on safe isolation — no public outings, primary-care visits deferred, and clinic visits planned so the infant goes straight into a cleaned room, not a waiting room. **In hospital:** a single positive-pressure room (HEPA-filtered or laminar-flow where available); hand washing, then mask, gown and gloves for everyone entering; non-essential staff stay out and visitors are kept to a minimum.[483,484,833]
- **Treat any infection promptly and aggressively** — diagnose with cultures, antigen detection and PCR; do not rely on serology. *Pneumocystis jirovecii* pneumonia (PJP) is frequent — chest X-ray and bronchoalveolar lavage; if suspected or proven, co-trimoxazole (trimethoprim-sulfamethoxazole) 20 mg/kg/day of trimethoprim IV in divided doses.[484]

- **Prophylaxis** from 4 weeks of age: co-trimoxazole 5 mg/kg/day of trimethoprim once daily and fluconazole 5 mg/kg/day once daily — younger infants: consult immunology / infectious diseases (sulfonamides displace bilirubin); RSV prophylaxis (nirsevimab, clesrovimab or palivizumab) in the RSV season[836,844]; **CMV prophylaxis** at the treating immunologist's discretion.[483,484]
- **IVIG replacement** 400–600 mg/kg every 3–4 weeks.[483,484]
- Only **irradiated, CMV-negative, leukoreduced** blood products; **all live vaccines are contraindicated** for the child with SCID or suspected SCID. **Healthy household contacts:** oral polio vaccine is contraindicated — use the inactivated (injectable) polio vaccine instead (live intranasal influenza and smallpox vaccines are also contraindicated; they are not given in Kuwait); all other vaccines are permitted. If a household contact develops a rash after varicella vaccine, isolate the child with SCID from that contact and contact health care for varicella-zoster immunoglobulin (VZIG). **Suspend breastfeeding**

until maternal CMV serology is known — the mother can express and store milk; resume if she is CMV-seronegative. **Contact with chickenpox or shingles: seek immediate medical attention** for varicella-zoster immunoglobulin (VZIG), as early as possible after exposure.[483,484]

- Growth failure → parenteral nutrition, and involve a dietitian early.[484]
- **Involve the transplant (HSCT) team immediately** and plan early **hematopoietic cell transplantation** (or gene therapy) once the diagnosis is confirmed.[483,484]

REFER

- Pediatric immunology for all suspected inborn errors of immunity — the same day for suspected SCID, any opportunistic infection, or profound lymphopenia.
- IVIG replacement and HLA-typing proceed under specialist direction.[481]

ADMIT · DISCHARGE · REFER

- **Admit** — as dictated by the presenting infection.
- **Home** — per the acute problem (from the emergency department or the ward, as that card dictates), with the workup arranged.
- **Refer — clinic** — immunology; avoid live vaccines and use irradiated blood products until cleared.

Pneumothorax — Tension, Traumatic & Spontaneous

MINUTES ATLS · NAEMSP 2024 · BTS 2023

Tension: decompress on clinical grounds before any X-ray. All others: decide who goes home, who is observed, and who needs a drain.[485]

RECOGNIZE

- **Tension** — rapidly worsening distress and **hypoxia** with **hypotension**, **unilateral absent/reduced breath sounds**, hyper-resonance, distended neck veins and (late) tracheal deviation —

after trauma, in asthma, or in a **ventilated child** who suddenly desaturates and drops their pressure.[16,485]

- **Simple traumatic** — blunt or penetrating chest injury, rib fractures, or after a central line or positive-pressure ventilation.
  Primary spontaneous — typically a tall, thin adolescent with sudden pleuritic pain ± breathlessness.
  Secondary spontaneous — asthma, cystic fibrosis, connective-tissue disease (Marfan, Ehlers–Danlos), congenital lung lesion, necrotizing pneumonia, or ventilation.[486,487,488]

⚠ TENSION PNEUMOTHORAX — DECOMPRESS NOW

- Tension pneumothorax is a **clinical diagnosis** — if tension pneumothorax is suspected in an unstable child, **do not wait for a chest X-ray**.[16,485]
- Perform immediate **needle decompression**, or **finger thoracostomy** where appropriate for the child's size and available expertise, followed by **chest-drain insertion**.[485]

- **Not for newborns** — neonatal pneumothorax (transillumination, needle/butterfly aspiration) follows the NRP / neonatal unit protocol; see **Neonatal Resuscitation**.

Needle decompression

LANDMARK

5th intercostal space at the mid-axillary line, or 2nd intercostal space (over the top of the 3rd rib) at the mid-clavicular line[16]

NOTES

Over the top of the rib; aspirate while advancing; ultrasound before puncture whenever time allows.[16,489]

Cannula size (suggestions)

LANDMARK

Infant: 22–20 G × 25–32 mm
Child (≈ 5 y): 20–18 G × 32 mm
Older child (≈ 10 y): 18 G × 45 mm
Adolescent: 16 G × 45 mm (adult-sized adolescent: adult device)

NOTES

ATLS range for children: 16–22 gauge, 2.5–4.5 cm, chosen by age and body habitus.[16] These sizes are suggestions. Select an appropriate device for the child's body habitus. The listed length is not the insertion depth. Aspirate continuously during insertion. Once air is aspirated, stop advancing the sharp needle; advance the plastic catheter off the needle and withdraw the needle. Use ultrasound if time allows. Avoid large-bore cannulas in infants. Chest-wall thickness varies widely and cannot be predicted from age or weight — choose by body habitus.[361,490,491]

Finger thoracostomy

LANDMARK

5th intercostal space, just anterior to the mid-axillary line (the chest-drain site) [16]

NOTES

When needle decompression fails, or the child is large enough and expertise is at hand; converts to a drain. [485]

Definitive

LANDMARK

Chest drain, 5th intercostal space, just anterior to the mid-axillary line (same site as in adults)

NOTES

Follows decompression — do not delay for imaging; size by age and indication (hemothorax needs a larger tube); X-ray afterwards for position. [16,485]

WORKUP (NON-TENSION)

- Upright chest X-ray. Lung ultrasound by a trained operator (absent lung sliding, lung point) is faster and more sensitive than a supine film (meta-analysis of mostly adult studies) [492] — in trauma as part of eFAST [16]. CT is not needed for a first spontaneous pneumothorax. [487]

ADMIT · DISCHARGE · REFER — BY SITUATION

Tension — any cause

ACTION

Decompress now (needle or finger thoracostomy), then chest drain; PICU.[16,485]

FOLLOW-UP

Inpatient

Drain needed now

ACTION

Hemodynamic compromise, significant hypoxia, bilateral, hemopneumothorax, or a ventilated child with a pneumothorax on X-ray → chest drain; admit (PICU if ventilated).[16,486]

FOLLOW-UP

Inpatient; pediatric surgery

Traumatic — small, or seen on CT only, child stable

ACTION

Admit; observe with repeat chest X-ray. An occult pneumothorax (< 2.7 cm on CT) needs no intervention unless it enlarges or causes symptoms.[16] Drain if it enlarges or the child deteriorates. Observation stays safe if ventilation or an anesthetic is needed, provided a drain can be placed at once; no routine drain before road transfer.[485,837,838] Before air transfer, discuss a drain with the receiving team.[16]

FOLLOW-UP

Trauma / pediatric surgery

Primary spontaneous (adolescent) — minimal symptoms

ACTION

No significant pain or breathlessness, no physiological compromise: observe in the emergency department, no intervention, regardless of size; home if stable on reassessment, with a reliable family and written advice to return at once if breathless.[486,487,494]

FOLLOW-UP

Chest X-ray and respiratory/surgical review in 2–4 weeks; recurrence ≈ 30% after non-surgical management; no smoking/vaping.[486,487,493]

Primary spontaneous — symptomatic

ACTION

Admit; needle aspiration or a small-bore chest drain.[486,487]

FOLLOW-UP

Surgery if the air leak persists 24–48 h[487]

Secondary spontaneous

ACTION

Asthma, connective-tissue disease, congenital lung lesion, necrotizing pneumonia: admit; low threshold for a chest drain; respiratory team.[486]

FOLLOW-UP

Respiratory clinic

Cystic fibrosis

ACTION

Large (≥ 3 cm apex to cupola): admit, chest drain. Small and stable: close observation. Withhold BiPAP while the pneumothorax is present.[488]

FOLLOW-UP

Pleurodesis only after a recurrence, never for a first episode; no flying for 2 weeks after resolution[488]

Infants and young children

ACTION

Admit; adult pathways do not apply — decide with pediatric surgery and respiratory.[493]

FOLLOW-UP

Inpatient

Surgical referral — any group

ACTION

Air leak beyond 24–48 h; second same-side or first opposite-side episode; tension at the first episode; bilateral.[486,487,488]

FOLLOW-UP

Pediatric surgery

- **Size:** there is no validated pediatric definition. Size alone no longer decides intervention; a rim of ≥ 2 cm laterally or apically is the usual minimum for safe aspiration or drain

insertion (adult guidance).[486] Most evidence is adult-derived (trials enrolled from age 14).[494]

✦ FLYING AND DIVING

No flying with an unresolved pneumothorax; fly only **≥ 7 days after X-ray resolution** (2 weeks in CF). **Scuba diving is discouraged permanently** unless definitive surgery (pleurectomy) has been performed. Adult guidance applied to adolescents.[486,488,495]

16

Rheumatologic

Cytokine storm (HLH/MAS) & Kawasaki vasculitis

Cytokine Storm — HLH / MAS (Systemic Hyperinflammation)

HOURS

EULAR/ACR 2022 · EULAR/PReS 2024

One process, many names: hematology calls it HLH, rheumatology calls it MAS — the joint EULAR/ACR consensus (rheumatology, hematology, immunology, infectious diseases and intensive care) is the common ground this card follows.

RECOGNIZE — A PATTERN THAT EVOLVES, NOT A SINGLE VALUE

- **Persistent fever that looks like sepsis but does not respond**, hepatosplenomegaly, **falling counts (≥ 2 lines)**, **very high or rising ferritin**, rising triglycerides, falling fibrinogen, rising transaminases and LDH, coagulopathy/DIC, and CNS signs (irritability, seizures, altered consciousness). Individual findings are non-specific — read them together and over time[496].

- **Examine perfusion first** — tachycardia with cool extremities, prolonged capillary refill or reduced urine output at a **normal blood pressure** is compensated shock; myocardial dysfunction is common in hyperinflammation, so get an **early echocardiogram**[3,497].
- **In sJIA / Still's disease:** a **falling ESR** with rising CRP and ferritin, a **falling platelet or white count from a high baseline**, and hypofibrinogenemia are early clues (consumption). On canakinumab or tocilizumab the fever and the ferritin rise may be blunted or delayed; the risk also rises when steroids or biologics are tapered[498,499].
- **Ferritin:** send it in every child with new or heightened suspicion, even if a previous value was normal, and repeat daily. > 500 ng/mL is 84% sensitive in children (the Histiocyte Society cut-off) but not specific; pediatric studies use 500–2,000; a rapidly rising or very high (> 10,000) ferritin is highly suggestive[496].
- The same process complicates infection (EBV, CMV, dengue, leishmaniasis, tuberculosis, typhoid, brucellosis), malignancy (leukemia,

lymphoma), rheumatic disease (sJIA, lupus, Kawasaki), MIS-C, immunotherapy, and inborn errors (familial HLH, XLP, Chédiak–Higashi, Griscelli)[496].

CRITERIA — USEFUL IN THE SETTING THEY WERE BUILT FOR; NONE IS SUFFICIENT EVERYWHERE[496]

HLH criteria — HLH-2004, revised 2024

BUILT FOR

HLH (hematology pathway): primary/familial HLH and secondary HLH outside rheumatic disease — not for MAS in sJIA (use MAS-2016 below)

RULE

5 of 7: fever ≥ 38.5 °C · splenomegaly · cytopenias in ≥ 2 lines (Hb < 90 g/L, < 100 g/L under 4 weeks; platelets < 100 × 10^9/L; neutrophils < 1.0 × 10^9/L) · fibrinogen ≤ 1.5 g/L and/or triglycerides ≥ 3.0 mmol/L (265 mg/dL) · ferritin ≥ 500 µg/L · hemophagocytosis in marrow or other tissue · sCD25 ≥ 2,400 U/mL. **NK-cell activity is no longer a criterion** (Histiocyte Society 2024): low perforin or defective degranulation is a separate cellular pathway that supports familial HLH, as do biallelic pathogenic variants or an affected sibling.[500,501]

MAS-2016

BUILT FOR

Febrile child with known or suspected sJIA

RULE

Ferritin > 684 ng/mL **and any 2 of**: platelets ≤ 181 × 10^9/L · AST > 48 U/L · triglycerides > 156 mg/dL · fibrinogen ≤ 360 mg/dL[499]

MS score

BUILT FOR

Separating MAS from an sJIA flare

RULE

7 items (CNS dysfunction, bleeding, active arthritis, platelets, fibrinogen, LDH, ferritin); score ≥ −2.1 → MAS (sensitivity 0.85, specificity 0.95)[502]

HScore

BUILT FOR

Adults; infection- or malignancy-associated HLH

RULE

Probability from < 1% (≤ 90) to > 99% (≥ 250); online calculator[503]

⚠ DO NOT WAIT TO SATISFY A SET OF CRITERIA BEFORE TREATING A DETERIORATING CHILD

- In a child with high-risk features or progression, start empiric immunomodulation during the initial evaluation — diagnostic work-up, treatment of the trigger and prevention of complications run in parallel[496,498].

◣ WORK-UP — STARTS ON SUSPICION, IN PARALLEL WITH TREATMENT

- **First tier (any hospital, same day):** CBC + film, ferritin, CRP, ESR, fibrinogen, D-dimer, PT/APTT,

triglycerides, AST/ALT/GGT/bilirubin/albumin, LDH, creatinine, sodium; blood cultures; EBV and CMV PCR, HIV; other infections by exposure (dengue or malaria after travel, tuberculosis, leishmaniasis, typhoid, brucellosis) — hyperinflammation can be the presentation of an infection. Send serology **before** IVIG[496].

- **Second tier (with the specialist teams): sCD25 (soluble IL-2 receptor-α)** — the most useful confirmatory test where available; **bone marrow** (also for malignancy — obtain **before** steroids when malignancy is plausible and it will not delay treatment; hemophagocytosis is neither required nor specific); IL-18 and CXCL9 where available; NK-cell function, CD107a degranulation, perforin/SAP/XIAP flow cytometry[496].
- **Genetics early in every child** (multigene panel or exome), and in anyone with consanguinity, family history, recurrence, albinism or prominent CNS disease — consanguinity makes this especially

relevant in Kuwait; a genetic diagnosis changes treatment, prognosis and family counseling[496].

- **CNS:** assess every child < 1 year, any suspected familial disease and any neurological sign — CSF (cells, protein, glucose, cytology) and contrast MRI — **without delaying treatment**[496].

TREAT — EMPIRIC IMMUNOMODULATION EARLY; TREAT THE TRIGGER AT THE SAME TIME (ANTIMICROBIALS BY EXPOSURE; AN ACTIVE INFECTION DOES NOT DELAY MAS TREATMENT)[496,498]

1 · Methylprednisolone — MAS pathway and undifferentiated hyperinflammation

DRUG & DOSE

Methylprednisolone pulse 15–30 mg/kg/day IV (max 1 g) × 3 days
then 2 mg/kg/day divided

NOTES

Strongest evidence across all forms of HLH/MAS; shorter-acting agents are preferred while the diagnosis is still evolving[496,498]

1 · Dexamethasone — HLH pathway (hematology leads) or CNS involvement

DRUG & DOSE

10 mg/m²/day IV or PO
(≈ 2–4 mg/kg/day methylprednisolone)

HLH-94/2004 8-week taper:
Wk 1–2 · 10 mg/m²/day
Wk 3–4 · 5 mg/m²/day
Wk 5–6 · 2.5 mg/m²/day
Wk 7 · 1.25 mg/m²/day
Wk 8 · taper to zero

NOTES

Preferred when HLH is the leading diagnosis because it crosses the blood–brain barrier (better CNS penetration). Long half-life — a shorter-acting steroid is preferable while the diagnosis is still evolving.[496,501,504]

2 · Add early — MAS / sJIA, Kawasaki or MIS-C overlap, undifferentiated hyperinflammation

DRUG & DOSE

Anakinra (IL-1 receptor antagonist)
2–4 mg/kg/day (above the standard 1–2 mg/kg/day)
Critically ill: escalate to 10 mg/kg/day, divided q6–12 h or repeated IV doses (EULAR/ACR 2022 table: 5–10 mg/kg/day, IV preferred, or SC)

NOTES

Immunomodulation without immunosuppression; short half-life; does not obscure a malignancy work-up[496,498,505]

2 · IVIG

DRUG & DOSE

1–2 g/kg

NOTES

Endorsed for empiric use, especially with Kawasaki/MIS-C overlap; a large colloid load — caution with cardiac dysfunction[496]

3 · Inadequate response at 24–72 h, or severe / rapidly worsening — with the reference team

DRUG & DOSE

Ciclosporin oral or IV, level-guided or tacrolimus 0.1 mg/kg/day PO divided q12h, trough 8–20 ng/mL (EULAR/ACR alternative)

NOTES

For MAS; **not** for primary HLH (proven ineffective). Combination therapy on a background of high-dose glucocorticoid is often needed and may be initial therapy in severe MAS[496,498]

3 · Emapalumab (anti-IFN-γ)

DRUG & DOSE

Primary HLH: 1 mg/kg IV twice weekly (with dexamethasone)

Still's / sJIA-MAS: 6 mg/kg once, then 3 mg/kg every 3 days to day 16, then twice weekly

If response unsatisfactory — Primary HLH: increase to 3 mg/kg (from day 4), 6 mg/kg (from day 7), max 10 mg/kg/dose (from day 10). Still's / sJIA-MAS: increase to a maximum cumulative 10 mg/kg over 3 days (interval may be shortened to every 2 days or daily); reduce once improved

NOTES

FDA-approved for primary HLH that is refractory, recurrent or progressive on (or intolerant of) conventional therapy, and for HLH/MAS in known or suspected Still's disease with inadequate response or intolerance to glucocorticoids or recurrent MAS; test for latent TB before starting and consider zoster, *Pneumocystis* and antifungal prophylaxis; monitor for TB, adenovirus, EBV and CMV[498,506]

3 · Ruxolitinib

DRUG & DOSE

Specialist, off-label

NOTES

JAK inhibition; promising in refractory HLH/MAS[496,498]

3 · Etoposide-based (HLH-94)

DRUG & DOSE

Hematology-directed

Primary/familial HLH, severe EBV-HLH: HLH-94 induction — etoposide 150 mg/m² IV twice weekly wk 1–2, then weekly to wk 8, with the dexamethasone taper above

Secondary HLH — severe, or no response to steroids ± IVIG at 72 h: start etoposide promptly — children 150 mg/m² once weekly; older teenagers 50–100 mg/m²
Dose per m² also under 10 kg (some centers use 5 mg/kg). Renal: reduce 25% if creatinine clearance 20–40, 50% if < 20 mL/min/1.73 m² (75% if bilirubin also > 3 mg/dL) — do not withhold.

NOTES

Life-saving in primary HLH and severe EBV-HLH; not first-line for MAS (low-dose only if refractory); not for most non-EBV infections. Ciclosporin is no longer given in the first weeks (HLH-2004 upfront ciclosporin showed no benefit).[496,498,504,507]

3 · Rituximab

DRUG & DOSE

Hematology-directed

NOTES

EBV-driven HLH (B-cell depletion)[496]

✦ SUPPORTIVE CARE AND MONITORING

- Sepsis-style resuscitation and broad antimicrobials pending cultures; consider *Pneumocystis*

and antifungal prophylaxis early (part of HLH-94); no live vaccines; irradiated blood products if transplant is possible[496].

- **Daily** ferritin, CRP, CBC, fibrinogen and ALT (± triglycerides); more often if critical. A ferritin that fails to fall predicts a poor outcome — escalate and re-examine the diagnosis (lymphoma, unrecognized infection, genetic HLH)[496].

◈ **KUWAIT JOINT PATHWAY — RHEUMATOLOGY · HEMATOLOGY/ONCOLOGY · PICU**

- **SAME FIRST HOUR, WHICHEVER TEAM IS CALLED FIRST:** ferritin + first-tier panel, cultures, methylprednisolone pulse ± anakinra. **NO TEAM DELAYS GLUCOCORTICOIDS WAITING FOR THE OTHER.**
- **RHEUMATOLOGY LEADS** when there is a known or strongly suspected rheumatic context (sJIA/Still's, lupus, Kawasaki, MIS-C): MAS pathway — glucocorticoid + anakinra ± ciclosporin → emapalumab[498].
- **HEMATOLOGY/ONCOLOGY LEADS** when: age < 2 years, consanguinity or

family history, EBV-driven disease, cytopenias or organomegaly dominant, possible malignancy, or no rheumatic context: HLH pathway — genetics and marrow first where safe; dexamethasone with the HLH-94 taper; etoposide when severe or no response at 72 h; emapalumab for refractory, recurrent or progressive primary HLH[496,501].

- **BOTH ARE CONSULTED WITHIN HOURS IN EVERY CASE**; PICU for organ dysfunction; infectious diseases for the trigger and prophylaxis; immunology for inborn-error evaluation. A multidisciplinary HLH/MAS team improves recognition and reduces over- and under-treatment[496]. Transfer of care is by agreement, not by admission ward.

ADMIT · DISCHARGE · REFER

- **Admit** — all → high-dependency/PICU.
- **Home from the ward** — not acutely; under the leading team with a written taper and monitoring plan.
- **Refer — now** — hematology and rheumatology within hours; PICU.[496]

- **Refer — clinic** — genetic counseling for every family tested.[496]

Kawasaki Disease HOURS

Medium-vessel vasculitis; leading cause of acquired heart disease in children.

RECOGNIZE

- Fever ≥ 4 days (day 1 = first day of fever) + ≥ 4 of: bilateral non-exudative conjunctivitis, oral mucosal changes (cracked/red lips, strawberry tongue, diffuse oropharyngeal erythema), polymorphous rash, extremity changes (swelling/peeling), cervical lymphadenopathy ≥ 1.5 cm (usually unilateral)[109]. Features need not be present together; with ≥ 4 features the diagnosis can be made on **day 4 of fever** (day 3 by an experienced clinician)[508].
- **Incomplete Kawasaki** is common in infants < 6 months and older children — fewer features but high coronary risk; use inflammatory markers and echocardiography[109].

✦ PEARL — THINK INCOMPLETE KAWASAKI

- Suspect **incomplete Kawasaki** in any infant (above all **< 6 months**) with **≥ 7 days of unexplained fever** even without the full clinical criteria — this is the group most often missed and at the highest risk of coronary aneurysms[109].
- Check inflammatory markers and arrange echocardiography; treat on a compatible picture rather than waiting for every feature. **AHA 2024 pathway:** prolonged unexplained fever + 2–3 clinical criteria (or an infant with ≥ 7 days of unexplained fever) → check CRP/ESR; if CRP ≥ 3 mg/dL and/or ESR ≥ 40 mm/h, look for ≥ 3 supplementary lab findings (anemia, platelets ≥ 450 $\times 10^9$/L, albumin ≤ 3 g/dL, raised ALT, WBC ≥ 15 $\times 10^9$/L, urine WBC ≥ 10/hpf) or a positive echocardiogram (LAD or RCA Z ≥ 2.5, or ≥ 3 other suggestive features)[109,508] → treat.

Treat within 10 days of fever onset to protect the coronaries[109]

FIRST-LINE

- IVIG 2 g/kg as a single infusion + **low-dose (antiplatelet) aspirin 3–5 mg/kg/day**; baseline echocardiogram[109].
- Discuss adjunct corticosteroids with cardiology/rheumatology for high-risk patients (infants < 1 year, coronary changes, high inflammatory markers, or Kawasaki disease shock syndrome)[109] — AHA 2024 defines high risk as **age < 6 months or baseline LAD/RCA z-score ≥ 2.5** (CRP ≥ 13 mg/dL and Asian ancestry also predict aneurysms) and supports intensified initial therapy for this group.[508]

IVIG

DOSE

2 g/kg single infusion over 10–12 h

ROUTE & NOTES

IV. IVIG-resistant fever ≥ 36 h after the end of the infusion → second IVIG 2 g/kg, or corticosteroids, or a biologic (infliximab, now dosed **10 mg/kg** IV over 2 h)[109,508] **Echo:** baseline at diagnosis (do not delay IVIG for it); if any coronary Z score ≥ 2.5, repeat **at least twice weekly** in hospital until dimensions stop progressing; repeat before discharge if IVIG-resistant or high-risk.[109,508]

Aspirin

DOSE

3–5 mg/kg/day PO once daily from diagnosis continue until 6–8 weeks after illness onset and the follow-up echocardiogram is normal; continue long term (cardiology-directed, potentially indefinitely) if any coronary aneurysm

ROUTE & NOTES

Antiplatelet dose only, from the outset. Anti-inflammatory doses (30–100 mg/kg/day) are not recommended — no coronary benefit, more adverse effects[509,510]. See the aspirin note below

Methylprednisolone → prednisolone (high-risk)

DOSE

Prednisolone 2 mg/kg/day (max 60 mg/day) IV in 3 divided doses (if IV prednisolone is unavailable, IV methylprednisolone 1.6–2 mg/kg/day as a substitute), switching to oral prednisolone when afebrile once CRP is normal taper over 15 days (RAISE-based regimen)

ROUTE & NOTES

Adjunct to IVIG in high-risk patients or Kawasaki disease shock syndrome[109,508]

⚠ NOTE

- Single-dose methylprednisolone with IVIG is **not** recommended as routine primary therapy[109].
- Avoid ibuprofen with aspirin (antagonizes antiplatelet effect[109]).
- **Aspirin and varicella/influenza:** withhold aspirin during active varicella or influenza (Reye syndrome) and use an alternative antiplatelet agent (clopidogrel) meanwhile; give the annual influenza vaccine to every child on aspirin[109].

◈ WHY THE ANTIPLATELET DOSE

- Anti-inflammatory dosing has never been shown to reduce coronary aneurysms[109]: a randomized trial found IVIG alone non-inferior to IVIG + high-dose aspirin[509]; a network meta-analysis of 1,944 patients found no difference in coronary lesions, IVIG resistance or hospital stay between no aspirin, 3–5, 30–50 and 80–100 mg/kg/day[510]; meta-analyses and cohorts show equal coronary outcomes with low-dose from the outset and fewer adverse effects (GI bleeding, transaminase rise, Reye syndrome)[511,512,513,514].
- One Japanese database study found more coronary abnormalities at 5 than at 30 mg/kg/day (OR 1.40) — observational and contradicted by the randomized data; a randomized noninferiority trial of moderate- vs low-dose aspirin with IVIG (DAPI) is under way[508,515].
- **AHA 2024** still describes moderate- (30–50 mg/kg/day) or high-dose (80–100 mg/kg/day)

aspirin until afebrile 48–72 h as traditional practice, but now states that medium- or high-dose aspirin in the acute phase "is likely not associated with improved CA outcomes" and gives no dose recommendation pending the ongoing randomized trial[109,508]; this guide recommends the antiplatelet dose (3–5 mg/kg/day) from diagnosis on the strength of the randomized and pooled evidence above.

CORONARY ARTERY INVOLVEMENT — AHA Z-SCORE CLASSIFICATION & CARDIOLOGY-DIRECTED THROMBOPROPHYLAXIS

No involvement

Z SCORE (LAD OR RCA)

`< 2`

ECHO FREQUENCY & ANTITHROMBOTIC PLAN

Repeat echo 1–2 weeks after discharge and at 4–6 weeks; AHA 2024: if normal at diagnosis and at 1–2 weeks, further imaging only if new concerns arise. Low-dose aspirin until the follow-up echo is normal.[109,508]

Dilation only

Z SCORE (LAD OR RCA)

`2 to < 2.5`

ECHO FREQUENCY & ANTITHROMBOTIC PLAN

As above; the AHA also counts a fall in Z score of ≥ 1 during follow-up as dilation.[109]

Small aneurysm

Z SCORE (LAD OR RCA)

`≥ 2.5 to < 5`

ECHO FREQUENCY & ANTITHROMBOTIC PLAN

Echo at least twice weekly in hospital until dimensions stop progressing; echo at discharge and again within 1 week. Low-dose aspirin.[109,508]

Medium aneurysm

Z SCORE (LAD OR RCA)

≥ 5 to < 10 and < 8 mm

ECHO FREQUENCY & ANTITHROMBOTIC PLAN

As for small aneurysm; low-dose aspirin, clopidogrel may be added; anticoagulation not routinely indicated — **except** consider continuing anticoagulation (cardiology decision) when a previously large/giant aneurysm has regressed to medium size, especially if regression involved thrombus (AHA 2024).[109]

Large or giant aneurysm

Z SCORE (LAD OR RCA)

≥ 10 or ≥ 8 mm

ECHO FREQUENCY & ANTITHROMBOTIC PLAN

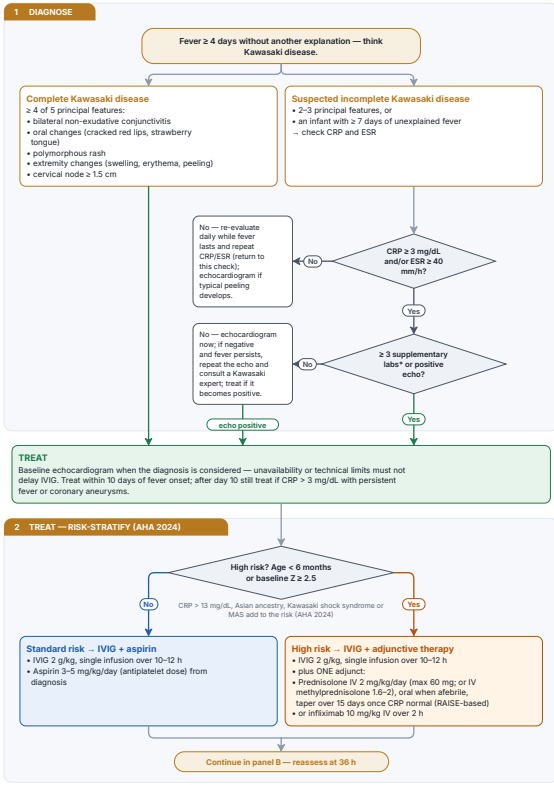
Twice-weekly echo while expanding, then at least weekly for the first 45 days. Low-dose aspirin **plus** anticoagulation (warfarin INR 2–3 or LMWH anti-Xa 0.5–1.0 U/mL; DOACs emerging); clopidogrel added for very extensive/distal aneurysms or prior thrombosis. Lifelong cardiology follow-up.[109,508]

Kawasaki disease — algorithm A: diagnosis and initial treatment

Adapted from the AHA Kawasaki disease scientific statement, 2024 update[109,508]. Aspirin 3–5 mg/kg/day from diagnosis is this guide's policy (see "Why the antiplatelet dose").

Kawasaki disease — A. Diagnosis and initial treatment

Adapted from the AHA Kawasaki disease scientific statement, 2024 update · Z = coronary artery Z score (LAD or RCA, adjusted for body surface area)



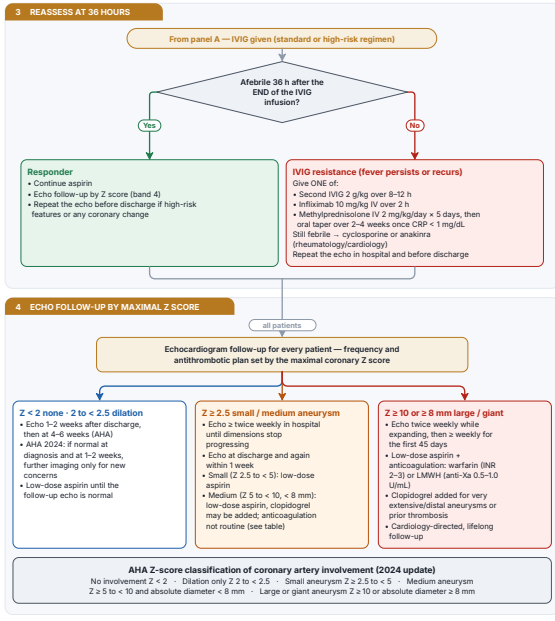
*Supplementary laboratory findings: anemia for age · platelets ≥ 450 ×10³/L after the 7th day of fever · albumin ≤ 3 g/dL · raised ALT · WBC ≥ 15 ×10³/L · urine ≥ 10 WBC/hpf. Aspirin 3–5 mg/kg/day from diagnosis is this guide's policy (see card); AHA still lists moderate/high dose until afebrile as an option.

Kawasaki disease — algorithm B: reassessment at 36 h and echocardiogram follow-up by Z score

IVIG resistance = persistent or recrudescent fever ≥ 36 h after the end of the infusion[508]; echo at least twice weekly for Z ≥ 2.5 and before discharge when IVIG-resistant or high-risk[109,508].

Kawasaki disease — B. Reassessment and echocardiogram follow-up

Adapted from the AHA Kawasaki disease scientific statement, 2024 update · Z = coronary artery Z score (LAD or RCA, adjusted for body surface area)



Source: Jone PN et al. Update on diagnosis and management of Kawasaki disease: a scientific statement from the AHA. Circulation 2024;150:e481–e500 (retains the diagnostic algorithm and Z-score classification of the earlier AHA statement). IVIG resistance = persistent or recrudescent fever ≥ 36 h after the end of the infusion (AHA 2024).

⚠ WATCH FOR

Macrophage activation syndrome (cytokine storm — see **HLH / MAS**) and **Kawasaki disease shock syndrome** (hypotension / poor perfusion) — both signal severe, high-risk disease; escalate, add adjunctive steroids, and

involve rheumatology/cardiology + PICU[109,499].

ADMIT · DISCHARGE · REFER

- **Admit** — all → for IVIG and monitoring; PICU for Kawasaki disease shock syndrome or MAS.
- **Home from the ward** — afebrile ≥ 36 h after the end of IVIG, with an **echocardiogram repeated before discharge** if fever persisted or recurred (IVIG resistance), high-risk features, or any coronary dilation/aneurysm; repeat echo **1–2 weeks after discharge** (within 1 week if Z ≥ 2.5) and at 4–6 weeks (AHA 2024: may be omitted when the first two are normal); aspirin plan written down; defer live vaccines (MMR, varicella) for 11 months after IVIG.[109,508]
- **Refer — now** — cardiology (echo, Z scores) and rheumatology for every case; IVIG-resistant cases urgently.[109]

- **Refer — clinic** — cardiology follow-up per the Z-score table; lifelong if an aneurysm ever formed.[109]

IgA Vasculitis (Henoch–Schönlein Purpura)

ASSESS SHARE 2019

Palpable purpura on the legs and buttocks — the commonest childhood vasculitis; the kidney is the long game.

📐 RECOGNIZE (PURPURA + ≥ 1)

- **Palpable purpura** (mandatory), lower-limb/buttock predominant, with normal platelets and coagulation, **plus** at least one of: diffuse abdominal pain · arthritis/arthralgia · biopsy showing IgA deposition · renal involvement (hematuria/proteinuria)[516].

⚠ TWO THINGS THAT TURN IT INTO AN EMERGENCY

- **Intussusception** — usually **ileo-ileal** (easily missed on routine

imaging — use ultrasound[517]) in a child with severe/colicky abdominal pain or GI bleeding.

- And **testicular pain/swelling** can mimic torsion[517].
- Severe abdominal pain, GI bleeding, scrotal pain or a rapidly rising creatinine/BP all need admission[517].

✦ THE KIDNEY CAN DECLARE ITSELF LATE

- Nephritis may appear **weeks to months** after the rash.[517]
- Check **blood pressure and urinalysis at every visit** and continue surveillance for **6 months** (schedule below) even after the rash resolves[517,518,519].
- Persistent proteinuria[517] → nephrology.

◣ WORKUP

- **Urinalysis + urine protein:creatinine ratio** and **blood pressure** at every visit — nephritis screen (monitor for 6–12 months even if initially normal[517]).
- Serum **creatinine / eGFR**[517].

- CBC + coagulation — platelets are **normal/high** in IgA vasculitis (excludes ITP/HUS[516]).
- **Renal biopsy** only for significant or persistent proteinuria or impaired function[517].

Joint / mild pain

APPROACH

Acetaminophen; NSAIDs if no renal involvement or GI bleeding

NOTES

Most cases are supportive only[517]

Severe abdominal pain / orchitis

APPROACH

Prednisolone 1–2 mg/kg/day (max 60 mg), short course with taper

NOTES

Eases pain; does **not** prevent nephritis[517]

Nephritis (significant)

APPROACH

Nephrology-directed (steroids ± immunosuppression)

NOTES

Do not manage severe nephritis alone[517]

◈ **WHERE TO MANAGE — MOST CHILDREN GO HOME**

- **UNCOMPLICATED IGA VASCULITIS** (rash ± joint pain, mild abdominal pain, normal blood pressure, normal or

trace urinalysis, eating and walking) is **OUTPATIENT CARE**: analgesia, counseling, and teaching the family to check the urine for protein at home over the next 3–6 months, with a written follow-up plan. No guideline recommends routine admission — most children need only supportive treatment[517,518,519].

- **RETURN AT ONCE IF:** severe or worsening abdominal pain, vomiting, blood in the stool, swollen or painful testicle, blood in the urine or foamy urine, swelling of the face/legs, headache or reduced urine output.
- **ADMIT ONLY FOR:** severe abdominal pain (needs parenteral analgesia), GI bleeding or suspected intussusception, unable to walk or drink, scrotal/testicular involvement until torsion is excluded, hypertension, acute kidney injury or a nephrotic/nephritic presentation, CNS or pulmonary involvement, or an unsafe discharge[517,518].

✦ FOLLOW-UP PLAN FOR THE NEPHRITIS SCREEN — GIVE IT IN WRITING AT THE FIRST VISIT

- **What:** blood pressure + early-morning urine dipstick at every visit; protein ≥ 1+ → urine

protein:creatinine ratio; creatinine/eGFR at diagnosis and whenever the urine is abnormal[517,519].

- **When:** diagnosis · **day 7** (a normal day-7 urinalysis predicts a normal renal outcome with 97% negative predictive value[520]) · day 14 · day 28 · months 2, 3 and 6 — at least monthly for 6 months even if normal[518,519]. Most nephritis appears within 4 weeks of the rash (about 85%) and nearly all within 6 months (Narchi 2005 systematic review)[521], so early normal results do not shorten the schedule; SHARE advises monitoring for at least 6–12 months[517].
- **Discharge from surveillance** at 6 months if blood pressure and urine have stayed normal; extend to 12 months if any abnormality occurred[517,518]; biopsy-proven nephritis is followed for years by nephrology[518,519].
- **Nephrology now:** urine protein:creatinine > 250 mg/mmol at any time (biopsy if it persists 4 weeks); 100–250 mg/mmol persisting (biopsy if 3 months); eGFR < 90 mL/min/1.73 m²

(biopsy if < 80); hypertension; nephrotic or nephritic syndrome; acute kidney injury[517,518,519]. ACE inhibitor/ARB for proteinuria lasting > 3 months[517].

- **Steroids do not prevent nephritis** — no prednisolone for the rash; reserve it for severe abdominal pain/GI bleeding once intussusception is excluded, orchitis, or other severe organ involvement[517,518].

ADMIT · DISCHARGE · REFER

- **Admit** — only for the indications above.
- **Home** — outpatient follow-up per the schedule, with the return precautions explained.
- **Refer — now** — surgery if intussusception; urology if the scrotum is involved.
- **Refer — clinic** — nephrology per the thresholds above.

MIS-C (Multisystem Inflammatory Syndrome)

MINUTES CDC/CSTE 2023 · ACR 2022

Post-COVID hyperinflammation that overlaps Kawasaki and toxic shock — and can crash the heart.

RECOGNIZE (CRITERIA)

- **CDC/CSTE 2023 case definition** — age < 21 y with **fever ≥ 38.0 °C** (subjective or documented; no minimum duration), **illness severe enough to need admission**, **CRP ≥ 3.0 mg/dL (30 mg/L)**, and **new involvement of ≥ 2 of 5 systems**: **cardiac** (LVEF < 55 %, coronary dilation/aneurysm/ectasia, or raised troponin) · **mucocutaneous** (rash, oral mucosal inflammation, conjunctival injection, or extremity erythema/edema) · **shock** · **gastrointestinal** (abdominal pain, vomiting, diarrhea) · **hematologic** (platelets < 150 $\times 10^9$/L or lymphocytes < 1.0 $\times 10^9$/L) — with **no more likely alternative diagnosis**.[522]
- **SARS-CoV-2 link: confirmed** when PCR or antigen is positive within the 60 days before or during admission, or antibodies are detected during the

illness; **probable** when there was close contact with COVID-19 in the preceding 60 days.[522]

⚠ IT LOOKS LIKE SEVERAL KILLERS AT ONCE

- Overlaps **Kawasaki disease, toxic shock syndrome and sepsis** — treat the shock, take cultures and cover for sepsis until excluded[497].
- Prominent abdominal pain can mimic appendicitis. **Cardiac**: myocardial dysfunction, arrhythmia and **coronary artery aneurysms** — get an early echocardiogram and troponin/BNP[497].
- **Shock is often compensated at first.** Tachycardia, cool or mottled extremities, prolonged capillary refill, weak pulses, reduced urine output or drowsiness **with a normal blood pressure** is shock until proven otherwise — hypotension is a late sign[3]. Myocardial dysfunction can be insidious and children can decompensate rapidly: examine perfusion at every review, get the **echocardiogram early** (left-ventricular function, coronary z-scores), and repeat

troponin/BNP[497]. Fluid cautiously (5–10 mL/kg, reassess) and start epinephrine early if the heart is the problem.

WORKUP

- **Inflammatory:** CRP, ESR, **ferritin**, procalcitonin, CBC (lymphopenia), fibrinogen[497], **D-dimer**.
- **Cardiac: troponin, BNP/NT-proBNP, ECG and echocardiogram** (coronary arteries + function)[497].
- **SARS-CoV-2** PCR and serology; **blood cultures** to exclude sepsis[497].
- CMP, LDH, triglycerides, coagulation.
- **Tiered approach when the child is stable:** tier 1 (any facility) CBC with differential, metabolic panel, ESR, CRP, SARS-CoV-2 testing → proceed to tier 2 (cardiac markers, ECG, echocardiogram, ferritin, D-dimer, procalcitonin, cytokine panel if available) when ESR/CRP is raised **plus one of**: lymphocytes < 1.0 $\times 10^9$/L, platelets < 150 $\times 10^9$/L, sodium < 135 mmol/L, neutrophilia or hypoalbuminemia (ACR 2022). A child with shock is treated while the work-up is completed[497].

- **Admit for observation** while under investigation if any of: abnormal vital signs, respiratory distress, altered mental status, renal or hepatic injury, marked inflammatory markers, abnormal ECG, or raised troponin/BNP[497]. ECG at least every 48 h in hospital; telemetry if conduction is abnormal[497].

TREATMENT PATHWAY — ACR 2022 (STEPWISE; DUAL THERAPY FIRST-LINE FOR MOST ADMITTED CHILDREN)

1 · First-line — IVIG (after the first glucocorticoid dose)

DRUG & DOSE

2 g/kg (ideal body weight, max 100 g)

NOTES

Start IVIG **after the first glucocorticoid dose has been given** and once cardiac function and fluid status have been assessed; with cardiac dysfunction give 1 g/kg/day over 2 days, slow the rate and/or add a diuretic to avoid volume overload[497]

1 · First-line — methylprednisolone, given first

DRUG & DOSE

1–2 mg/kg/day IV
Give the first dose at once — before the IVIG infusion is set up

NOTES

Dual therapy with IVIG for most hospitalized patients (ACR 2022); giving IV methylprednisolone **before** the IVIG reduces cardiac inflammation and improves cardiac function before the heart is loaded with the IVIG volume (CPS 2021); furosemide halfway through the infusion may be considered when cardiac function is impaired[523]; IVIG alone only in mild disease or when steroids are contraindicated, with intensification at the first sign of worsening. Glucocorticoid monotherapy is not recommended[497]

2 · Refractory (no response within 24 h: persistent fever or ongoing organ involvement) or shock on inotropes

DRUG & DOSE

Methylprednisolone pulse 10–30 mg/kg/day

NOTES

Do **not** repeat IVIG (hemolysis, volume overload). Children in shock on multiple inotropes/vasopressors respond best to high-dose glucocorticoid[497]

2 · Alternatives

DRUG & DOSE

Anakinra > 4 mg/kg/day (often 5–10 mg/kg/day) IV/subcut · or infliximab 5–10 mg/kg IV once

NOTES

No infliximab if there are features of macrophage activation syndrome; anakinra also as a steroid-sparing agent[497]

Aspirin

DRUG & DOSE

3–5 mg/kg/day PO (max 81 mg)

NOTES

All patients unless active bleeding, significant bleeding risk or platelets ≤ 80 $\times 10^9$/L; continue until platelets are normal and coronaries are confirmed normal at ≥ 4 weeks; add gastric protection with steroids[497]

Anticoagulation

DRUG & DOSE

Enoxaparin (anti-Xa 0.5–1.0) + low-dose aspirin

NOTES

Coronary z-score ≥ 10: enoxaparin for ≥ 2 weeks, then warfarin (INR 2–3) or DOAC for as long as z ≥ 10 · **Ejection fraction < 35%:** therapeutic anticoagulation until EF > 35% · **Documented thrombosis:** therapeutic anticoagulation for 3 months, re-image at 4–6 weeks · Otherwise individualized to thrombosis risk (central line, age > 12 y, PICU, D-dimer > 5 × ULN) [497]

Taper

DRUG & DOSE

2–3 weeks or longer

NOTES

Guided by serial CRP/ferritin and cardiac reassessment to avoid rebound [497]

◈ CARDIAC FOLLOW-UP

- Repeat echocardiogram at 7–14 days and at 4–6 weeks in every child (more often with LV dysfunction or aneurysms); consider one at 1 year if the heart was involved; cardiac MRI at 2–6 months after moderate–severe LV dysfunction [497].

ADMIT · REFER

- **Admit** — all confirmed cases; PICU for shock, cardiac dysfunction or conduction abnormality.
- **Refer — now** — call pediatric rheumatology/infectious diseases and cardiology from the start (multidisciplinary team).
- **Refer — clinic** — follow up coronary imaging.

17 Surgical Emergencies

Recognize early · resuscitate · refer fast

Malrotation / Midgut Volvulus

MINUTES OFTEN < 1 MO

Bilious (green) vomiting in a well infant — the "drop-everything" abdomen.

RECOGNIZE

Bilious vomiting ± distension/pain; bloody stool and shock are late (ischemia)[524].

RESUSCITATE & CONFIRM

- Nil by mouth, NG decompression, IV fluids, bloods.
- **Urgent upper-GI contrast** (abnormal duodeno-jejunal junction, "corkscrew") ± Doppler ultrasound[524].

CONSULT FIRST

- Consult **pediatric surgery immediately** — for definitive care and **safe transport**.
- Do not image at a center that will not operate; if surgery is unavailable on-site, **transfer without delaying for contrast studies**.

Immediate surgery — Ladd procedure. Peritonitis or shock → straight to the operating room, do not delay for imaging[525].

ADMIT · DISCHARGE · REFER

- **Admit** — all suspected → emergency, nil by mouth, fluids.
- **Home from the ward** — not acutely; post-operative.

- **Refer — now** — pediatric surgery IMMEDIATELY (bilious vomiting = volvulus until excluded); urgent upper-GI contrast.[525]

Intussusception HOURS 6 MO–3 YR

Telescoping bowel; the classic triad is usually incomplete.

RECOGNIZE

- Intermittent colicky pain (drawing up the legs), vomiting, lethargy between episodes.
- Sausage-shaped mass; "redcurrant jelly" stool is **late**. Unexplained lethargy may be the only clue[526].

CONFIRM

Ultrasound — "target/doughnut" sign (highly sensitive and specific in experienced hands)[526]. Resuscitate with IV fluids first.

DECISION

Stable, no peritonitis/perforation?

YES

Non-operative air or contrast enema reduction — perform only at a center with **pediatric surgical backup** where the child will be definitively treated (perforation needs immediate surgery)[526].

NO / failed

Operative reduction; resect non-viable bowel[526].

ADMIT · DISCHARGE · REFER

- **Admit** — all → for reduction and observation.
- **Home from the ward** — after successful reduction and an observation period without recurrence.
- **Refer — now** — pediatric surgery and interventional radiology (air/contrast enema); surgery if reduction fails or peritonitis.

Hypertrophic Pyloric Stenosis

HOURS

3–6 WK

Progressive non-bilious projectile vomiting in a hungry infant.

RECOGNIZE & CONFIRM

- "Olive" mass, visible gastric peristalsis, dehydration. Labs: **hypochloremic hypokalemic metabolic alkalosis.**[527] Ultrasound: muscle ≥ 3–4 mm, channel ≥ 14–16 mm[527].

① CORRECT FIRST

Rehydrate and normalize chloride, potassium and bicarbonate **before** surgery. NG if vomiting[527].

② Pyloromyotomy once biochemically stable. The electrolytes are the emergency, not the surgery[527].

ADMIT · DISCHARGE · REFER

- **Admit** — all → correct fluids/electrolytes before surgery.
- **Home from the ward** — post-operative, feeding established.

- **Refer — now** — pediatric surgery (pyloromyotomy) after biochemical correction — it is not a surgical emergency until corrected.

Acute Appendicitis HOURS

Most common surgical abdomen; young children atypical, high perforation risk.

RECOGNIZE

- Periumbilical pain migrating to the right lower quadrant, anorexia, fever, vomiting; guarding/rebound, pain on movement[528].
- Clinical scores (Alvarado / Pediatric Appendicitis Score) + ultrasound first-line; CT or MRI selectively[528].

MANAGE

Nil by mouth · IV fluids · analgesia for pain · **urgent surgical evaluation** → laparoscopic appendectomy **within 24 h of admission**. For **uncomplicated** appendicitis, **antibiotics alone** are an accepted alternative in children (WSES 2025, conditional) with close monitoring and shared decision-making — a surgical-team decision. With an **appendiceal abscess**, early laparoscopic appendectomy is suggested; non-operative treatment is the alternative where expertise is lacking, without routine interval appendectomy.[528]

⚠ MIMICS

Examine the testes (torsion), consider DKA (see **Diabetic Ketoacidosis**), lower-lobe pneumonia, UTI, ovarian torsion (clinical practice point).

⚠ DO NOT BYPASS SURGICAL EVALUATION

- **Antibiotics —** not for *suspected* appendicitis before surgical assessment; started before diagnosis is confirmed, they can partially treat and mask it (blunted

WBC/neutrophils, softer signs) — expert practice point, not guideline-stated.

- Start once diagnosis is confirmed and surgical plan agreed — or immediately if the child is septic or perforated. **Analgesia —** never leave a child in pain, but stay opioid-sparing while awaiting surgical review: give non-opioid analgesia first (IV or oral acetaminophen).
- Never give parenteral opioids then discharge an undifferentiated abdomen.
- Analgesia does not reduce diagnostic accuracy — never a reason to delay evaluation[529].

ANTIBIOTICS — ONCE DIAGNOSIS CONFIRMED AND SURGICAL PLAN AGREED (OR NOW, IF SEPTIC/PERFORATED)

Piperacillin-tazobactam

DOSE

100 mg/kg/dose (piperacillin component) IV every 8 h
2–9 months: 80 mg/kg/dose IV every 8 h
> 40 kg (adult dose): 3.375 g (piperacillin 3 g + tazobactam 0.375 g) IV every 6 h

ROUTE & NOTES

Single-agent cover including anaerobes; common first choice[530,531].

Ceftriaxone + metronidazole

DOSE

Ceftriaxone 50–75 mg/kg/dose IV once daily (max 2 g) + metronidazole 10 mg/kg/dose IV every 8 h (max 500 mg/dose)

ROUTE & NOTES

Alternative combination; give the first dose promptly once diagnosed[25,530].

◈ DURATION

- Uncomplicated appendicitis: perioperative prophylaxis only — a single pre-operative dose; WSES 2025 makes no recommendation on postoperative antibiotics in children (very low certainty)[528].
- Complicated or perforated: continue ~4–5 days after

adequate source control, or until afebrile with a normalizing white count and returning bowel function (STOP-IT — a predominantly adult trial; pediatric use is extrapolated)[532].

ADMIT · DISCHARGE · REFER

- **Admit** — all → under the surgical team (appendectomy, or antibiotics alone in selected uncomplicated cases).
- **Home from the ward** — post-operative per pathway.
- **Refer — now** — pediatric surgery; interventional radiology for an abscess (drainage) when non-operative.

Incarcerated Inguinal Hernia HOURS

Irreducible tender groin or scrotal lump — reduce it or operate.

RECOGNIZE

- Firm, tender, **irreducible swelling** in the groin extending to the scrotum or labia; irritability and vomiting (may

mimic bowel obstruction[533]).

- Common in infancy, especially preterm.[534] **Overlying skin erythema or a toxic child suggests strangulation[533].**

REDUCE

- If no signs of strangulation: analgesia or sedation, head-down (Trendelenburg) position, gentle sustained manual reduction (taxis) by experienced hands[533].
- If it does not reduce on the first attempt, stop and consult pediatric surgery — repeated attempts worsen edema and make later reduction harder[533].
- Once reduced, admit for repair on the same admission — re-incarceration risk is high[533,534].

⚠ DO NOT REDUCE — STRAIGHT TO SURGERY

Skin erythema, systemic toxicity, peritonitis, bloody stools, or prolonged incarceration — signal ischemic bowel or gonad → emergency exploration[533].

ADMIT · DISCHARGE · REFER

- **Admit** — all → for reduction/observation or surgery.

- **Home from the ward** — after repair on the same admission (usually 24–48 h after reduction, once edema settles); discharge before repair only by explicit pediatric-surgical decision with a booked early date and clear return advice.
- **Refer — now** — pediatric surgery urgently; emergency if irreducible or strangulated.

18

Toxicology & Environmental

Poisoning · burns · heat & drowning

Poisoning & Toxic Ingestion HOURS

Resuscitate, identify the agent, call for advice, give the antidote.

☎ Kuwait Poison Control Center (KPCC): 1804774 — 24/7. Call early for any exposure: agent-specific advice, decontamination, antidotes, and disposition.[8]

GENERAL APPROACH (ABCDE FIRST)

- Stabilize airway, breathing, circulation; give oxygen; check glucose and a 12-lead ECG (QRS width, QT interval).[535]
- Identify the agent, amount, time, and intent; in any deliberate ingestion send **acetaminophen and salicylate levels**.[535,536]
- Decontamination: decide in the first hour, with KPCC — single-dose activated charcoal, whole bowel irrigation, or neither (box below).[8,537,538]
- Call KPCC **1804774**; give the specific antidote below; observe for delayed toxicity.[8]

DECONTAMINATION — DECIDE IN THE FIRST HOUR

- **Stabilize first.** Gut decontamination is **never routine**: neither activated charcoal nor whole bowel irrigation (WBI) has been shown to improve outcome — use it only after a potentially toxic ingestion, and decide with KPCC **1804774**.[8,538,539,540]

- **Swallowed a poison that charcoal binds, and the airway is safe** (awake with intact airway reflexes, or already intubated) → **single-dose activated charcoal**, as early as possible: most benefit within 1 h; for many poisons still worthwhile up to 6 h, and later when absorption continues (modified-release products, tablet masses, very large ingestions).[537,539]
- **Carbamazepine, cardiac glycosides, colchicine, dapsone, phenobarbital, phenytoin, thallium or theophylline → multiple-dose activated charcoal** to speed elimination, on toxicology advice.[537,541]
- **Substantial iron, lithium or potassium**, a **sustained-release or enteric-coated** drug (especially > 2 h after ingestion), or **swallowed drug packets** (body packing) → consider **WBI**: charcoal has no role for iron or lithium, and there are few other ways to empty the gut.[537,538,540]
- **Charcoal and the airway.** Not intubated → give charcoal **by mouth only**; do **not** pass a nasogastric tube just to give it. Already intubated for another reason (unprotected airway,

respiratory failure, low conscious level, refractory seizures, shock) → a nasogastric or orogastric tube for charcoal is reasonable. Do **not** intubate just to give charcoal, unless life-threatening toxicity is expected; decide with a toxicologist.[537]

- **Not recommended: routine gastric lavage**: should not be used routinely, if ever; if ever considered, only by experienced staff with a protected airway.[542] **Ipecac**: no benefit; delays charcoal, oral antidotes and WBI.[543]

Activated charcoal — single dose

DOSE / RATE

1 g/kg once
max 50 g
by mouth; by nasogastric/orogastric tube only if intubated (confirm tube position on X-ray)
additional (second) dose, if advised: same dose[535,537]

USE FOR · DO NOT USE

Use for a potentially toxic amount of a poison that charcoal binds (most drugs), with a safe airway. An **additional dose** may be advised after carbamazepine, acetaminophen, paraquat, phenobarbital, salicylates, thallium, theophylline, valproic acid or verapamil, modified-release products, or a dose too large for one charcoal dose. **No role** (do not give): iron, lithium, alcohols (ethanol, methanol, ethylene glycol), lead, arsenic, copper, caesium, metformin. **Do not use** if airway reflexes are absent or may be lost (unless intubated), with a risk of bowel perforation, absent peristalsis, likely upper endoscopy (caustics — see **Caustic (Corrosive) Ingestion**), or a hydrocarbon with high aspiration risk[535,537,539]

Activated charcoal — multiple dose

DOSE / RATE

first dose 1 g/kg (max 50 g)
then 1 g/kg (max 50 g) every 4 h
or 0.5 g/kg (max 25 g) every 2 h
continue until the child's condition and drug levels are improving
IV antiemetic often needed[537,541]

USE FOR · DO NOT USE

Use for poisoning with carbamazepine, cardiac glycosides, colchicine, dapsone, phenobarbital, phenytoin, thallium or theophylline — to speed

elimination, on toxicology advice. **Do not use** without an intact or protected airway, or with bowel obstruction[537,541]

Whole bowel irrigation (WBI)

DOSE / RATE

polyethylene glycol electrolyte solution (PEG-ES) by small-bore nasogastric tube (tip in mid-stomach on X-ray)
9 months–6 years: 500 mL/h
6–12 years: 1000 mL/h
adolescents: 1500–2000 mL/h
sitting up, or head of bed ≥ 45°
continue at least until the rectal effluent is clear (many hours); longer if X-ray or ongoing passage shows toxin still in the gut
vomiting: parenteral non-sedating antiemetic (metoclopramide also speeds gastric emptying); if it persists, halve the rate for 30–60 min, then resume[540]

USE FOR · DO NOT USE

Consider for substantial iron, lithium or potassium ingestion; sustained-release or enteric-coated drugs, especially > 2 h after ingestion; swallowed packets of illicit drugs (body packing) — no proven outcome benefit. **Do not use** with bowel obstruction, perforation or ileus, clinically significant gastrointestinal bleeding, an unprotected or compromised airway, hemodynamic instability, or uncontrollable vomiting; caution in debilitated children. Charcoal given during WBI may bind less[538,540]

◣ RECOGNIZE THE TOXIDROME — THE PATTERN NAMES THE POISON BEFORE THE HISTORY DOES

↑ increased · ↓ decreased · ± can go either way · **normal** = usually

unchanged · **no specific change** = sources describe no typical finding. Patterns are typical, not universal: dose, timing, age and co-ingestants change them. The combination of vital signs, pupils, gut and skin is more reliable than any single sign; a known ingestion does not exclude a second agent.[535]

How the colors work: the color shows the **state of the child** —

- **red · orange · pink = excited**
- **blue · gray = depressed**
- **green = wet (secretions)**
- **purple = metabolic (fast, deep breathing)**

Then **skin, gut, pupils and breathing** separate patterns of the same color: excited + **sweaty** = sympathomimetic, or serotonin toxicity if there is **clonus**; excited + **dry skin, quiet gut** = anticholinergic; depressed + **pinpoint pupils and slow breathing** = opioid; depressed + **near-normal vital signs** = sedative-hypnotic (benzodiazepine alone; alcohol and barbiturates do slow breathing); wet + **pinpoint pupils** = cholinergic, though a young child may show only coma and floppiness. The line under each name (e.g. “hot, red,

dry, blind, mad, full") is the memory hook.[535,544,545,546,547]

EXCITED — FAST, HOT, AGITATED

Sympathomimetic

amphetamines, cocaine, pseudoephedrine, caffeine, ADHD stimulants

🔥 **fast, hot, wet, wild**

MENTAL STATUS

Agitation, psychosis, hallucinations; seizures

VITAL SIGNS · BREATHING

HR ↑ · BP ↑ · T ↑ (hyperpyrexia) · RR ↑

PUPILS · GUT · SKIN

Pupils dilated · gut: no specific change · skin **sweaty**

CLUES

Wet skin separates it from anticholinergic; clonus points to serotonin toxicity instead; tremor, hyperreflexia, rhabdomyolysis; tachycardia may be absent on β-blockers[535,544,546,548,549]

Anticholinergic

antihistamines (diphenhydramine), tricyclics, atropine/ scopolamine, antipsychotics, *Datura*

🌵 **hot, red, dry, blind, mad, full**

MENTAL STATUS

Agitated delirium, hallucinations, or drowsiness; seizures, coma

VITAL SIGNS · BREATHING

HR ↑ · BP mildly ↑ (↓ if severe) · T ↑ (usually ≤ 38.8 °C) · RR ↑

PUPILS · GUT · SKIN

Pupils dilated, poorly reactive (may look fixed) · gut ↓ (bowel sounds ↓ or absent) · skin hot, flushed, **dry**; dry mouth

CLUES

Urinary retention (“full”); dry skin and a quiet gut separate it from sympathomimetic and serotonin toxicity; no clonus; wide QRS with diphenhydramine or tricyclics (get an ECG); antihistamine overdose in young children: excitation, hallucinations, seizures [10,535,544,546,548,550]

Serotonin syndrome

SSRIs/SNRIs, alone or with linezolid, tramadol, dextromethorphan, ondansetron or methylene blue; MDMA

⚡ clonus, sweat, hot, agitated

MENTAL STATUS

Agitation, hypervigilance, easy startle → agitated delirium, coma

VITAL SIGNS · BREATHING

HR ↑ · BP ↑ (severe: may collapse into shock) · T normal (mild) to ↑ (> 41 °C life-threatening) · RR ↑

PUPILS · GUT · SKIN

Pupils dilated · gut ↑, diarrhea · skin sweaty, shivering

CLUES

Clonus (inducible, spontaneous, ocular), hyperreflexia, tremor; legs > arms; rigidity in severe cases may mask clonus; about 60% present within 6 h of a new drug, dose change or overdose; Hunter criteria[10,535,544,551,552]

DEPRESSED — SLOW, SLEEPY

Opioid

morphine, methadone, fentanyl, codeine, tramadol, buprenorphine

slow, small pupils, not breathing

MENTAL STATUS

Sedation → stupor → coma

VITAL SIGNS · BREATHING

HR normal or ↓ · BP normal or ↓ · T normal or ↓ · **RR ↓ (apnea): the defining sign**

PUPILS · GUT · SKIN

Pupils pinpoint (may be normal or dilated with tramadol, meperidine or co-ingestants; dilated if hypoxic) · gut ↓ · skin cold, clammy

CLUES

Naloxone response. Children: toxicity may be delayed, severe and prolonged; admit children ≤ 3 y for 24 h after methadone, a fentanyl patch or an extended-release opioid, and admit any toddler exposed to buprenorphine. **Clonidine, or imidazoline eye-drop / nasal-spray, ingestion** in young children mimics it: lethargy, bradycardia, hypotension, respiratory depression; no worsening after 4 h; pupils small or dilated; naloxone response inconsistent[535,545,553,554,555,556]

Sedative-hypnotic

benzodiazepines, Z-drugs (zolpidem), barbiturates, alcohol

💤 asleep, near-normal vital signs

MENTAL STATUS

Drowsiness → coma; dysarthria, ataxia

VITAL SIGNS · BREATHING

Benzodiazepine alone: HR, BP, RR usually normal · barbiturates, alcohol: BP ↓ · RR ↓ · T ↓ · HR ±

PUPILS · GUT · SKIN

Pupils normal or small (dilated late in severe barbiturate poisoning) · gut and skin: no specific change

CLUES

Isolated benzodiazepine overdose rarely causes life-threatening hypoventilation or hypotension; if present, look for a co-ingestant (alcohol, opioid); miosis + coma *without* marked respiratory depression points away from opioid[535,545,546,549,557]

WET — SECRETIONS EVERYWHERE

Cholinergic

organophosphate and carbamate pesticides

💧 **wet everywhere: DUMBELS**

MENTAL STATUS

Lethargy, confusion → coma; seizures in about 1 in 5 children

VITAL SIGNS · BREATHING

HR ↓ or ↑ (tachycardia in about half of children) · BP ± · T: no specific change · bronchorrhea, bronchospasm → respiratory failure

PUPILS · GUT · SKIN

Pupils **pinpoint** (in about 3 of 4 children) · vomiting, diarrhea · sweating, salivation, tears

CLUES

Fasciculations, weakness; pesticide/solvent smell; carbamates look the same; atropine titrated to a dry chest (antidote table). **Young children:** CNS depression and floppiness may dominate and muscarinic signs may be missing, so their absence does not exclude it[535,546,547,558,559]

METABOLIC — FAST DEEP BREATHING

Salicylate

aspirin, oil of wintergreen, bismuth subsalicylate

🌀 fast breathing, ringing ears, acidosis

MENTAL STATUS

Lethargy, confusion → seizures, coma

VITAL SIGNS · BREATHING

RR ↑, deep (hyperpnea): respiratory alkalosis early, then anion-gap metabolic acidosis · T ↑ (hyperpyrexia = advanced poisoning) · HR ↑ with fever or dehydration · BP: no specific change

PUPILS · GUT · SKIN

Pupils: no specific change · vomiting, abdominal pain, hematemesis · skin sweaty

CLUES

Tinnitus, deafness, dehydration; cerebral and non-cardiogenic pulmonary edema; oil of wintergreen 1 mL ≈ aspirin 1.4 g, so more than a lick or taste in a child < 6 y needs ED assessment; a normal acid–base picture does not exclude toxicity: keep a low threshold for a salicylate level[535,560]

Acetaminophen (paracetamol)

ANTIDOTE · DOSE

Acetylcysteine IV — total 300 mg/kg; dose weight capped at 100 kg
Two-bag (20 h), preferred ≥ 41 kg: 200 mg/kg over 4 h → 100 mg/kg over 16 h
Three-bag (21 h), use ≤ 40 kg: 150 mg/kg over 1 h → 50 mg/kg over 4 h → 100 mg/kg over 16 h
High-risk ingestion: double the final 16-h bag to 200 mg/kg over 16 h (the second bag of the two-bag regimen; the third bag of the three-bag regimen) — on toxicology advice[536,561,562]

RATE · TARGET · MONITOR

Treat if the level is on/above the nomogram treatment line (150 mg/L at 4 h). The **high-risk line** (300 mg/L at 4 h) marks a large ingestion — give a higher acetylcysteine dose and call toxicology.[536] Both regimens prevent liver injury equally; the two-bag causes fewer anaphylactoid reactions, so it is preferred where weight allows.[563,564] Dilute in 0.45% sodium chloride (preferred) or 5% dextrose; adjust the volume < 41 kg (≤ 20 kg loading bag 3 mL/kg) — unadjusted volumes cause **hyponatremia, seizures**.[562] Monitor acetaminophen, ALT/AST, INR, electrolytes. **Stop** only when acetaminophen < 10 mg/L, INR < 2.0, ALT/AST normal or fallen 25–50% from peak, and the child is well — do not stop automatically at 20–21 h.[536,561]

Anticholinergic

ANTIDOTE · DOSE

Physostigmine 0.02 mg/kg IV; may repeat every 5–10 min to effect, up to a total of 2 mg
— or a benzodiazepine for agitation[535,565,566]

RATE · TARGET · MONITOR

Give by **slow** IV, ≤ 0.5 mg/min, for anticholinergic delirium/agitation; reverses central and peripheral signs and outperforms benzodiazepines, which do not reverse delirium.[566,567] Keep **atropine** at the bedside.[565] **Do not give if the QRS is prolonged on the ECG**; use caution after an overdose of a QRS-prolonging drug (e.g., a tricyclic) and with known coronary disease — bradyasystolic arrest and seizures have been reported.[568] Monitor ECG, heart rate and secretions; watch for cholinergic excess (bradycardia, bronchorrhea, vomiting).[565]

Benzodiazepine

ANTIDOTE · DOSE

Supportive care (airway, ventilation) — the mainstay
Flumazenil 0.01 mg/kg IV (max 0.2 mg per dose) over 15 s; may repeat every 60 s, up to 4 further doses — max total 0.05 mg/kg or 1 mg, whichever is lower — selected cases only[549,569]

RATE · TARGET · MONITOR

Isolated benzodiazepine overdose is rarely fatal — observe and support breathing. Reserve flumazenil for reversing pure benzodiazepine respiratory depression in a **benzodiazepine-naïve** child (e.g., iatrogenic procedural sedation).[549] **Avoid in undifferentiated overdose**: it can precipitate seizures or dysrhythmias in benzodiazepine-dependent patients or with co-ingested tricyclics, and is contraindicated when a benzodiazepine is controlling a life-threatening condition (e.g., status epilepticus, raised intracranial pressure) or with signs of serious tricyclic overdose.[549,569] Observe for resedation up to ~2 h after use.[569]

Beta-blocker

ANTIDOTE · DOSE

High-dose insulin: 1 unit/kg IV bolus, then 1–10 units/kg/h
Vasopressors (norepinephrine/epinephrine), titrated
Glucagon 0.05–0.15 mg/kg IV bolus, then infusion 1–15 mg/h (adult range; do not exceed the adult dose) [549,570]

RATE · TARGET · MONITOR

Severe toxicity (hypotension, bradycardia, conduction block): call KPCC 1804774 and PICU early.[8] Give vasopressors and high-dose insulin for hypotension; insulin is an inotrope, so start it early, together with a vasopressor.[549,570] Run dextrose to keep glucose normal (needed for ~24 h after insulin stops) and replace potassium. **Monitor glucose and potassium frequently.**[570,571] Glucagon for bradycardia or hypotension; expect vomiting.[549] Escalate to pacing or VA-ECMO for refractory shock.[549]

Calcium-channel blocker

ANTIDOTE · DOSE

Calcium chloride 10% 0.2 mL/kg (20 mg/kg) — or calcium gluconate 10% 0.6 mL/kg (60 mg/kg) — IV, repeat every 10–20 min or infuse
High-dose insulin 1 unit/kg bolus then 1–10 units/kg/h
Vasopressors (norepinephrine/epinephrine) [549, 571]

RATE · TARGET · MONITOR

Severe toxicity (hypotension, bradycardia, conduction block): call KPCC 1804774 and PICU early.[8] Give calcium (central line preferred, especially in children), high-dose insulin and vasopressors as first-line for hypotension; the choice is led by the clinical picture.[549,571] Titrate calcium to blood pressure; **do not exceed ionized calcium 1.5–2× the upper normal**. Run dextrose and replace potassium with high-dose insulin — **monitor glucose and potassium frequently**.[549,571] Lipid emulsion and VA-ECMO are rescue options. These steps come from an adult expert consensus; pediatric data are limited.[571]

Carbon monoxide

ANTIDOTE · DOSE

Oxygen 100% by non-rebreather mask, or by endotracheal tube if intubated[572]
Continue until symptom-free[18]
Hyperbaric oxygen (HBO) — consider for every acute symptomatic CO poisoning; children can be treated safely[572]

RATE · TARGET · MONITOR

Refer for HBO whatever the COHb if any loss of consciousness, neurologic signs, cardiovascular dysfunction or severe acidosis; COHb correlates poorly with severity, so use it as one factor, not a cut-off (COHb ≥ 25% is one more reason to discuss HBO); the shortest delay gives the best result[572,573]

Children take up CO faster than adults but also clear it faster[572]

Monitor — COHb by co-oximetry on venous or arterial blood; COHb ≥ 2% supports the diagnosis in a non-smoker[18]

Pulse oximetry is falsely reassuring — a standard oximeter cannot tell COHb from oxyhemoglobin; a pulse CO-oximeter (SpCO) cannot rule CO out[572]

Fire victim → treat cyanide too (next row); HBO is also indicated for CO with cyanide poisoning[572] — see **Smoke Inhalation & Carbon Monoxide Poisoning**

Cyanide (smoke inhalation, nitroprusside)

ANTIDOTE · DOSE

Hydroxocobalamin 70 mg/kg IV/IO (max 5 g) over 15 min[20,549,574]
Second dose if needed: 70 mg/kg (max 5 g) over 15 min (very unstable) to 2 h
Total max 140 mg/kg (max 10 g)[20,574]
± Sodium thiosulfate 250 mg/kg = 1 mL/kg of 25% (max 12.5 g = 50 mL), slow IV, in a separate line[549,575]
Oxygen 100%[549]

RATE · TARGET · MONITOR

Treat empirically — fire/smoke exposure with cardiac arrest, altered mental status, raised lactate, severe metabolic acidosis or hypotension[549]
Lactate > 10 mmol/L (fire victims) or ≥ 8 mmol/L (other cyanide poisoning) is a sensitive marker, but specificity is only moderate — do not rely on lactate alone[576,577]
Repeat — second dose according to severity and clinical response[574]
Monitor — blood pressure (transient rise); renal function (urea, creatinine) for 7 days; skin discoloration; hydroxocobalamin interferes with colorimetric laboratory tests[549,574]
Never give thiosulfate or nitrite through the hydroxocobalamin line[20]
Sodium nitrite only if hydroxocobalamin is unavailable — its methemoglobin may worsen oxygen delivery when CO is also present (smoke)[549]

Digoxin

ANTIDOTE · DOSE

Digoxin-specific immune Fab (each vial binds ~0.5 mg)
Acute, amount known: vials = body load (mg) ÷ 0.5, where body load = mg ingested × 0.8 for tablets (no correction for capsules/IV); round up
Acute, unknown: 10–20 vials (start 10, repeat 10)
Chronic, unknown level: adults/children ≥ 20 kg 6 vials; < 20 kg 1 vial
By level: vials = level (ng/mL) × weight (kg) ÷ 100[549,578]

RATE · TARGET · MONITOR

Give for life-threatening cardiac-glycoside toxicity — ventricular dysrhythmia, bradycardia/high-grade block unresponsive to atropine, or potassium > 5.5 mEq/L (adults) / > 6 mEq/L (children).[578] Infuse over ≥ 30 min (bolus if arrest is imminent). In small children reconstitute/dilute to avoid volume overload. **Monitor potassium closely for several hours** (can fall fast); serum digoxin becomes unreliable after Fab. Re-dose if toxicity persists or recurs.[549,578]

Iron

ANTIDOTE · DOSE

Deferoxamine IV, infusion rate up to 15 mg/kg/h; max 6,000 mg/24 h[579]

RATE · TARGET · MONITOR

Refer any ingestion ≥ 40 mg/kg elemental iron, or with severe or persistent symptoms (persistent vomiting or diarrhea, altered consciousness, hematemesis, bloody diarrhea).[580] Chelate for systemic toxicity, on toxicology (KPCC) advice.[8,579] Slow or stop the infusion for **rate-related hypotension**. **Limit continuous IV infusion to ~24 h** — longer durations are linked to ARDS.[579,581] Monitor blood pressure and urine colour (a reddish change may follow chelation); switch IV→IM once stable.[579]

Isoniazid

ANTIDOTE · DOSE

Pyridoxine IV — amount known: 1 g for each 1 g of isoniazid ingested[582,583]
Amount unknown: 80 mg/kg (maximum = adult dose, 5 g)
Slow IV bolus over 3–5 min
Repeat if seizures continue (more than 10 g is rarely needed)[582]
Diazepam if seizures continue after pyridoxine (doses: Convulsive Status Epilepticus)[582]

RATE · TARGET · MONITOR

Who — every symptomatic child, and any acute ingestion > 80 mg/kg even if well[582]
Expect seizures, severe metabolic acidosis and coma 30 min–3 h after ingestion[582]
Target — seizures stop; they may not respond to anticonvulsants until pyridoxine is given, so keep IV pyridoxine readily available[584]
Phenytoin only with caution (isoniazid slows its metabolism)[582] — see **Isoniazid Poisoning**

Local anesthetic systemic toxicity (LAST)

ANTIDOTE · DOSE

Lipid emulsion 20%
Under 70 kg: bolus 1.5 mL/kg over 2–3 min, then 0.25 mL/kg/min
Over 70 kg: bolus ~100 mL over 2–3 min, then ~250 mL over 15–20 min
Still unstable: repeat the bolus and double the infusion (0.5 mL/kg/min)
Max 12 mL/kg[549,585]
Epinephrine — smaller than usual doses; start with < 1 mcg/kg[585]
Seizures — benzodiazepine preferred[585]

RATE · TARGET · MONITOR

When — call for help, get the LAST rescue kit and give lipid early; LAST resuscitation is different from standard advanced life support[585]

Continue the infusion for > 15 min after the circulation is stable[585]

Avoid vasopressin, calcium-channel blockers, β-blockers and more local anesthetic[585]

Monitor — ≥ 2 h after a seizure; 4–6 h after cardiovascular instability[585]

Methanol / ethylene glycol

ANTIDOTE · DOSE

Fomepizole IV — loading 15 mg/kg
then 10 mg/kg every 12 h × 4 doses
then 15 mg/kg every 12 h
Each dose as a slow infusion over 30 min
During hemodialysis: every 4 h[586]
Methanol — add folinic (or folic) acid[587,588]
Ethanol only if fomepizole is unavailable (harder dosing, more monitoring, more adverse effects)[587]

RATE · TARGET · MONITOR

Stop when methanol or ethylene glycol is undetectable or < 20 mg/dL and the child is symptom-free with a normal pH[586]

Monitor — blood gas and pH, electrolytes, urea, creatinine, urinalysis, methanol/ethylene glycol levels[586]

Dialysis — methanol: coma, seizures, new visual loss, pH ≤ 7.15, acidosis despite antidote, anion gap > 24 mmol/L, methanol > 700 mg/L (21.8 mmol/L) on fomepizole, or impaired kidney function; stop when methanol < 200 mg/L (6.2 mmol/L) and the child is improving[588]

Dialysis — ethylene glycol: coma, seizures or acute kidney injury; glycolate > 12 mmol/L or anion gap > 27 mmol/L; consider if ethylene glycol > 50 mmol/L or osmolal gap > 50 on fomepizole; stop when anion gap < 18 mmol/L[589]

Adjust fomepizole doses during dialysis[586,589]

Methemoglobinemia

ANTIDOTE · DOSE

Methylene blue 1 mg/kg IV (range 1–2 mg/kg) over 5–30 min[21,549,590]

Repeat 1 mg/kg after 30–60 min if MetHb stays > 30% or symptoms persist[21,590]

Max cumulative 5–7 mg/kg (toxicity from 7 mg/kg)[21,549,590]

G6PD deficiency — contraindicated (hemolysis; may not work) → ascorbic acid or exchange transfusion[21,590]

RATE · TARGET · MONITOR

Treat when MetHb ≥ 20% with symptoms, or ≥ 30% without; 10–30% if symptomatic with heart or lung disease, significant anemia or CO poisoning[590]

Stop the oxidant; give oxygen; make sure glucose is available[590]

Target — MetHb falls within ~1 h; no response after 2 doses → exchange transfusion or hyperbaric oxygen (PICU)[21,590]

Monitor — MetHb by co-oximetry; pulse oximetry is unreliable (sticks near 85% with high MetHb) and methylene blue lowers the reading — use a blood gas[21,590]

MetHb may rebound after dapsone or aniline — recheck[21,590]

Serotonergic drugs or opioids — risk of serotonin syndrome; avoid the combination[21]

Infants with diarrhea and acidosis and MetHb < 20% may improve with fluids and bicarbonate alone[590]

Opioids

ANTIDOTE · DOSE

Naloxone 0.1 mg/kg IV/IO/IM (max 2 mg), repeat every 2–3 min
Small titrated increments if opioid-dependent
Infusion: two-thirds of the effective waking dose per hour[535,549,591]

RATE · TARGET · MONITOR

Titrate to adequate ventilation and airway reflexes, not full arousal.[549] In a known opioid-dependent child give gradual small increments to avoid precipitated withdrawal.[535,545] Naloxone is shorter-acting than most opioids, so **observe until consciousness and vital signs normalise** and start an infusion (⅔ of the effective dose per hour) if resedation occurs — longer for methadone, sustained-release products or buprenorphine.[545,549]

Organophosphate / carbamate

ANTIDOTE · DOSE

Atropine 0.02 mg/kg IV/IO (not above the adult 1–2 mg); double the dose every 5 min until the chest is dry
Then infusion 10–20% of the total loading dose per hour[549]
Pralidoxime (organophosphate) 20–50 mg/kg (max 2 g/dose) IV over 15–30 min
then 10–20 mg/kg/h
or repeat 20–50 mg/kg after ~1 h if weakness persists, then every 10–12 h[549,592]
Diazepam for seizures or agitation (doses: Convulsive Status Epilepticus)[558]

RATE · TARGET · MONITOR

Target — bronchorrhea and bronchospasm reversed, bradycardia and hypotension corrected (adult targets: pulse > 80/min, systolic BP > 80 mm Hg)[549,558]

Too much atropine → anticholinergic delirium[558]

Pralidoxime — never as a rapid bolus (vomiting, tachycardia, laryngospasm, rigidity); max 200 mg/min; start once atropine is working[558,592]

Known carbamate: pralidoxime is not indicated (may increase carbaryl toxicity)[592]

Succinylcholine — prolonged paralysis; use only with caution[592]

Monitor ≥ 48–72 h — sudden respiratory muscle weakness (intermediate syndrome), recurrent cholinergic signs, changing atropine needs[558,592]

Salicylate

ANTIDOTE · DOSE

Sodium bicarbonate — IV bolus, then infusion (≈ 150 mEq/L in 5% dextrose with potassium) to alkalinize the urine
Hemodialysis for severe poisoning[593,594,595]

RATE · TARGET · MONITOR

Alkalinize to a **urine pH 7.5–8.0**, running the infusion to a urine output ~2–3 mL/kg/h; check urine pH frequently.[593,594] **Keep potassium normal/high-normal** — hypokalemia prevents urinary alkalinization; replace early.[593,594] Maintain high minute ventilation if intubated (avoid respiratory acidosis).[593] **Hemodialysis** for altered mental status, ARDS needing oxygen, failure of standard therapy, severe acidemia, or a very high level (≈ 100 mg/dL acute).[593,595]

Serotonin syndrome

ANTIDOTE · DOSE

Stop all serotonergic drugs[544,596]
Benzodiazepine for agitation (doses: Convulsive Status Epilepticus)[544,596]
Active cooling[544,596]
Cyproheptadine — oral only; adult dose 4–12 mg for moderate toxicity; benefit unproven and dose not well defined[544,596]

RATE · TARGET · MONITOR

Severe — temperature > 39 °C with agitation, reduced consciousness, rigidity, or no response to cooling → early paralysis and intubation (PICU); supportive care comes before any antidote[544,596]
Monitor — temperature (rapid rise), muscle rigidity, clonus[596]
Expect improvement within 24 h of stopping the drug[544] — see **Drug-Induced Hyperthermia Syndromes**

Sodium-channel blocker / tricyclic

ANTIDOTE · DOSE

Sodium bicarbonate 1–3 mEq/kg IV bolus, repeat to narrow the QRS
Lidocaine if refractory[549]

RATE · TARGET · MONITOR

Give for QRS > 100 ms, ventricular dysrhythmia or hypotension; repeat boluses (then an infusion) until the **QRS narrows**, avoiding excessive alkalemia.[549,597] A class Ib agent (lidocaine) is a reasonable next step for refractory wide-complex toxicity; lipid emulsion for life-threatening cases unresponsive to other therapy.[549] Monitor the ECG (QRS width), blood pressure, serum pH, sodium and potassium.[549]

Sulfonylurea

ANTIDOTE · DOSE

Octreotide — children 1–1.5 µg/kg IV/SC, then 2–3 further doses 6 h apart (adults 50 µg)
Dextrose for hypoglycemia (bolus then infusion)[598,599]

RATE · TARGET · MONITOR

Treat hypoglycemia first with IV dextrose, then give octreotide to stop insulin release and prevent recurrent hypoglycemia; hypoglycemia recurred in half of the reported children, so repeat doses are often needed.[598,599] Taper the dextrose infusion as octreotide takes effect.[599] **Check glucose frequently**; do not give prophylactic IV dextrose.[598] **Observe ~12 h after the last octreotide/dextrose dose** for relapse — longer for large or sustained-release ingestions.[598,599]

Sympathomimetic (cocaine, amphetamines)

ANTIDOTE · DOSE

Sedation first — IV benzodiazepine titrated to control agitation (doses: Convulsive Status Epilepticus)[549,600]

Rapid external cooling for life-threatening hyperthermia — ice-water immersion or evaporative cooling (faster than cooling blankets or cold packs)[549,600]

Sodium bicarbonate 1–3 mEq/kg IV for cocaine wide-complex tachycardia or cardiac arrest (lidocaine is an alternative for the tachycardia)[549]

Vasodilator (nitrate, phentolamine, calcium-channel blocker) for coronary vasospasm or a hypertensive emergency that persists after sedation[549,600]

RATE · TARGET · MONITOR

Target — benzodiazepines are the mainstay of initial control of agitation and blood pressure[549]

Monitor — ECG, temperature; watch for seizures, hyperthermia, rhabdomyolysis, metabolic acidosis and myocardial infarction[600]

β-blockers — safety in cocaine toxicity is controversial (both benefit and harm reported)[549]

⚠ AVOID

- Flumazenil is generally avoided (seizure risk) — see the benzodiazepine row.[535]
- Several agents have **delayed or biphasic** toxicity (acetaminophen,[536] iron, sustained-release products,[535]

sulfonylureas[598]) — observe and recheck.

ADMIT · DISCHARGE · REFER

- **Admit** — symptomatic, a significant/unknown ingestion, or a delayed-toxicity agent (observe).
- **Home from the emergency department** — asymptomatic after the appropriate observation window with a non-toxic exposure.
- **Refer — now** — the poison center/toxicology; psychiatry for intentional ingestion; safeguarding as needed.

One Pill Can Kill — Toddler Alert

HOURS < 6 YR · AAPCC 2005–2007

One tablet or one teaspoon of these can seriously harm or kill a 10-kg toddler — observe for the full period even if the child is well.

RECOGNIZE

- One or two adult dose units can kill a 10-kg toddler. The classic list includes tricyclic antidepressants, antipsychotics, antimalarials (quinine derivatives), calcium-channel blockers, opioids, oral hypoglycemics, camphor and methyl salicylate.[601,602]
- These few drugs caused 40% of toddler poisoning deaths reported to US poison centers in 1990–2000.[602]
- The list keeps growing. By 2018 it had doubled, adding newer anticoagulants, a PDE-5 inhibitor, newer antiepileptics, antidiabetic drugs, multiple-sclerosis drugs and second-generation antipsychotics.[603]
- Toxicity can be **delayed and prolonged** (methadone, modified-release products,

sulfonylureas, diphenoxylate). A child who is well on arrival is not reassuring.[545,598,604,605]

DECIDE

- **Any possible ingestion of a listed agent by a child < 6 y = toxic**, even if the ingestion is unconfirmed or the amount unknown.[545,602,606]
- Call KPCC **1804774**. Check glucose and a 12-lead ECG on arrival.[8,535]
- **Observe for the full period in the table even if the child looks well. Never send home early.**[545]
- Do not induce emesis.[560,597,604,607]

AGENTS, DANGER DOSE AND MINIMUM OBSERVATION

Antimalarials — chloroquine, hydroxychloroquine

DANGER AT ONE DOSE

1–2 chloroquine tablets have caused serious toxicity
> 10 mg/kg chloroquine base or unknown amount: hospital
Treat hydroxychloroquine the same[606]

OBSERVE AT LEAST

4–6 h[606]

FIRST ACTION

12-lead ECG and cardiac monitor; call KPCC[535,601,606]

Antipsychotics — second-generation; phenothiazines

DANGER AT ONE DOSE

Child < 12 y, hospital at:
aripiprazole 15 mg
clozapine 50 mg
olanzapine 10 mg
quetiapine 100 mg
risperidone 1 mg
ziprasidone 80 mg[607]

OBSERVE AT LEAST

6 h[607]

FIRST ACTION

Continuous cardiac monitoring (conduction disturbances)[601,602,607]

Buprenorphine (tablet, film)

DANGER AT ONE DOSE

> 2 mg, or more than a lick or taste if < 2 y
Every child taking > 4 mg had some effect; most often drowsiness, vomiting, miosis; respiratory depression in 7%
Onset 20 min–3 h[608]

OBSERVE AT LEAST

Admit
Effects lasted 8–24 h in 26%, > 24 h in 4%[545,608]

FIRST ACTION

Naloxone for respiratory depression (at least partial response in 67%); dose in the **Poisoning** antidote table[545,608]

Calcium-channel blockers — amlodipine, nifedipine, verapamil, diltiazem

DANGER AT ONE DOSE

Amlodipine 5 mg caused hypotension in a 2-year-old[609]

OBSERVE AT LEAST

Immediate-release: 6–8 h
Modified-release: 24 h[604,609]

FIRST ACTION

Cardiac monitor, blood pressure; IV fluids, then IV calcium for hypotension (**antidote table**)[602,604,609]

Camphor — camphorated oil, rubs

DANGER AT ONE DOSE

5 mL of 20% camphorated oil killed a 19-month-old

> 30 mg/kg: hospital

Toxic effects, including seizures, often within 10–20 min[609,610]

OBSERVE AT LEAST

4–8 h (one seizure reported at 9 h)[609,610]

FIRST ACTION

Benzodiazepine for seizures; no activated charcoal[601,609,610]

Clonidine; imidazoline eye drops and nasal sprays

DANGER AT ONE DOSE

Clonidine 0.1 mg is toxic; one 0.3-mg tablet caused coma

1–2 mL of drops or spray: coma, bradycardia, slow breathing (≤ 5 y)

Onset 30–90 min; may last 1–3 days[556,609]

OBSERVE AT LEAST

4 h after arrival (no later deterioration in a pediatric series); admit if any symptom[555]

FIRST ACTION

Monitor heart rate, blood pressure, breathing; support the airway — naloxone works inconsistently[554,555,556,609]

Diphenoxylate–atropine (Lomotil)

DANGER AT ONE DOSE

Half a tablet has caused toxicity

Mainly opioid: coma, respiratory depression, cerebral edema, death[605,609]

OBSERVE AT LEAST

24 h in a monitored bed (respiratory depression recurred at 13–24 h)[605,609]

FIRST ACTION

IV naloxone, then a continuous infusion if needed[605,609]

Methadone, fentanyl patch, extended-release opioids

DANGER AT ONE DOSE

One methadone tablet can kill a toddler

In children, toxicity is delayed, severe and prolonged[545,611]

OBSERVE AT LEAST

Admit for 24 h (≤ 3 y), even if the ingestion is unconfirmed. Older children: observe at least 6 h in the emergency department after any methadone exposure and consider admission; longer for extended-release products and patches.[545,611]

FIRST ACTION

Naloxone (children may need larger doses; repeat or infuse if breathing slows again); undress the child and look for patches[545,611]

Methyl salicylate (oil of wintergreen)

DANGER AT ONE DOSE

5 mL of 98% = 7,000 mg salicylate
< 5 mL has been fatal
More than a lick or taste (< 6 y): hospital[560,609]

OBSERVE AT LEAST

Salicylate level every 2 h until improving and non-toxic[609]

FIRST ACTION

Salicylate level now; call KPCC[8,560,609]

Sulfonylureas — glibenclamide, glipizide

DANGER AT ONE DOSE

A single tablet can cause hypoglycemia
Hypoglycemia in 30% of exposed children (96% of them within 8 h); may be delayed and persistent[598,609,612]

OBSERVE AT LEAST

12–24 h; keep until morning rather than discharge at night[598,609]

FIRST ACTION

Glucose checks often; feed; no prophylactic IV dextrose. Hypoglycemia: IV dextrose bolus (**Hypoglycemia**), then octreotide (**antidote table**)[598,609,612]

Tricyclic antidepressants — amitriptyline, imipramine, nortriptyline

DANGER AT ONE DOSE

> 5 mg/kg: hospital (nortriptyline, desipramine > 2.5 mg/kg)
One 50-mg tablet = 5 mg/kg in a 10-kg child
15–20 mg/kg potentially lethal[597,609]

OBSERVE AT LEAST

6 h, with a normal ECG at the end[597,609]

FIRST ACTION

ECG: QRS > 100 ms → sodium bicarbonate (**antidote table**); benzodiazepine for seizures; no flumazenil[597,609]

⚠ PITFALLS

- Naloxone wears off before methadone or diphenoxylate do, so respiratory depression returns. Re-dose or start an infusion, and keep the child in a monitored bed.[545,605]
- In clonidine poisoning, naloxone helps inconsistently; 6 of 47 children needed intubation.[555]
- Sulfonylureas: no prophylactic IV dextrose, and no discharge at night.[598]
- Ask about every adult's medicines in the home — toddlers find and swallow them.[545]

ADMIT · DISCHARGE · REFER

- **Admit** — methadone, fentanyl patch or extended-release opioid (≤ 3 y, 24 h; older children: observe at least 6 h and consider admission); any buprenorphine; diphenoxylate–atropine (24 h, monitored); modified-release calcium-channel blocker; sulfonylurea when the 12 h would end at night; any symptomatic child.[545,598,605,609]
- **Home from the emergency department** — well at the end of the agent's observation period, with normal vital signs, a normal ECG (tricyclics) and normal glucose (sulfonylureas), after KPCC advice. Advise storing medicines, eye drops and nasal sprays out of children's reach.[8,556,598,609]
- **Refer — now** — PICU for coma, apnea, hypotension, bradycardia, seizures, QRS widening or recurrent hypoglycemia. Involve child protection when supervision or malicious administration is a concern.[545,597,607,611]

Caustic (Corrosive) Ingestion HOURS

Acid or alkali burns — protect the airway; do no harm.

◢ RECOGNIZE

- Drooling, dysphagia, painful swallowing, oral or lip burns, chest or abdominal pain. Stridor or respiratory distress means airway injury.
- The **absence of oral burns does not exclude esophageal injury.** Alkali (drain cleaner) causes deep liquefactive necrosis; acid causes coagulative necrosis.[613]

⚠ DO NOT

No induced emesis, no gastric lavage, **no activated charcoal**, no neutralizing or forced dilution — these re-expose the esophagus and worsen injury.[613]

DO

- Airway first — anticipate swelling and intubate early if any compromise (by anesthesia/ENT/PICU)
- Avoid blind nasogastric-tube insertion unless directed after endoscopic/surgical assessment.
- Keep nothing by mouth; give IV fluids, analgesia, antiemetics.
- Chest and abdominal X-ray for free air. **If esophageal perforation is suspected (free air, severe chest or abdominal pain, or sepsis), keep nothing by mouth, start IV fluids and broad-spectrum IV antibiotics (aerobic and anaerobic cover; WSES 2019)[614], and consult pediatric surgery immediately.** Contact poison control.[613]

◈ **ENDOSCOPY**

- **ANY SYMPTOM OR SIGN** (mouth lesion, drooling, vomiting, dysphagia, hematemesis, breathing difficulty, abdominal pain) → upper endoscopy **WITHIN 24 H**, once stabilized with a secure airway; acid and alkali alike. Three or more symptoms predict severe injury.[615]

- **NO SYMPTOMS, NO DROOLING AND NO MOUTH LESIONS** → routine endoscopy is not needed, provided follow-up is assured.[615]
- Best within 12–24 h (acceptable up to 48 h; reported safe up to 96 h). Avoid endoscopy from about day 5 to day 15, when the healing wall is weakest and perforation risk is highest.[613]
- Watch for delayed strictures over the following weeks.
- **CORTICOSTEROIDS:** not routine and not before endoscopy. Endoscopic grade IIb only — GI-led high-dose IV methylprednisolone 1 g/1.73 m^2 per day for 3 days reduces stricture formation (Usta et al., Pediatrics 2014); no proven benefit in grades I, IIa or III.[615]
- A swallowed button battery is a separate emergency[238] — see **Button (Lithium) Battery Ingestion**.

ADMIT · DISCHARGE · REFER

- Disposition depends on agent, amount, intent, symptoms and poison-center/GI assessment, and on the ability to tolerate oral intake.

- **Admit** — all symptomatic or significant exposures → nil by mouth, plan imaging/endoscopy.
- **Home from the emergency department** — asymptomatic minor exposure after observation.
- **Refer — now** — ENT/GI/surgery (endoscopy) and PICU; do not blind-pass a nasogastric tube.

Hydrocarbon Ingestion & Pneumonitis

HOURS YOUNG CHILDREN · Clin Toxicol 2014

The danger is the lungs, not the gut — observe 6–8 h, X-ray at the end, never make the child vomit.

RECOGNIZE

- **High aspiration risk — thin, runny, volatile products:** gasoline, kerosene, spot removers, mineral spirits. Lamp oil, kerosene and lighter fluid/naphtha cause most of the serious lung injury.[616]
- **Extra danger beyond the lungs:** camphor (toxic effects, including seizures, often within 10–20 min; >

30 mg/kg needs hospital care); halogenated solvents (they sensitize the heart to epinephrine and can trigger a non-perfusing rhythm); products containing pesticides, metals or methanol.[609,610,616]

- **Aspiration signs:** cough, vomiting, drowsiness, fever, fast breathing, tachycardia, altered mentation. Wheeze, tachypnea or altered mentation **within 2 h** predicts the need for treatment.[616]
- **Timeline:** pneumonitis follows about 15% of ingestions and evolves over the first 6–8 h. It peaks within 48 h, then improves; up to 5% progress rapidly to respiratory failure. Chest X-ray changes appear by 4–8 h and do not always match the clinical picture. Pneumatoceles can appear after 6–10 days and resolve within 6 months.[616,617]
- Most children stay well: in a poison-center cohort of all ages, 1% developed significant complications.[617,618]

DO

- Airway and breathing first; give oxygen for hypoxemia; watch the work of breathing.[616,617]
- **Observe 6–8 h**, then take a **chest X-ray at the end of observation**. An early film can be falsely normal.[616,617,619]
- Call KPCC **1804774** with the product name. Ingredients such as camphor, pesticides, halogenated solvents or methanol change management.[8,616]
- **Halogenated or inhaled volatile hydrocarbon:** continuous cardiac monitoring in a calm environment. Avoid epinephrine and other catecholamines where possible — they can precipitate ventricular arrhythmia in the sensitized heart; beta-blockers have been suggested for these arrhythmias — discuss with KPCC/PICU.[616]

⚠ DO NOT

- No induced emesis and no gastric lavage — both cause aspiration. **No activated charcoal** — it provokes gagging and vomiting.[539,616]

- No prophylactic corticosteroids (no benefit). No prophylactic antibiotics: fever and infiltrates are part of chemical pneumonitis. Give antibiotics only for bacterial superinfection.[616,617]

TREATMENT

Activated charcoal

DOSE · ROUTE
Not indicated[539,616]

ENDPOINT · MONITORING
Gagging and vomiting raise the risk of aspiration[539,616]

Antibiotics

DOSE · ROUTE
Not prophylactic
Only for bacterial superinfection[616,617]

ENDPOINT · MONITORING
Fever and infiltrates alone are not an indication[616,617]

Benzodiazepine (seizures, e.g. camphor)

DOSE · ROUTE
Dose as in Convulsive Status Epilepticus

ENDPOINT · MONITORING
Seizure stops; watch breathing[610]

Corticosteroids

DOSE · ROUTE

Not indicated[616,617]

ENDPOINT · MONITORING

No benefit shown[616,617]

Oxygen

DOSE · ROUTE

Supplemental, to correct hypoxemia
Intubation and mechanical ventilation if hypoxemia does not respond or the CNS is severely involved[616,617]

ENDPOINT · MONITORING

SpO_2, work of breathing, mental status. ECMO, surfactant and high-frequency ventilation are reported only in case reports[616,617]

ADMIT · DISCHARGE · REFER

- **Admit** — symptomatic on arrival or during the 6–8 h observation, or an abnormal chest X-ray. About 90% of admitted children have a benign course.[617,619]
- **Home from the emergency department** — well through at least 6 h of observation with a normal chest X-ray. Children with early symptoms who settle within the 6 h and have a normal X-ray also do well.[616,619]

- **Refer — now** — PICU for increased work of breathing, altered sensorium, seizures, or hypoxemia despite oxygen. Discuss camphor, pesticide or halogenated products with KPCC.[8,617]

Isoniazid (INH) Poisoning – Refractory Seizures

MINUTES ISONIAZID LABEL 2025

Seizures that will not stop, with acidosis and coma, in a child with TB medicine at home — give IV pyridoxine now.

RECOGNIZE

- **Who:** a child taking INH for TB infection, or one with access to a household member's TB medicine. Ingestion may be accidental or deliberate. With known access to INH, **a seizure is INH toxicity until proved otherwise**.[584,620]
- **Onset 30 min–3 h:** nausea, vomiting, dizziness, slurred speech, blurred vision and visual hallucinations.

These progress rapidly to stupor, coma, respiratory depression and severe, intractable seizures.[582]

- **Triad:** seizures that do not respond to anticonvulsants · severe metabolic acidosis · coma. Ketonuria and hyperglycemia are typical.[582,584,620]
- **Dose:** in a pediatric series, seizures followed ingestions of 14–99 mg/kg (mean 54 mg/kg). An acute ingestion of **> 80 mg/kg** needs IV pyridoxine even without symptoms.[582,584]

DO

- Airway, breathing, oxygen. Give a benzodiazepine for the seizure **together with** pyridoxine; the two act synergistically in animal studies.[582,620]
- **IV pyridoxine now** (dose below). **Repeat it if seizures continue.** A single gram-for-gram dose prevented recurrent seizures and shortened coma.[582,583]
- Send blood gas, electrolytes, urea and glucose. Acidosis usually clears once seizures are controlled, so dialysis is rarely needed.[582,583]
- Call KPCC **1804774** and ask pharmacy for the full pyridoxine dose at once.[8,621]

MEDICATIONS

Benzodiazepine (midazolam, lorazepam, diazepam)

DOSE

Dose as in Convulsive Status Epilepticus

ROUTE · RATE · REPEAT

Route as in that card

Give together with pyridoxine, not instead of it[620]

ENDPOINT · MONITORING

Seizure stops

Watch breathing[582,620]

Pyridoxine (vitamin B6)

DOSE

Known amount: equal to the INH ingested (1 mg per mg)
Unknown amount: 80 mg/kg (maximum = adult dose, 5 g)
Well child, > 80 mg/kg ingested: equal to the INH ingested
Total > 10 g rarely needed; maximum safe dose unknown[582]

ROUTE · RATE · REPEAT

IV

Seizing: slow bolus over 3–5 min

Not seizing: over 30–60 min

Repeat the dose if seizures continue[582]

ENDPOINT · MONITORING

Seizures stop; acidosis and coma resolve

Monitor seizure activity, ventilation, blood gas, electrolytes, glucose[582,583]

◈ IF IV PYRIDOXINE IS NOT IN THE DEPARTMENT

- Keep treating seizures with benzodiazepines; if they continue,

give a GABA-ergic agent — phenobarbital 15–20 mg/kg IV (as in the **Convulsive Status Epilepticus** card), then a midazolam or propofol infusion with a secured airway in PICU — while KPCC and pharmacy obtain pyridoxine. Do not rely on phenytoin/fosphenytoin (no role in INH seizures); levetiracetam and valproate are unproven here. Seizures may stop only once parenteral pyridoxine is given.[8,584]

- When it was not stocked in the ED, pyridoxine was delayed by 5.8 h on average and one child had to be transferred. Pyridoxine should be **immediately available** in every ED.[584,621]
- At 100 mg/mL in 1-mL vials, a 5-g dose is 50 vials.[622]

⚠ PITFALLS

- **Under-dosing:** an infant given 70 mg/kg (650 mg) after a 290 mg/kg ingestion seized again and needed 2 g more. When the amount is known, dose gram-for-gram regardless of age.[620]

- **Phenytoin/fosphenytoin:** avoid — ineffective for INH seizures, and INH inhibits its metabolism.[582]
- **Sodium bicarbonate** in a hypoventilating child can worsen hypercarbia. Monitor CO_2 and support ventilation first.[582]
- **Missed diagnosis:** INH was not suspected at a first seizure and the child returned with another. Ask about TB medicines in the home.[584]

ADMIT · DISCHARGE · REFER

- **Admit** — every symptomatic child. Seizures, coma or acidosis need intensive care with repeated blood gases to protect against hypoxia, hypotension and aspiration.[582]
- **Home from the emergency department** — only a well child after a small accidental ingestion, once the observation period agreed with KPCC has passed. Advise locked storage of TB medicines.[8]
- **Refer — now** — PICU for recurrent seizures, coma or respiratory insufficiency. Psychiatry after a

deliberate ingestion (3 of 8 episodes in a pediatric series were suicide attempts).[582,584]

Burns HOURS

Cool it, size it, replace fluid to urine output — and protect the airway.

ASSESS

- Estimate % total body surface area (TBSA) with a Lund-Browder chart (age-adjusted values are in the Lund–Browder figure on this card; the child's palm including fingers ≈ 1%); assess depth and mechanism.[623]
- **Airway red flags** — stridor, hoarseness, respiratory distress, black sputum, singed nasal hairs, facial swelling or progressive airway edema → prepare pediatric airway equipment, involve anesthesia/airway expertise early; low threshold for early intubation. If intubated, **do not trim the endotracheal tube** (facial swelling can leave it too short) — secure it carefully and reassess.[624,625,626]

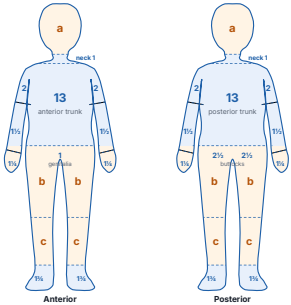
- **Enclosed-space flame/flash burn → 100 % oxygen**; co-oximetry for carboxyhemoglobin; consider cyanide (hydroxocobalamin) — see **Smoke Inhalation & Carbon Monoxide Poisoning**.[625]
- **Elevate** significantly burned limbs and the head of the bed for head/neck burns; document distal perfusion. **Circumferential limb or chest burn** → check distal perfusion / chest excursion frequently; urgent burns advice if perfusion or ventilation is compromised; escharotomy only with expert guidance.[625,626]
- Mechanism suggesting trauma (fall, blast, vehicle) → trauma primary survey first (**§13 Major Trauma**); spinal precautions when indicated.[625]

Burns — Lund–Browder estimate of % TBSA

Age-adjusted regions a, b, c; fixed regions carry their value per side and aspect; the child's palm with fingers ≈ 1 %[623,627].

Burns — Lund–Browder estimate of % total body surface area (TBSA)

Values are per region for that aspect (front or back) · amber regions a, b, c change with age (table) · the child's palm with fingers = 1 %



Percentage of body surface by age

	0 y	1 y	5 y	10 y	15 y adult
a - ½ head	9½	8½	6½	5½	4½ 3½
b - ½ one thigh	2¾	3¼	4	4¼	4½ 4¾
c - ½ one lower leg	2½	2½	2¾	3	3¼ 3½

Fixed regions (blue; per side, per aspect)

neck 1 · trunk 13 · genitalia 1 (anterior)
buttock 2½ each (posterior)
upper arm 2 · forearm 1½ · hand 1¼
foot 1¾ · front + back add up to 100 %

How to count

Count partial- and full-thickness burn only (ignore simple erythema). For a region that is partly burned, take that fraction of its value. Formal IV resuscitation when TBSA > 10 %.

Source: Lund CC, Browder NC. The estimation of areas of burns. Surg Gynecol Obstet 1944;79:352–358; ISBI practice guidelines 2016. Age-adjusted values a, b, c from Lund & Browder. Original drawing for this guide.

FIRST AID

Stop the burning; cool with running water for **20 min** — worthwhile even if started up to **3 h** after the burn (**not** ice; no hydrogel products); then **cool the burn, warm the child**: remove wet clothing and jewelry, warm room, blankets (infants lose heat fastest); cover; analgesia.[623,625,626,628]

FLUIDS (TBSA > 10%)

- Lactated Ringer's starting at **3 mL/kg × %TBSA** for the first 24 h (sources give 2–4): ½ in the first 8 h from the time of the burn, ½ over the next 16 h, **plus** maintenance with dextrose (4-2-1); adjust the rate hourly to urine output — the formula is only a starting estimate.[623,629]
- **Shock at presentation** is unusual from the burn alone in the first hours — look for hemorrhage/trauma, inhalation injury or sepsis; give **10–20 mL/kg** isotonic crystalloid and reassess rather than repeated boluses (over-resuscitation harms).[625,626]
- Titrate to urine output **1 mL/kg/h if < 30 kg; 0.5 mL/kg/h if ≥ 30 kg**.[623,625]

REFER TO A BURNS CENTER

> 10% TBSA, full-thickness, face/hands/feet/perineum/joints, electrical or chemical, inhalation injury, or suspected inflicted injury (expert consensus; the 10% threshold is ISBI's cut-off for formal fluid resuscitation in children).[623]

⚠ AIRWAY / CIRCULATION RED FLAGS

- Enclosed-space fire → 100 % O_2; consider carbon monoxide ± cyanide.
- Hoarseness, stridor, respiratory distress, black sputum, singed nasal hairs or progressive facial swelling → early airway/anesthesia involvement; do not trim the tube.
- Circumferential chest burn + impaired ventilation → urgent burn-specialist advice.
- Circumferential limb burn → check distal perfusion frequently.
- Elevate significantly burned limbs and head/neck burns.
- Cool the burn, but keep the child warm.[625]

⚠ AVOID OVER-RESUSCITATION ("FLUID CREEP")

- The formula is only a starting estimate — titrate to urine output, not to the number.[623]
- Don't apply ice or home remedies.

⚠ RAISE SUSPICION FOR INFLICTED INJURY

- A significant share of pediatric burns are inflicted — most intentional burns are scalds.[630]
- Red flags: a **well-demarcated** burn with **uniform depth** and **no splash marks**; a symmetric immersion ("stocking/glove") pattern with a clear upper margin and skin-fold sparing; burns in normally **protected sites** (groin, perineum, buttocks, back, thighs); a **patterned contact burn** reproducing the shape of an object (iron, cigarette, lighter, heater, hair dryer)[625]; delayed presentation or a history that does not fit the burn pattern or the child's developmental stage.
- Look for other injuries and old fractures; safeguard.[630]

◣ ADMIT · DISCHARGE · REFER

- **Admit** — large or deep burns, airway/inhalation injury, electrical/chemical burns, or a safeguarding concern → burns center.

- **Home from the emergency department** — small superficial burns with dressing and review.
- **Refer — now** — a burns unit per criteria; ophthalmology/surgery as needed.

Heat Stroke MINUTES

A clinical diagnosis — core ≥ 40°C + CNS dysfunction after heat exposure. Cool fast; antipyretics do not work.

DIAGNOSE CLINICALLY

- **Core temperature ≥ 40°C** with **CNS dysfunction** after environmental heat exposure. Criteria and cooling evidence are largely adult/exertional and are extrapolated to children.[631] Well-hydrated older children and adolescents tolerate exercise in the heat about as well as adults,[632] but infants and young children gain heat faster (larger surface-area-to-mass ratio, higher metabolic heat production, less effective sweating) and cannot remove themselves from hot environments such as closed vehicles.[19]

- **CNS:** confusion, delirium, irritability, hallucinations, ataxia, slurred speech, seizures, coma. **CVS:** tachycardia, hypotension, dehydration/shock. **GI:** nausea, vomiting (± diarrhea). **Other:** hot skin, tachypnea.

INVESTIGATIONS — DO NOT DELAY COOLING

RBS (hypoglycemia) · CBC · electrolytes (Na/K/Ca) · urea & creatinine · LFTs · coagulation (DIC) · blood gas (metabolic acidosis ± early respiratory alkalosis) · creatine kinase (rhabdomyolysis) · urinalysis (myoglobinuria).[631]

MANAGEMENT

- **1 · ABCDE** — secure airway, support breathing and circulation.
- **2 · Immediate rapid cooling (do not delay). Ice-water immersion (1–5°C)** when feasible — the fastest method; aim to cool by ≥ 0.15°C/min. Otherwise **immerse in cool water (8–17°C — the AHA's "tepid", not lukewarm)** or use **tarp-assisted ice-water cooling**; only if immersion is not possible use **evaporative cooling** — remove clothing,

spray/mist water, high-flow fans, mesh stretcher/hammock — plus **ice packs to neck, axillae, and groin**. Room-temperature 0.9% saline for dehydration/shock (avoid overload). **Continuous rectal core-temperature monitoring.**[19,631]

- **3 · Stop active cooling at a core temperature of 38.6°C** to avoid overshoot hypothermia.[19]
- **4 · No antipyretics** (acetaminophen/ibuprofen) — ineffective in heat stroke and may worsen liver, renal, or GI injury.[631] Treat shivering cautiously with IV midazolam or lorazepam; treat seizures per the pediatric status epilepticus protocol (see **Convulsive Status Epilepticus**).

⚠ **DISPOSITION**

- **Admit** — children with true heat stroke (CNS dysfunction) go to a PICU or high-dependency/PICU-capable setting depending on severity and organ injury — thermal instability and organ injury (rhabdomyolysis, AKI, DIC) can evolve over days.[631]

- High-yield in Kuwait's climate.

ADMIT · DISCHARGE · REFER

- **Admit** — all with CNS dysfunction or organ injury → high-dependency/PICU.
- **Home from the emergency department** — mild heat exhaustion, resolved and hydrated with normal mentation.
- **Refer — now** — PICU; nephrology for rhabdomyolysis/AKI.

Drowning MINUTES

Respiratory impairment from submersion/immersion — ventilate first; rescue breaths are the key intervention.

INITIAL MANAGEMENT (ABCDE)

- **Airway & breathing:** start **rescue breathing immediately** (the single most important intervention); give 100% oxygen; support ventilation as needed. **A Heimlich maneuver and postural drainage have no role in**

drowning — do not perform them; they delay ventilation and risk aspiration.[633]

- **Circulation:** check pulse; if no pulse, start CPR per the **PALS cardiac-arrest algorithm** — **rescue breaths and chest compressions** (compressions only if the rescuer cannot give breaths). Start CPR before applying an AED and never delay CPR to get one; give oxygen as soon as available.[19] In the ED, **check the rhythm and give electrical therapy with a manual defibrillator** if the rhythm is shockable.[633]
- **Temperature:** remove wet clothing; if core < 35°C, prevent further heat loss and begin active rewarming.[633]
- **Post-ROSC:** manage per PALS post–cardiac-arrest care.

OBSERVE ALL IN THE EMERGENCY DEPARTMENT FOR 6–8 H

- Every submersion patient, even if asymptomatic: continuous pulse oximetry with serial respiratory and neurological exams[633,634] (delayed pulmonary edema can appear within 4–8 h)
- No routine chest X-ray or laboratory tests in an asymptomatic child.[633,634]

ASYMPTOMATIC

No cough, normal work of breathing, $SpO_2 \geq 95\%$ on room air, normal mental status and lung exam.
No routine chest X-ray or blood tests → well at 6–8 h → **discharge** with return precautions.[633,634]

MILD — NO ADMISSION NEEDED

Mild cough only; normal work of breathing; $SpO_2 \geq 95\%$ on room air; normal mental status; normal or minimally abnormal lung exam; stable circulation.

Pulse oximetry, oxygen only if needed, chest X-ray, serial exams; observe 6–8 h.

Symptoms resolved, $SpO_2 \geq 95\%$ on room air, normal exams and chest X-ray → **discharge** with return precautions. Symptoms persist or worsen → **admit**.[634] Cough with a normal lung exam carried 0% mortality in 1,189 drowning patients.[635]

MODERATE — ADMIT (WARD)

Persistent cough, increased work of breathing, abnormal lung exam, SpO_2 < 95% on room air that responds to oxygen, or GCS 13–14; stable circulation.
Oxygen, cardiorespiratory monitoring, glucose, blood gas, CBC, electrolytes, renal function, chest X-ray, ECG; avoid fluid overload. CPAP/BiPAP for persistent hypoxemia if the airway is protected (HFNC if not tolerated).
PICU if the oxygen need rises, NIV is needed, or breathing or mental status worsens.[634]

SEVERE — PICU

Severe distress or respiratory failure, SpO_2 < 90% despite oxygen/NIV, frothy secretions, significant altered mental status, shock, or ARDS.
Secure the airway; intubate with lung-protective ventilation and PEEP, 100% oxygen initially; rewarm; cautious fluids ± vasopressors; consider ECMO where available.[634]

⚠ ADMIT

- **Admit** — moderate symptoms (ward); mild symptoms that persist or worsen after 6–8 h; severe symptoms, rising oxygen need or need for NIV/ventilation (PICU). Mild cases that recover during observation do not need admission.[634]

◈ NOT RECOMMENDED

- Heimlich maneuver
- postural drainage
- routine chest X-ray or blood tests in an asymptomatic child
- glucocorticoids
- routine antibiotics
- routine cervical-spine immobilization unless trauma (e.g., a diving injury) is suspected.[633,634]

◣ ADMIT · DISCHARGE · REFER

- **Admit** — moderate symptoms → ward; severe → PICU; mild symptoms only if they persist or worsen after 6–8 h observation.[634]

- **Home from the emergency department** — asymptomatic or mild, well after 6–8 h observation with $SpO_2 \geq 95\%$ on room air and a normal exam (and a normal chest X-ray if mild). Return at once for increasing or persistent cough, difficulty breathing, cyanosis or chest pain, persistent vomiting, drowsiness or seizure, or fever after the first 24 h.[634]
- **Refer — now** — PICU for severe or worsening respiratory compromise; child protection when the history, supervision, delay in presentation or injury pattern raises concern.[634]

Smoke Inhalation & Carbon Monoxide Poisoning

MINUTES FIRE / SMOKE

Fire injures three ways — airway, carbon monoxide, cyanide. Look for and treat all three.

DEFINE

- Fire/smoke injures by three mechanisms: **(1) thermal / chemical airway injury**, **(2) carbon monoxide (CO)**, **(3) hydrogen cyanide (HCN)**. Suspect all three after any **enclosed-space fire**, especially with altered mental status.[624]

APPROACH — THE AIRWAY FIRST

- Signs of inhalation injury: **facial/neck burns, singed nasal hairs, soot in the mouth or sputum, carbonaceous sputum, hoarseness, stridor, oropharyngeal edema or blistering**.
- Airway injury is **progressive** — edema worsens over hours. Reassess continuously.[624]

⚠ SECURE THE AIRWAY EARLY

- Deep facial/neck burns, oropharyngeal blistering or edema, hoarseness/stridor, or large cutaneous burns → **intubate early** (call PICU/anesthesia urgently — expert airway control) before edema makes the airway impassable.[624]
- Avoid over-aggressive IV fluids — they worsen airway edema.[624]

CARBON MONOXIDE

◣ RECOGNIZE & MEASURE

- CO binds hemoglobin ~**200–250× more avidly than oxygen**[624] → tissue hypoxia plus direct cellular toxicity; **symptoms and COHb level correlate poorly**.[573]
- **Pulse oximetry reads falsely normal** (it cannot distinguish carboxyhemoglobin) — measure **COHb by co-oximetry** (blood gas). COHb ≥ 2% (non-smoker) or ≥ 9% (smoker) supports the diagnosis.[18]
- Symptoms: headache, nausea, dizziness, confusion, syncope, seizure, cardiac ischemia, coma.

◈ HYPERBARIC OXYGEN (HBO) — AVAILABLE LOCALLY

- High-flow **100% OXYGEN VIA A NON-REBREATHER** (or ventilator) is first-line and cuts COHb half-life from ~4–5 h to ~60–90 min.
- With a chamber on site, **CONSIDER HBO** for severe poisoning: **LOSS OF CONSCIOUSNESS/SYNCOPE**, seizure or altered mental status, **CARDIAC ISCHEMIA** or arrhythmia, persistent metabolic acidosis, end-organ damage, a markedly raised COHb, or **PREGNANCY** (COHb > 15%) — decide early; the Undersea and Hyperbaric Medical Society (UHMS) advises considering HBO for any acute symptomatic CO poisoning. Pediatric COHb cut-offs are not established.[572,573]
- HBO speeds elimination and may reduce delayed neurocognitive sequelae; trial evidence is mixed, so weigh case by case.[636]
- In children benefit is extrapolated from adult trials (the pivotal RCT excluded patients under 16 years and pregnant women[637]); let CO exposure duration, COHb level, neurologic signs, and lactate guide the decision.[573]

⚠ CYANIDE — DON'T MISS IT

- Suspect HCN co-poisoning in an enclosed-space fire with soot, **altered mental status, hemodynamic instability, or severe lactic acidosis (lactate ≥ 10 mmol/L in a fire victim; ≥ 8 mmol/L applies to cyanide exposure without smoke)**.
- Treat **empirically — do not wait for levels**.[20]
- Use **hydroxocobalamin**; avoid nitrite-based kits in smoke victims (induced methemoglobinemia worsens hypoxia).[20,624]

MANAGEMENT

Oxygen

DOSE

100% via non-rebreather (or intubate)

NOTES

Continue until symptom-free and COHb < 5%.[18,573]

Hydroxocobalamin (suspected cyanide)

DOSE

70 mg/kg IV/IO (max 5 g) over 15 min; may repeat once — 70 mg/kg (max 5 g) over 15 min to 2 h (total max 140 mg/kg, 10 g). Separate line from sodium thiosulfate/nitrite.

NOTES

Empiric in smoke inhalation with shock, or lactate ≥ 10 mmol/L plus compatible clinical findings (do not rely on lactate alone); repeat once if needed.[20]

HBO (severe CO)

DOSE

Per hyperbaric-unit protocol (pressure and number of sessions set by the unit)

NOTES

Refer to the hyperbaric unit for the criteria above; the pivotal adult RCT gave three sessions within 24 h.[637]

ALSO

- Cardiac monitoring + ECG, serial lactate and COHb, cautious fluid resuscitation; ICU/burns referral.

- See also **Burns** and **Poisoning & Toxic Ingestion** for concurrent burn and antidote management.

✦ **PEARL — THE OXIMETER LIES**

- A normal SpO_2 does not exclude CO poisoning — measure carboxyhemoglobin.
- In a fire victim with shock and a high lactate, give hydroxocobalamin without waiting for confirmation.[20]

◣ **ADMIT · DISCHARGE · REFER**

- **Admit** — respiratory symptoms, altered mentation, or a significant carboxyhemoglobin → oxygen and monitoring.
- **Home from the emergency department** — asymptomatic with normal levels after observation.
- **Refer — now** — hyperbaric/PICU for severe CO; burns/ENT for airway injury.

Envenomation — Scorpion Sting & Snakebite

MINUTES · WHO 2016 · regional

Two regional envenomations: scorpion sting = an autonomic storm; snakebite = local tissue injury and coagulopathy (± neurotoxicity).

SCORPION STING

- Severe local pain, then an **autonomic storm**: sweating, salivation, vomiting, hypertension and tachycardia, agitation, and in severe cases **pulmonary edema, myocardial dysfunction and cardiogenic shock** (severity depends on venom dose, time to care and the victim's age).[638,639]
- Supportive care and analgesia. Hypertension is usually transient and may be followed by hypotension: do not treat it routinely; give an antihypertensive (**prazosin** is the most studied) only for a hypertensive crisis or pulmonary edema. **Pulmonary edema or cardiogenic shock**: intensive care, oxygen (target $SpO_2 \geq 92\%$), non-invasive or invasive ventilation, and **dobutamine** 5–15 mcg/kg/min. Give **antivenom**

for systemic envenomation per local protocol — with prazosin it hastened recovery in an Indian RCT (*Mesobuthus tamulus*), but evidence for other Old World species is weaker.[638,639] Benzodiazepines for agitation, severe neuromuscular excitation or seizures.[639]

SNAKEBITE

- Look for **local** swelling/necrosis and **systemic** effects — coagulopathy/bleeding, neurotoxicity (ptosis, bulbar/respiratory weakness) or rhabdomyolysis, depending on species.[640]
- First aid: reassure; **immobilize/splint the bitten limb and minimize movement**; remove constrictions; move to hospital. Give species-appropriate IV **antivenom** for systemic envenomation (shock, spontaneous bleeding or incoagulable blood, neurotoxicity, dark urine/acute kidney injury) or severe local envenomation (rapidly progressive swelling, bite on a digit, species known to cause necrosis). **Children receive the same**

antivenom dose as adults — do not reduce it by weight. Monitor the airway and clotting.[640]

⚠ **DON'T MAKE IT WORSE**

- **No** tourniquets, incision, suction or ice on snakebites — they increase harm.[640]
- Watch for delayed coagulopathy and compartment syndrome; recheck clotting serially.
- Anticipate **anaphylaxis to antivenom** and have epinephrine ready.[640]

◈ **LOCAL** The national/KPCC protocol and species-specific antivenom take precedence over generic international regimens. Call KPCC **1804774** early for species identification and antivenom dosing.[8]

◣ **WORKUP**

- **Snakebite: 20-minute whole-blood clotting test**, CBC/platelets, PT/INR + fibrinogen, D-dimer, renal function + potassium, CK, urinalysis (myoglobin), ECG, **serial limb marking**, group & crossmatch.[640]

- **Scorpion:** continuous cardiac/BP monitoring, serial ECG, **cardiac enzymes (troponin/CK-MB) + echocardiogram** if cardiac signs (stress-type cardiomyopathy), glucose, electrolytes, blood gas (pulmonary edema).[638,639]

ADMIT · REFER

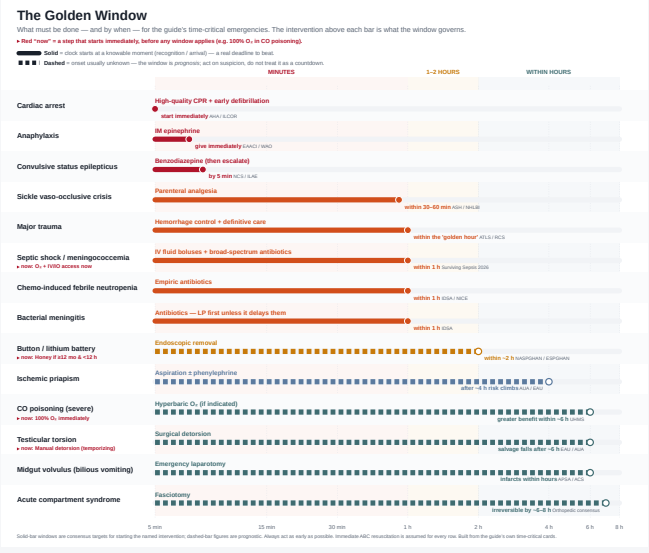
- **Admit** — observe every child with a suspected snakebite for at least 24 h, even if initially well (repeat the 20-minute whole-blood clotting test/clotting screen and neurological checks); admit all systemic envenomation and any child with progressing local signs. Acetaminophen or an opioid for pain — no aspirin or NSAIDs; tetanus booster once clotting is normal; antibiotics only for infection or necrosis; fasciotomy only for proven compartment syndrome after antivenom and correction of coagulopathy.
- **Refer — now** — call critical care and Poison Control; surgery for compartment syndrome/necrosis.

Quick Reference

Weight · airway · vital signs · master doses

Time-critical emergencies — quick reference

Solid bar = knowable clock / deadline · dashed bar = unknown onset / prognosis. See each condition's card for detail.



When to Admit

General triggers first, then condition-specific thresholds.

ANY ACUTELY UNWELL CHILD

Toxic or septic appearance; shock or unstable vital signs; hypoxia (SpO_2 < 92%); unable to tolerate oral fluids or

medicines; moderate to severe dehydration; fever under 3 months; diagnostic uncertainty in an unwell child; or unreliable follow-up.

Febrile young infant

ADMIT IF

≤ 28 days: admit all; 29–60 days: admit unless low-risk on screening; 61–90 days: admit if ill-appearing, abnormal screening tests or unreliable follow-up.

UTI

ADMIT IF

Under 3 months; toxic; vomiting or unable to take oral; no response by 48 h or a resistant organism; known uropathy, obstruction, chronic kidney disease, or transplant; suspected renal abscess; acute kidney injury.

Gastroenteritis / dehydration

ADMIT IF

Shock or severe dehydration; failed oral or nasogastric rehydration; persistent vomiting; significant electrolyte disturbance; under 6 months with heavy losses; possible surgical abdomen.

Bronchiolitis

ADMIT IF

Apnea; SpO_2 persistently under 90–92%; feeding under 50–75% or dehydration; severe respiratory distress; under 3 months or comorbidity (prematurity, congenital heart disease, chronic lung disease).

Croup

ADMIT IF

Stridor at rest persisting after a corticosteroid; repeated nebulized L-epinephrine; hypoxia, exhaustion, or toxic appearance.

Asthma

ADMIT IF

Incomplete response to bronchodilators; ongoing oxygen need; needing bronchodilator more often than every 3–4 h; silent chest, exhaustion, or altered consciousness (→ critical care).

Pneumonia

ADMIT IF

Sustained SpO_2 under 90%; moderate to severe distress; under 3–6 months; not tolerating oral; dehydration; moderate-to-large effusion or empyema; or failed oral antibiotics.

Nephrotic syndrome

ADMIT IF

First presentation; hypovolemia (abdominal pain, cool peripheries, hypotension, oliguria); peritonitis or sepsis; thromboembolism; severe edema with respiratory compromise; acute kidney injury; relapse not responding to oral steroids.

BRUE

ADMIT IF

Under 2 months; prematurity; more than one event; event needed CPR or vigorous stimulation; or a concerning history or examination (higher-risk).

Rabies Post-Exposure Prophylaxis

HOURS WHO 2018

Dog, cat, or bat bite/scratch — wash, risk-stratify, give vaccine ± immunoglobulin same day.

FIRST — WOUND CARE (MOST IMPORTANT)

- Wash/flush the wound **~15 minutes** with soap and running water, then apply a virucidal (povidone-iodine or 70% alcohol).[641]
- Avoid early suturing; if unavoidable, suture loosely **after** immunoglobulin infiltration.[641]
- Give **tetanus prophylaxis**; add antibiotics for a deep or contaminated bite (e.g., amoxicillin-clavulanate).

I

EXPOSURE
Touching/feeding, licks on intact skin

ACTION
No PEP — wash only

II

EXPOSURE
Nibbling of uncovered skin; minor scratch/abrasion without bleeding

ACTION
Wound care **+ vaccine**

III

EXPOSURE
Transdermal bite/scratch, lick on broken skin, mucous-membrane contamination, or **any bat contact**[641]

ACTION
Wound care **+ vaccine + immunoglobulin**

VACCINE & IMMUNOGLOBULIN

- **Never previously vaccinated** — cell-culture vaccine IM into the deltoid (anterolateral thigh in infants and young children; **never the gluteal area**) on days **0, 3, 7, 14** (add day 28 if immunocompromised; CDC/ACIP schedule — WHO 2018 IM: days 0, 3, 7 and one dose between days 14–28); the WHO

1-week 2-site intradermal schedule (days 0, 3, 7) is an accepted dose-sparing option.[641]

- **Previously fully vaccinated** — 2 doses only (days 0 and 3); **no immunoglobulin**.[641]
- **Rabies immunoglobulin** (category III, or category II if immunocompromised) — human RIG **20 IU/kg** (equine 40 IU/kg) as a single day-0 dose; infiltrate as much of the calculated dose as is anatomically possible into and around every wound (dilute with saline if the volume is too small for multiple wounds). WHO 2018 no longer advises injecting any remainder IM at a distant site; CDC/ACIP still does — if the local protocol follows ACIP, give the remainder IM away from the vaccine site. **Never give RIG in the same syringe or site as the vaccine.** If unavailable on day 0, RIG can be given up to day 7 after the first vaccine dose, not later.[641]
- Repeat exposure within 3 months of a complete course → wound care only (no vaccine or RIG).[641]

⚠ DO NOT DELAY

- Start PEP the same day — rabies is almost always fatal once symptomatic.[641]
- Immunoglobulin can blunt live vaccines (separate MMR/varicella by ~4 months).[642]
- Follow the Kuwait MOH / local rabies protocol and notify public health.

IV → Oral Switch & the DIVA Patient

ASSESS

In difficult access, every lost cannula is a switch decision — not an automatic re-stick.

◣ WHY IT MATTERS IN DIVA

- In **difficult intravenous access (DIVA)**, each re-cannulation means pain, delay, distress, and line risk. Reassess switch eligibility at **every line failure** rather than reflexively re-sticking — for many infections, evidence supports switching to oral earlier than previously recommended.[643]

DIVA SCORE — PREDICT DIFFICULT ACCESS

History of prematurity	**POINTS** 3
Age: < 1 yr / 1–2 yr / ≥ 3 yr	**POINTS** 3 / 1 / 0
Vein not palpable (after tourniquet)	**POINTS** 2
Vein not visible (after tourniquet)	**POINTS** 2

◈ INTERPRETATION

- Score **≥ 4** (max 10) → > 50% chance of first-attempt cannulation failure.[644]
- Use it early: escalate to an ultrasound-guided / senior inserter or vein-finder — and in a child improving and able to take oral, favor an **IV → ORAL SWITCH** over repeated sticks.
- The simpler **DIVA-3** (age + vein visibility + palpability, dropping prematurity) performs as well.[645]

SWITCH CRITERIA — ALL SHOULD BE MET (COMS)

- **C**linically improving and responding to treatment.
- **O**ral route works — functioning gut, tolerating intake, not vomiting, no malabsorption.
- **M**arkers settling — defervescing, hemodynamically stable, no ongoing sepsis (± falling CRP/white count).
- **S**uitable oral agent — adequate spectrum and bioavailability.

DECISION

Deep-seated / high-risk infection?

SWITCH EARLY

Uncomplicated CAP, UTI/pyelonephritis, uncomplicated skin/soft-tissue infection, and acute osteomyelitis/septic arthritis (early oral non-inferior, with fewer line complications).

KEEP IV

Bacterial meningitis/brain abscess, endocarditis, *S. aureus* bacteremia, febrile neutropenia (until low-risk/recovery criteria), undrained deep abscess, septic shock until stabilized.

◈ LEAN ON HIGH ORAL-BIOAVAILABILITY AGENTS

- Near-IV exposure, ideal in DIVA: ciprofloxacin, levofloxacin, linezolid, metronidazole, fluconazole, trimethoprim-sulfamethoxazole, clindamycin, doxycycline, rifampicin.
- Beta-lactams (e.g., high-dose amoxicillin) are usable but dose adequately for their lower oral absorption.

⚠ DIVA RULE OF THUMB

- Do not place a PICC or midline solely to finish an IV course that an oral agent could complete.
- Weigh the procedural burden of central access against the switch criteria above.

Weight & Airway Sizing

Quick estimates — a length-based tape is more reliable.

Weight (1–5 yr)

FORMULA

`(age × 2) + 8 kg`

Weight (6–12 yr)

FORMULA

`(age × 3) + 7 kg`

Endotracheal tube (uncuffed)

FORMULA

`(age ÷ 4) + 4 mm`

Endotracheal tube (cuffed)

FORMULA

`(age ÷ 4) + 3.5 mm`

Tube depth at lip

FORMULA

`tube size × 3 cm`

Hypotension (< 1 yr)

FORMULA

`< 1 month: systolic BP < 60 mmHg · 1–12 months: < 70 mmHg`

Hypotension (1–10 yr)

FORMULA

systolic BP < 70 + (2 × age) mmHg

Hypotension (> 10 yr)

FORMULA

systolic BP < 90 mmHg

◈ **GROWTH CHARTS**

- Plot weight, length/height, and head circumference — WHO standards (birth–5 yr)
- CDC charts (2–19 yr).

Oxygen Delivery Systems & Cylinder Duration

Device → flow → approximate FiO_2 → when to escalate; and how long a cylinder will last.

OXYGEN DELIVERY SYSTEMS

LOW Nasal cannula (low-flow)

FLOW · FIO_2

Infant 1–2 L/min
Child up to 4 L/min
Older child up to 6 L/min
FiO_2 ~24–45%

NOTES & ESCALATION

Variable — FiO_2 rises with flow, falls with high inspiratory demand / mouth-breathing. Above **~2 L/min** the dry gas irritates and dries the nasal mucosa — **add humidification** (and warming) at these flows.

LOW Simple face mask

FLOW · FIO_2

5–10 L/min
FiO_2 ~40–60%

NOTES & ESCALATION

Minimum 5 L/min to flush CO_2 (avoid rebreathing). Variable performance.

HIGH O_2 Non-rebreather (reservoir) mask

FLOW · FiO_2

10–15 L/min
keep the bag inflated
FiO_2 ~60–90%

NOTES & ESCALATION

Highest FiO_2 without support — **resuscitation / emergency**.

FIXED Venturi (air-entrainment) mask

FLOW · FiO_2

2–15 L/min per valve
fixed FiO_2 24 / 28 / 31 / 35 / 40 / 60%

NOTES & ESCALATION

Delivers a **precise FiO_2** regardless of breathing pattern — when a controlled FiO_2 matters.

SUPPORT High-flow nasal cannula (HFNC)

FLOW · FiO_2

≈ 2 L/kg/min
(to device max, up to ~60 L/min)
FiO_2 21–100% (titratable)

NOTES & ESCALATION

Warmed & humidified; adds **1–3 cmH_2O PEEP** + deadspace washout. Can be run on the **ward where a clear written escalation protocol exists** (defined limits, monitoring, and criteria to step up); otherwise HDU / PICU.

SUPPORT CPAP / BiPAP (NIV)

FLOW · FIO_2

Device-set flow
set FiO_2

NOTES & ESCALATION

Non-invasive support for rising work of breathing, recurrent apnea, or hypoxemia despite O_2. **PICU-directed.**

◎ READING THE TABLE

- **LOW** low-flow, **VARIABLE** FiO_2 · **HIGH O_2**/**FIXED** high or **CONTROLLED** FiO_2 · **SUPPORT** also provides **PRESSURE / WASHOUT** → escalation.
- **TARGET SPO_2:** give O_2 for SpO_2 < 90% (consider < 92% in young infants, prematurity, or cardiac / lung disease); titrate to target and wean.
- **INFANTS:** if prongs/mask are not tolerated use **BLOW-BY**; a **HEAD BOX / HOOD** gives up to ~80–90% FiO_2 but needs a gas flow of **2–3 L/KG/MIN** to avoid CO_2 rebreathing (WHO 2016, which prefers nasal prongs or catheters). Neonatal resuscitation: T-piece or self-inflating bag **WITH RESERVOIR**.
- Low-flow FiO_2 figures are estimates — the faster the child breathes, the lower the true delivered FiO_2.

READING THE PULSE OXIMETER — PRACTICAL NOTES

GET A RELIABLE NUMBER

- **Trust it only with a good trace.** Confirm a clean plethysmograph **waveform** and that the oximeter's **pulse rate matches** the palpated / ECG rate — a damped or absent trace means the number is unreliable.
- **Weak signal = poor perfusion.** Cold, shock, vasoconstriction or hypotension drop the signal (under-reads or fails) — warm the hand, try another site (toe, earlobe), check the perfusion index if shown.
- **Motion and bright / ambient light** cause erratic or false readings — settle the limb, shield the probe, use motion-tolerant sensors.
- **Nail polish, henna, dirt** — remove them or turn the probe sideways. In **darker skin** oximeters can **overestimate** true saturation (occult hypoxemia) — correlate with the clinical picture and a blood gas if in doubt.

⚠ WHEN THE NUMBER LIES — FALSELY

REASSURING

- **Carbon monoxide poisoning:** a standard oximeter reads **carboxyhemoglobin as oxyhemoglobin**, so SpO_2 looks **normal / high despite real hypoxia**. Suspect it by history; confirm with **co-oximetry / ABG** and give **100% O_2 regardless of the SpO_2**.
- **Methemoglobinemia** pins SpO_2 around **~85%** whatever the true saturation (a "saturation gap" vs the ABG) — suspect it with cyanosis **unresponsive to O_2** (topical anesthetics, dapsone).
- **Severe anemia / blood loss:** SpO_2 measures **saturation, not oxygen content** — it can read normal while oxygen delivery is inadequate.

✦ SPO_2 IS NOT PAO_2 — AND IT LAGS

- On the dissociation curve, **SpO_2 90% ≈ PaO_2 60 mmHg**; **below 90%** a small SpO_2 fall means a **large PaO_2 drop** — act quickly. The curve is **flat near the top**, so "100%" hides the reserve and

cannot detect hyperoxia (important in preterm / neonates).

- SpO_2 **lags** real change by seconds (longer if poorly perfused) — a falling number can already be a **late** sign.
- **Neonates — pre- vs post-ductal:** right hand = pre-ductal, foot = post-ductal; a difference **> 3%** (or lower post-ductal) suggests a right-to-left shunt / **critical CHD** (CCHD screening).

OXYGEN CYLINDER — CONTENT & HOW LONG IT LASTS

Usable duration (quick · psi)

EQUATION

```
(gauge psi − 200) × cylinder factor ÷ flow (L/min)
```

Usable content (metric)

EQUATION

```
capacity (L) × (gauge bar − 14) ÷ full pressure (bar)
```

Duration (metric)

EQUATION

```
usable content (L) ÷ flow (L/min)
```

◎ WHAT THE TERMS MEAN

- **PSI** = pounds per square inch, a unit of gas pressure (what the cylinder gauge reads); **1 BAR ≈ 14.5 PSI**.
- **CYLINDER FACTOR** = liters of oxygen released per 1 psi of pressure (= the cylinder's full capacity ÷ its full pressure). Multiply the **USABLE** pressure (gauge − 200 psi safe residual) by this factor to get the liters available.

◎ SAFE RESIDUAL & CYLINDER DATA

- **SAFE RESIDUAL ≈ 200 PSI (~14 BAR)** — a cylinder is treated as **EMPTY** at this pressure; **SUBTRACT IT FROM THE GAUGE** before calculating, and do not run lower.
- **CONTENT WHEN FULL (BOC):** CD **460 L** (230 bar) · D **340 L** (137 bar) · E **680 L** (137 bar) · F **1360 L** (137 bar). US E ≈ 625–680 L at ~2000 psi. 1 bar ≈ 14.5 psi. **CHECK THE LABEL — CAPACITY/PRESSURE VARY BY SUPPLIER.**
- **CYLINDER FACTORS (L/PSI):** D 0.16 · E 0.28 · M 1.56 · G 2.41 · H/K 3.14.

✦ WORKED EXAMPLES

- **Imperial:** E cylinder, gauge **1800 psi**, flow **6 L/min** → (1800 − 200) × 0.28 ÷ 6 ≈ **75 min**.

- **Metric:** BOC E cylinder (in the calculator choose Custom / metric, water capacity 4.7 L → ≈ 101 min; the E preset is the smaller US cylinder → ≈ 88 min), gauge **100 bar**, flow **4 L/min** → 680 × ((100 − 14) ÷ 137) ≈ **427 L** → ÷ 4 ≈ **107 min**.
- **High flow drains fast:** at 30–60 L/min a full E cylinder lasts only ~**10–20 min** — use wall O_2 or a large cylinder (and an air blender) for transport.

⚠ SAFETY MARGIN

Do not use a cylinder below the **safe residual (~200 psi / ~14 bar)** — treat it as empty. Change or refill at about **~500 psi / ~35 bar** to keep a working reserve, and for transport carry **≥ 2×** the calculated requirement (account for device / blender flush).

◎ BEST CLINICAL RESOURCES (OPEN-ACCESS)

- **OPEN CRITICAL CARE — OXYGEN DELIVERY DEVICES** (evidence-based, WHO-aligned): opencriticalcare.org

- **WHO — OXYGEN THERAPY FOR CHILDREN** (2016 manual): who.int

Normal Vital Signs by Age

Reference ranges (awake, at rest) — PALS 2020 age bands, the same set as the red-zone figure.

Age	Heart rate /min	Respiratory rate /min	Systolic BP mmHg
< 1 month	100–205	30–53	67–84
1–12 months	100–180	30–53	72–104
1–2 years	98–140	22–37	86–106
3–5 years	80–120	20–28	89–112
6–11 years	75–118	18–25	97–120
≥ 12 years	60–100	12–20	110–131

Source: PALS Provider Manual 2020 (awake heart rate, respiratory rate, systolic BP by age).[24]

◈ **BLOOD-PRESSURE PERCENTILES** Age-, sex-, and height-based BP centiles (elevated BP ≥ 90th; hypertension ≥ 95th) — AAP 2017 BP tables .

Scales, Equations & Synonyms

The scores, formulas, and drug names you reach for at the bedside.

Glasgow Coma Scale — child values in brackets (best 15, worst 3)

6

EYE
—

VERBAL (<2 Y)
—

MOTOR (INFANT)
Obeys (spontaneous movement)

5

EYE
—

VERBAL (<2 Y)
Oriented (coos, babbles)

MOTOR (INFANT)
Localizes (withdraws to touch)

4

EYE

Spontaneous

VERBAL (<2 Y)
Confused (irritable cry)

MOTOR (INFANT)
Withdraws to pain

3

EYE
To voice

VERBAL (<2 Y)
Wrong words (cries to pain)

MOTOR (INFANT)
Abnormal flexion

2

EYE
To pain

VERBAL (<2 Y)
Sounds only (moans)

MOTOR (INFANT)
Extension

1

EYE
None

VERBAL (<2 Y)
None

MOTOR (INFANT)
None

APGAR — score at 1 and 5 minutes (≤3 low, 4–6 moderate, 7–10 reassuring)

Appearance

0
blue / pale

1
body pink, limbs blue

2
all pink

Pulse

0
absent

1
< 100

2
≥ 100

Grimace

0
none

1
grimace

2
cry / cough

Activity (tone)

0
limp

1
some flexion

2
active

Respiration

0

absent

1
slow, irregular

2
strong cry

Dehydration — severe means shock; give 20 mL/kg

General

MILD ~3–5%
alert, thirsty

MODERATE ~6–9%
restless, irritable

SEVERE ≥10%
lethargic, floppy

Eyes / mucosa

MILD ~3–5%
normal, moist

MODERATE ~6–9%
sunken, dry

SEVERE ≥10%
deeply sunken, parched

Skin pinch

MILD ~3–5%
instant

MODERATE ~6–9%
< 2 s

SEVERE ≥10%
> 2 s

Cap refill / pulse

MILD ~3–5%
normal

MODERATE ~6–9%
prolonged

SEVERE ≥10%
> 3 s, weak, cool

Urine

MILD ~3–5%
normal

MODERATE ~6–9%
reduced

SEVERE ≥10%
minimal or none

Quick equations

Maintenance fluid

FORMULA
4·2·1: 4 mL/kg/h first 10 kg + 2 next 10 + 1 each kg over 20 (Holliday–Segar)

Fluid deficit (mL)

FORMULA
% dehydration × weight (kg) × 10

Corrected Na (high glucose)

FORMULA
add 2.4 mmol/L per 5.6 mmol/L (100 mg/dL) glucose above 5.6 mmol/L (Hillier; the older 1.6 factor underestimates at high glucose)

Calcium

FORMULA

Measure **ionized** calcium — albumin-corrected calcium is unreliable (misses hypocalcemia in critical illness and kidney disease)

Anion gap

FORMULA

Na − (Cl + HCO_3); normal about 12 ± 2 mmol/L (ISPAD 2022) — use your laboratory's reference range

Serum osmolality

FORMULA

2 × Na + glucose + urea (mmol/L). **Osmolar gap = measured − calculated** osmolality; **> 10** suggests an unmeasured osmole (methanol, ethylene glycol, ethanol, mannitol).

Expected pCO_2 (met. acidosis)

FORMULA

Winter: 1.5 × HCO_3 + 8 ± 2 (mmHg) — the **expected respiratory compensation** for a metabolic acidosis; measured $PaCO_2$ **above** the range = added respiratory acidosis, **below** = added respiratory alkalosis.

QTc (Bazett)

FORMULA

QT ÷ √RR (s); prolonged > 0.45 s in children before puberty, infants and post-pubertal males, > 0.46 s in post-pubertal females (see QTc calculator)

eGFR (Schwartz)

FORMULA

36.5 × height (cm) ÷ creatinine (µmol/L) — i.e. 0.413 × height ÷ creatinine (mg/dL)[646]

Glucose infusion rate

FORMULA
mg/kg/min = dextrose% × rate (mL/h) ÷ (6 × weight kg)

Names & synonyms

Epinephrine

ALSO KNOWN AS
adrenaline

Norepinephrine

ALSO KNOWN AS
noradrenaline

Albuterol

ALSO KNOWN AS
salbutamol

Acetaminophen

ALSO KNOWN AS
paracetamol

Furosemide

ALSO KNOWN AS
frusemide

Lidocaine

ALSO KNOWN AS
lignocaine

Acyclovir

ALSO KNOWN AS
aciclovir

Amoxicillin–clavulanate

ALSO KNOWN AS
co-amoxiclav

Valproic acid

ALSO KNOWN AS
sodium valproate

Regular insulin

ALSO KNOWN AS
soluble insulin

Normal saline (0.9% NaCl)

ALSO KNOWN AS
isotonic saline

Lactated Ringer's

ALSO KNOWN AS
Hartmann's, compound sodium lactate

Succinylcholine

ALSO KNOWN AS
suxamethonium

Chlorpheniramine

ALSO KNOWN AS
chlorphenamine

Procedural Sedation, RSI & Analgesia

Quick weight-based doses — prepare airway, suction, and monitoring first.

◈ NEONATAL INTUBATION — PREMEDICATE?

- **Emergency** (delivery room, life-threatening airway) → intubate now; no premedication.[647]
- **All other intubations** → premedicate every time, IV, in this order:[647]
  1. **Atropine** 20 mcg/kg — prevents severe bradycardia[647,648]
  2. **Fentanyl**, slow IV: < 28 wk 1–2 mcg/kg · 28–32 wk 2–3 mcg/kg · > 32 wk 3–4 mcg/kg[647]
  3. **Succinylcholine** 2 mg/kg — not in hyperkalemia, malignant-hyperthermia risk or neuromuscular disease[647,649]
- **Do not** use an opioid alone (morphine or remifentanil) as the only premedication.[647]
- **Alternative** if blood pressure is normal: **propofol** — ≥ 28 wk 2 mg/kg (repeat 1 mg/kg if needed);

< 28 wk 1 mg/kg steps, max 2 mg/kg.[647]

ANALGESIA

Acetaminophen

DOSE

PO/PR: 15 mg/kg/dose every 4–6 h (max 1 g/dose; ≤ 75 mg/kg/day, not > 4 g/day)
IV, > 10 kg: 15 mg/kg/dose every 6 h (max 60 mg/kg/day; ≥ 50 kg: 1 g/dose, max 4 g/day)
IV, ≤ 10 kg: 7.5 mg/kg/dose, max 30 mg/kg/day (UK SmPC) — US label: neonates 12.5 mg/kg/dose every 6 h (max 50 mg/kg/day), 29 days–2 y 15 mg/kg/dose every 6 h (max 60 mg/kg/day)

ROUTE & NOTES

PO/PR/IV; mild–moderate pain. IV in neonates and infants: follow the local formulary and prescribe the dose in **mg and mL** (10-fold mg/mL errors have caused overdoses)

Ibuprofen

DOSE

10 mg/kg/dose every 6–8 h (max 400 mg/dose, 40 mg/kg/day)

ROUTE & NOTES

PO; age ≥ 6 months; mild–moderate pain (avoid in dehydration, renal impairment, GI bleeding)

Morphine

DOSE

0.05–0.1 mg/kg

ROUTE & NOTES

IV, titrate; for moderate–severe pain

Fentanyl

DOSE

1–2 mcg/kg IV; 1.5 mcg/kg intranasal

ROUTE & NOTES

Rapid onset; useful when no IV access

PROCEDURAL SEDATION

Procedural sedation and RSI by credentialed clinicians only — airway-rescue capability, full monitoring, and an institutional sedation policy.

Ketamine

DOSE

1–2 mg/kg IV; 4–5 mg/kg IM

ROUTE & NOTES

Dissociative; usually preserves airway reflexes/respiratory drive — but airway obstruction, laryngospasm, and apnea can still occur

Midazolam

DOSE

IV, titrated slowly: 6 months–5 y 0.05–0.1 mg/kg (total max 6 mg); 6–12 y 0.025–0.05 mg/kg (total max 10 mg)
Buccal/intranasal: 0.3–0.5 mg/kg (max 10 mg)

ROUTE & NOTES

Anxiolysis; respiratory depression with opioids; not recommended < 6 months

RAPID SEQUENCE INTUBATION

Induction

DOSE

Ketamine 1–2 mg/kg
Propofol 2–3 mg/kg
Etomidate 0.3 mg/kg (avoid in septic shock) [12]
Midazolam 0.1–0.3 mg/kg
± Fentanyl 1–2 mcg/kg (pre-treatment)

ROUTE & NOTES

Choose by hemodynamics

Paralytic

DOSE

Rocuronium 1–1.2 mg/kg
Succinylcholine 1–2 mg/kg

ROUTE & NOTES

IV

Atropine (pre-treatment)

DOSE

0.02 mg/kg

ROUTE & NOTES

IV in young infants if bradycardia risk

⚠ BEFORE ANY SEDATION/RSI

- Have oxygen, suction, bag-mask, the right tube size [(age ÷ 4) + 4 uncuffed], monitoring, and a reversal plan ready.

- See Weight & Airway Sizing.

Emergency Drug Doses MINUTES

PALS 2025

Resuscitation doses by rule and by weight — use measured weight or a length-based tape; cross-check weight, concentration and the local chart before every dose.

Epinephrine — cardiac arrest

RULE (PER KG · MAX)

0.01 mg/kg IV/IO = 0.1 mL/kg of 0.1 mg/mL (max 1 mg)

NOTES

Repeat every 3–5 min.[3] Only if IV/IO access cannot be obtained (least-preferred route): endotracheal 0.1 mg/kg (0.1 mL/kg of 1 mg/mL; PALS 2020 figure).

Epinephrine — anaphylaxis

RULE (PER KG · MAX)

0.01 mg/kg IM = 0.01 mL/kg of 1 mg/mL (max 0.3 mg before puberty; 0.5 mg in adolescents)

NOTES

Anterolateral thigh; repeat every 5–15 min.[414,416]

Amiodarone — VF / pulseless VT

RULE (PER KG · MAX)

5 mg/kg IV/IO bolus (max 300 mg; repeat doses max 150 mg)

NOTES

May repeat up to twice for refractory VF/pVT (3 doses total); **repeat doses max 150 mg each** (PALS 2025). Perfusing tachycardia: give over 20–60 min.[3]

Adenosine — SVT, 1st dose

RULE (PER KG · MAX)

0.1 mg/kg rapid push (max 6 mg)

NOTES

Immediate saline flush; use the line closest to the heart.[3]

Adenosine — SVT, 2nd dose

RULE (PER KG · MAX)

0.2 mg/kg rapid push (max 12 mg)

NOTES

If the first dose fails.[3]

Atropine — bradycardia

RULE (PER KG · MAX)

0.02 mg/kg IV/IO (min 0.1 mg, max 0.5 mg)

NOTES

May repeat once.[3]

Calcium gluconate 10% — hyperkalemia, Ca-channel-blocker toxicity, hypocalcemia

RULE (PER KG · MAX)

50 mg/kg = 0.5 mL/kg slow IV/IO (max 2 g = 20 mL) [181]

NOTES

Calcium chloride 10% 20 mg/kg (0.2 mL/kg) only via a central line — sclerosing, high extravasation risk. [3]

Dextrose 10% — hypoglycemia

RULE (PER KG · MAX)

2 mL/kg (0.2 g/kg) slow IV (max 200 mL = 20 g, the adult dose)

NOTES

Recheck glucose in 15 min; see **Hypoglycemia**. [180] Adult dose: 200 mL of 10% glucose over 15 min (JBDS-IP 2022). [831]

Magnesium sulfate — torsades, severe asthma

RULE (PER KG · MAX)

25–50 mg/kg IV/IO (max 2 g)

NOTES

Torsades: rapid. Severe asthma (≥ 2 y): 40–50 mg/kg over 20 min. [3,420]

Naloxone — opioid toxicity

RULE (PER KG · MAX)

0.1 mg/kg IV/IM/IN (max 2 mg)

NOTES

Titrate to breathing; re-dose (short half-life). [549,591]

Sodium bicarbonate 8.4%

RULE (PER KG · MAX)

1 mEq/kg slowly IV/IO (max 50 mEq) = 1 mL/kg of 8.4%; neonates and children < 2 years: use 4.2% (0.5 mEq/mL → 2 mL/kg) and give slowly

NOTES

Tricyclic toxicity (QRS > 100 ms),[549] severe acidosis, hyperkalemia.[181]

Lidocaine — VF/pVT (alternative to amiodarone)

RULE (PER KG · MAX)

1 mg/kg IV/IO (max 100 mg)

NOTES

Then infusion 20–50 mcg/kg/min.[3]

Isotonic fluid bolus — shock

RULE (PER KG · MAX)

10–20 mL/kg per bolus — no fixed volume cap in PALS/SSC; reassess after each

NOTES

10 mL/kg in neonates, cardiac disease or severe malnutrition; DKA: 10–20 mL/kg over 20–30 min (20 mL/kg boluses only if shocked — see Diabetic Ketoacidosis); reassess after each bolus.[12,183]

Defibrillation — VF/pVT

RULE (PER KG · MAX)

2 J/kg → 4 J/kg → ≥ 4 J/kg

NOTES

Max 10 J/kg or the adult dose (≈ 200 J biphasic).[3]

Synchronized cardioversion — unstable SVT/VT

RULE (PER KG · MAX)

`0.5–1 J/kg → 2 J/kg`

NOTES

Sedate if conscious and time permits.[3]

DOSES BY WEIGHT — PICK THE COLUMN NEAREST THE WEIGHT

Epinephrine (adrenaline)

0.01 mg/kg IV/IO — mg (mL of 0.1 mg/mL)[3]

5 kg	10 kg	20 kg	30 kg	50 kg
0.05 (0.5)	0.1 (1)	0.2 (2)	0.3 (3)	0.5 (5)

Amiodarone

5 mg/kg (arrest) — mg

5 kg	10 kg	20 kg	30 kg	50 kg
25	50	100	150	250

Adenosine

0.1 mg/kg (1st, max 6) — mg

5 kg	10 kg	20 kg	30 kg	50 kg
0.5	1	2	3	5

Atropine

0.02 mg/kg (0.1–0.5) — mg

5 kg	10 kg	20 kg	30 kg	50 kg
0.1	0.2	0.4	0.5	0.5

Calcium gluconate 10%

0.5 mL/kg (max 20) — mL

5 kg	10 kg	20 kg	30 kg	50 kg
2.5	5	10	15	20

Dextrose 10%

2 mL/kg — mL

5 kg	10 kg	20 kg	30 kg	50 kg
10	20	40	60	100

Fluid bolus

20 mL/kg (10 if neonate/cardiac; DKA see card) — mL

5 kg	10 kg	20 kg	30 kg	50 kg
100	200	400	600	1000

Defibrillation — 1st shock

2 J/kg — J

5 kg	10 kg	20 kg	30 kg	50 kg
10	20	40	60	100

Defibrillation — 2nd shock

4 J/kg (max 200) — J

5 kg	10 kg	20 kg	30 kg	50 kg
20	40	80	120	200

Numbers are per single dose, already capped. Pick the nearest column and adjust to the child’s actual weight.

Concentrations & pitfalls

- Epinephrine 0.1 mg/mL (old 1:10 000) is for IV/IO; 1 mg/mL (old 1:1000) is for IM and endotracheal use — confirm the ampoule before every dose.[650]
- Amiodarone is 150 mg/3 mL.
- Use a length-based (Broselow) tape when weight is unknown.

⚠ ALWAYS CROSS-CHECK

- Confirm weight, ampoule concentration, and the local resuscitation chart before every dose.
- From **40 kg**, weight-based doses apply only until the adult maximum is reached (rows then show "(max)") — PALS 2025: dose by weight without exceeding the adult dose; PPAG 2024: 40 kg threshold.[3,818]

Anticoagulation — VTE Prophylaxis & Treatment

ASSESS · ASH/ISTH 2024 · 2026

Who to treat, for how long, who needs prophylaxis — and enoxaparin doses with anti-Xa targets.

Enoxaparin — treatment, < 2 months

DOSE

1.5 mg/kg/dose SC every 12 h

MONITORING / NOTES

Anti-Xa target 0.5–1.0 IU/mL, drawn 4–6 h post-dose (after the 3rd–4th dose). Treatment anticoagulation is hematology-guided with anti-Xa monitoring; adjust for renal function, age, weight, and bleeding risk[42,50]

Enoxaparin — treatment, ≥ 2 months

DOSE

1.0 mg/kg/dose SC every 12 h

MONITORING / NOTES

Infants often need more: term up to 1.7, preterm up to 2 mg/kg/dose

Enoxaparin — prophylaxis, < 2 months

DOSE

0.75 mg/kg/dose SC every 12 h

MONITORING / NOTES

Anti-Xa 0.1–0.3 IU/mL if monitored

Enoxaparin — prophylaxis, ≥ 2 months

DOSE

`0.5 mg/kg/dose SC every 12 h`

MONITORING / NOTES

Routine anti-Xa not required

TREAT — WHO

- **Anticoagulate:** symptomatic DVT or PE; cerebral sinovenous thrombosis (CSVT); neonatal renal vein thrombosis.[651]
- **Individualize:** DVT or PE found by chance on imaging — anticoagulation or none are both acceptable.[651]
- **No thrombolysis** for proximal DVT or for PE without hemodynamic compromise; thrombolysis, then anticoagulation, only for PE with hemodynamic compromise.[651]
- **Line-related clot:** if the central line is no longer needed or is not functioning, remove it — either immediately or after a few days of anticoagulation (both acceptable; favor a few days first with a large clot or a right-to-left shunt). A functioning line that is still needed can stay in place under anticoagulation. No IVC filter.[651,652]

TREAT — HOW LONG

- **Provoked, risk factor resolved:** 6 weeks — continue to 3 months if the 6-week scan still shows an occlusive clot.[651,653]
- **3 months** for PE, cancer-associated VTE, recurrent VTE, a persisting risk factor, major thrombophilia, or persistently positive antiphospholipid antibodies.[651]
- **Unprovoked:** 6–12 months, not indefinite.[651]
- **Agent:** rivaroxaban or dabigatran is suggested over LMWH or warfarin, started after ≥ 5 days of parenteral anticoagulation; not in preterm neonates, eGFR < 30, significant liver disease or active bleeding. Hematology sets the dose.[651]

PROPHYLAXIS — WHO

- **Give:** TPN for more than 60 days (home TPN or intestinal failure; not neonates); antiphospholipid syndrome (secondary prevention).[654]
- **Either:** leukemia or lymphoblastic lymphoma, during asparaginase cycles only — favor prophylaxis if age ≥ 10 y, obesity, T-cell or

high-risk disease, or a personal or family history of thrombosis. No antithrombin supplements.[654]

- **Not routinely:** general ward patients, critically ill children, trauma, noncardiac surgery, solid tumors, central lines, or positive antiphospholipid antibodies without a past clot. Consider case by case when several risk factors combine (adolescence, immobility, mechanical ventilation, a central line > 7 days, obesity, estrogen or the combined pill, thrombophilia, previous VTE, major surgery) and bleeding risk is low.[654]
- **Before starting:** weigh bleeding risk — do not start if it is high; reassess regularly; plan doses around lumbar puncture and spinal procedures. Continue only while the risk lasts (e.g., the asparaginase cycle, long-term TPN).[654]

Before starting

- Baseline complete blood count, renal function, and coagulation screen.

- Reduce dose if creatinine clearance < 30 mL/min.[655]

Reversal & alternatives

- Protamine partially reverses enoxaparin (1 mg per 1 mg enoxaparin given in the prior 8 h; 0.5 mg per 1 mg if > 8 h or a second dose is needed) — anti-Xa activity is only partly neutralized (maximum ~60%).[655]
- Use an IV unfractionated heparin infusion instead of enoxaparin when rapid reversal may be needed (high bleeding risk or an imminent procedure) or creatinine clearance is < 30 mL/min — half-life 0.5–2 h, cleared by the liver, neutralized by protamine (1 mg per 100 units; no more than 50 mg in 10 min).[46,655]

Maximum Local Anesthetic Doses

ASSESS

Single-dose ceilings — count total mg/kg across all sites. Use lower limits in neonates/infants, liver disease, or low cardiac

output; count the total across all injection sites and when agents are combined.

Lidocaine 1% (plain)

MAX SINGLE DOSE

4.5 mg/kg (max 300 mg)
= 0.45 mL/kg of 1% (max 30 mL)

NOTES

Onset fast; ~30–60 min duration. 1% = 10 mg/mL.

Lidocaine 1% + epinephrine

MAX SINGLE DOSE

7 mg/kg (max 500 mg)
= 0.7 mL/kg of 1% (max 50 mL)

NOTES

Longer duration. Lidocaine ceilings (4.5 mg/kg, max 300 mg plain; 7 mg/kg, max 500 mg with epinephrine) are the US-label adult maximums applied per kg — adult-derived (the label sets pediatric doses by age and weight)[656]. Caution with epinephrine on end-arteries (digits, pinna, penis).

Neonates and young infants

MAX SINGLE DOSE

Lower ceiling

NOTES

Use a lower ceiling (local practice 3–4 mg/kg for a neonatal penile block — see **Circumcision**).

Toxicity (LAST)

- Perioral numbness, tinnitus, and agitation progress to seizures,

then arrhythmia or arrest.

- Stop injection, secure airway and oxygen, treat seizures with a benzodiazepine, and give 20% lipid emulsion (see **Poisoning & Toxic Ingestion**).
- Dilute to the least concentrated effective solution, aspirate before injecting, and inject slowly in divided doses; reduce maximums in neonates.[585]

Vital signs — normal vs red zone by age

The escalation threshold, not just the normal range. Normal ranges: PALS 2020.[24]

Vital Signs — Normal vs Red Zone by Age

The number that should trigger escalation. Red-zone values are concern thresholds, not just "abnormal."

Compensated pediatric shock is often normotensive — tachycardia + poor perfusion precede hypotension, which is a late, pre-arrest sign.

Age	Normal HR	HR red zone	Normal RR	RR red zone	Hypotension SBP
< 1 month	100–205	**<100 or >205**	30–53	**>60**	**<60**
1–12 months	100–180	**<100 or >180**	30–53	**>60**	**<70**
1–2 years	98–140	**<90 or >140**	22–37	**>40**	**<70+(2×age)**
3–5 years	80–120	**<80 or >120**	20–28	**>34**	**<70+(2×age)**
6–11 years	75–118	**<60 or >120**	18–25	**>30**	**<70+(2×age)**
≥ 12 years	60–100	**<60 or >100**	12–20	**>20**	**<90**

Hypotension (5th-centile SBP): 70 + (2 × age in years) for 1–10 y; < 90 mmHg for ≥ 10 y. Example — 4-year-old: < 78 mmHg.

Sepsis/shock red flags (any): capillary refill > 2–3 s or flash, mottled/cold or bounding pulses, altered mental status, lactate > 2 mmol/L, reduced urine output.

Normal ranges: PALS Provider Manual 2020; red-zone thresholds: escalation triggers (PALS hypotension definitions). Bradycardia and bradypnea in a sick child are ominous late signs — treat as pre-arrest.

Kuwait Childhood Immunization Schedule

REFERENCE MOH Kuwait 2025

The routine schedule at a glance — and the ages a missed dose should prompt catch-up.[657]

Pregnant mother

VACCINE

Tdap — one dose in this pregnancy, and every subsequent pregnancy

ROUTE

IM

Within 24 h of birth

VACCINE

Hepatitis B (HBV) — 1st dose

ROUTE

IM

End of 2 months

VACCINE

Hexa (1st) · Pneumococcal (1st) · Rotavirus (1st)

ROUTE

IM · IM · Oral

End of 3 months

VACCINE

BCG

ROUTE

ID

End of 4 months

VACCINE

Hexa (2nd) · Pneumococcal (2nd) · Rotavirus (2nd)

ROUTE

IM · IM · Oral

End of 6 months

VACCINE

Hexa (3rd) · Pneumococcal (3rd) · Rotavirus (3rd)*

ROUTE

IM · IM · Oral

End of 12 months

VACCINE

OPV (1st) · MMR (1st) · Varicella (1st) · Meningococcal conjugate (ACWY)

ROUTE

Oral · SC · SC · IM

At 18 months

VACCINE

OPV (2nd) · Hexa booster · Pneumococcal booster

ROUTE

Oral · IM · IM

End of 2 years

VACCINE
MMRV (1st)

ROUTE
SC

End of 3.5 years

VACCINE
DTaP booster

ROUTE
IM

4–6 years (preschool)

VACCINE
Check immunization status before school admission

ROUTE
—

10–12 years (school)

VACCINE
Tdap booster

ROUTE
IM

16–18 years (school)

VACCINE
Tdap booster

ROUTE
IM

◈ **VACCINE KEY**

- **HEXA** = diphtheria, tetanus, acellular pertussis, hepatitis B, inactivated poliovirus (IPV) & Hib
- **MMRV** = measles, mumps, rubella, varicella
- **DTAP/TDAP** = diphtheria, tetanus, acellular pertussis
- **OPV** = oral polio
- * rotavirus is 2 or 3 doses according to the vaccine type used; give the first dose by 14 weeks 6 days (do not start at 15 weeks or older) and the last dose by 8 months 0 days (ACIP 2009).

✦ WHAT CHANGED IN THE 2025 SCHEDULE

- **Hexa** replaces the pentavalent (adds IPV)
- **MMRV** at 2 years replaces the old separate 2nd MMR + varicella
- **DTaP** replaces DPT at 3.5 years
- **Tdap** replaces Td at 10–12 and 16–18 years and is now given in **every pregnancy**
- the old OPV booster at 3.5 years and the girls-only MMR booster at 10–12 years were dropped.

✦ USE EVERY EMERGENCY VISIT AS A CATCH-UP TRIGGER

- An unwell or injured child is a chance to check the card.
- A missed **MMR/MMRV** in an outbreak, an incomplete primary series in a young infant with a fever, or no **tetanus-containing** cover before a dirty wound all change management on the spot.

Kuwait Newborn Screening Panel

REFERENCE `Kuwait program · since Oct 2014`

What the heel-prick looks for, how the result reaches you — and why a sick newborn is treated before it does.

◣ THE NATIONAL DRIED-BLOOD-SPOT PANEL —

22 DISORDERS

Amino acid disorders (6)

DISORDERS SCREENED

Phenylketonuria · maple syrup urine disease · classical homocystinuria · citrullinemia (types I and II) · tyrosinemia type I · argininosuccinic aciduria

MARKER · WHAT A POSITIVE MEANS FOR YOU

Tandem mass spectrometry amino acids; MSUD, citrullinemia and argininosuccinic aciduria can present as a neonatal encephalopathy before the result — see **Metabolic Crisis**[658]

Organic acid disorders (8)

DISORDERS SCREENED

Propionic acidemia · methylmalonic acidemia · isovaleric acidemia · glutaric acidemia type I · 3-methylcrotonyl-CoA carboxylase deficiency · β-ketothiolase deficiency · multiple (holo)carboxylase deficiency · HMG-CoA lyase deficiency

MARKER · WHAT A POSITIVE MEANS FOR YOU

Acylcarnitines; acidosis, hyperammonemia and lethargy in the first week — treat on suspicion[658]

Fatty acid oxidation disorders (4)

DISORDERS SCREENED
MCAD deficiency · VLCAD deficiency · LCHAD deficiency · trifunctional protein deficiency

MARKER · WHAT A POSITIVE MEANS FOR YOU
Acylcarnitines (C8; C14:1 for VLCAD). VLCAD is the commonest in Kuwait (1 in 8,290 births; 1 in 5,405 Kuwaiti newborns; founder variant c.65C>A) — hypoketotic hypoglycemia, cardiomyopathy, arrhythmia; never let these infants fast[659]

Other metabolic (2)

DISORDERS SCREENED
Classical galactosemia · biotinidase deficiency

MARKER · WHAT A POSITIVE MEANS FOR YOU
Galactosemia: stop lactose feeds at once if suspected (*E. coli* sepsis, jaundice, cataract)[658]

Endocrine (2)

DISORDERS SCREENED
Congenital hypothyroidism · congenital adrenal hyperplasia

MARKER · WHAT A POSITIVE MEANS FOR YOU
TSH; 17-hydroxyprogesterone. Salt-wasting CAH collapses at 1–3 weeks — see **Adrenal Crisis**[658]

- **Not in the panel:** hemoglobinopathies, G6PD deficiency, cystic fibrosis, SCID and

lysosomal disorders — do not assume a "normal screen" covers them.[658]

HOW THE PROGRAM RUNS

- **Sample:** dried blood spot 24–72 h after birth (ideally 48–72 h, after at least 2–3 feeds), accepted up to 1 month; a sample taken before 24 h is repeated within 7 days; **preterm infants give three samples** (72 h, 2 weeks, 1 month).[658,659]
- **Laboratory:** every sample — public and private hospitals — goes to the Newborn Screening Laboratory, Kuwait Medical Genetics Center (coverage 100 % since 2019); results are available at a median of about 4 days of age.[658,659]
- **Positive screen:** the hospital's newborn screening office recalls the infant for a confirmatory sample (second blood spot for acylcarnitines/amino acids, urine organic acids at the Al-Sabah biochemistry laboratory); a confirmed result goes to the metabolic team. A recall that is not completed is a missed diagnosis — one VLCAD infant, not followed up

after a positive screen, presented at 3 months with dilated cardiomyopathy needing PICU admission.[659]

⚠ IN THE EMERGENCY DEPARTMENT

- A pending or normal screen never excludes disease: a newborn with poor feeding, vomiting, lethargy, hypoglycemia, acidosis, hyperammonemia, seizures or cardiomyopathy is a **metabolic emergency now** — stop feeds/protein, give 10 % dextrose, send glucose, gas, ammonia, lactate and the newborn-screening sample if not yet taken, and call the metabolic team (Metabolic Crisis, Neonatal Hypoglycemia).
- A phone call about a positive screen for MSUD, an organic acidemia, a fatty acid oxidation disorder, galactosemia or CAH means same-day assessment, not a clinic appointment.

Think Here — Consanguinity & Gulf-Prevalent Conditions

REFERENCE `Gulf pre-test probability`

The same presentation carries a different differential in Kuwait — recessive disease is not rare here.

WHY THE BASELINE DIFFERS

- Consanguineous marriage is common in Kuwait — **54%** of marriages in a 1983 national sample, mostly first cousins; 23% (Capital) to 42% (Jahra) for first- and second-cousin marriages among Kuwaiti nationals in a 1999 two-governorate survey.[660,661] Homozygosity sharply raises the pre-test probability of **autosomal-recessive** disease.[662,663]

✦ RAISE THESE ON THE DIFFERENTIAL EARLIER THAN THE TEXTBOOK WOULD

- **Inborn errors of metabolism** in the encephalopathic / acidotic / hypoglycemic neonate or the child who decompensates with fasting or intercurrent illness — check gas, glucose, ammonia,

lactate and start **IV dextrose** early.[194,195,659]

Hemoglobinopathies (sickle cell, β-thalassemia) and **G6PD deficiency** in the pale, jaundiced, or acutely hemolyzing child.[664,665,666]

- A **recessive syndrome** when a sick infant has an affected sibling or known parental consanguinity.[662]

High-Alert Drugs & Fluid Safety

EVERY SHIFT · ISMP 2024 · AAP 2018

The commonest pediatric harm is not the missed diagnosis — it's the decimal point.

◣ HIGH-ALERT DRUGS — WHERE A DECIMAL KILLS

- **Insulin** (units, U-100 vs U-500) · **opioids** (mcg vs mg) · **concentrated KCl / K-phosphate** (never IV push) · **heparin / LMWH** (1,000 vs 10,000 units/mL) · **chemotherapy** (intrathecal vincristine = fatal) · **digoxin / milrinone** · **magnesium sulfate** (mg vs mmol vs mEq) ·

hypertonic saline / dextrose · neuromuscular blockers · oral methotrexate (weekly, not daily).[36]

- **Epinephrine concentration: 1 mg/mL** (old 1:1,000, IM) vs **0.1 mg/mL** (old 1:10,000, IV)[667] — the classic 10-fold pediatric error.[650,668] State the concentration, never the ratio.[650,669]

⚠ THE THREE ERROR MODES TO DOUBLE-CHECK

- **10-fold / decimal** errors[669,670]
- **mg vs mL vs microgram vs unit** confusion[669]
- **concentration mix-ups**.[650,671]
- For any high-alert drug: independent double-check of dose, concentration and pump rate.[36,671,672]

◣ SODIUM — CORRECT WITHIN THE SAFE RAILS

- **Hyponatremia:** raise Na **≤ 8 mmol/L per 24 h** (a conservative expert limit; NICE pediatric ceiling 12 mmol/L per 24 h)[182,183] to avoid **osmotic demyelination**.[182,673] **Acute symptomatic (seizing):** 3% saline **2 mL/kg (max 100 mL)** IV over 10 min, repeated once or twice until

symptoms improve; each bolus raises Na by about 2 mmol/L.[182,183] Full protocol: **Acute Electrolyte Emergencies**.

- **Hypernatremia:** lower Na **≤ 10–12 mmol/L per 24 h** (≈ 0.5 mmol/L/h)[183,184] to avoid **cerebral edema** (pediatric correction-rate evidence is evolving).[674]

FLUIDS & POTASSIUM

- **Maintenance fluids (AAP 2018):** for children **28 days–18 years**, use **isotonic** fluid (0.9% saline or a balanced solution) with KCl and dextrose — hypotonic maintenance caused iatrogenic hyponatremia.[675] Volume still by Holliday-Segar.[183]
- **IV potassium:** peripheral ≤ **40 mmol/L**[132,676] (40–60 mmol/L only where local protocol allows); ward rate ≤ **0.5 mmol/kg/h**[132] (max 10 mmol/h)[676]; faster rates only with **continuous ECG**[676] — PICU rates up to **1 mmol/kg/h** are local practice (not guideline-stated). Never IV push: direct injection of the concentrate can be instantly fatal.[676] Confirm concentration/rate ceilings against local protocol.

✦ EXTRAVASATION — STOP, ASPIRATE, AND KNOW THE TWO ANTIDOTES

- Vesicants: calcium, concentrated potassium, **vasopressors**, hypertonic dextrose/saline, TPN, chemotherapy.[185,677,678,679]
- Immediately **stop the infusion, aspirate, elevate**.[677]
- Antidotes: **hyaluronidase** (most hyperosmolar/calcium/TPN infiltrations)[677,678] and **phentolamine** (vasopressor extravasation, e.g. norepinephrine/dopamine).[678,680,681]

Must-Avoid Drugs — Conditions & Serious Interactions

EVERY SHIFT · FDA · EMA · SOCIETY GUIDELINES

The diagnosis on the chart decides what you must not prescribe — check this list before the first dose.

⚠ HOW TO READ THIS CARD

- **Not exhaustive.** This card covers the conditions, ages and drug combinations that most often

cause serious harm in children, but no list can be complete — read around each patient's condition and check every new drug against its current product information and an interaction checker, especially in rare diseases or polypharmacy.

- ⛔ label contraindication or boxed warning · ⚠ guideline or label "avoid" / "not recommended" / Class III (Harm) · △ caution or monitor.
- Rows are alphabetical; within a row drugs are listed from the most to the least frequently used in pediatric practice. Every row carries its primary source (regulator label, society guideline or GeneReviews).
- A listed drug may still be given when it is the only effective treatment — the decision belongs to the treating consultant, documented in the notes.

Three lists: A — by the child's condition · B — by the child's age · C — drug combinations

A

Avoid because of the child's **condition**

Find the diagnosis (alphabetical) — 28 conditions

Acute hepatic porphyria (AIP, VP, HCP) — rare in children

AVOID — MOST TO LEAST FREQUENTLY USED

⚠ Metoclopramide · co-trimoxazole and other sulfonamides · phenytoin · phenobarbital and other barbiturates · valproate · rifampicin · progestins
Avoid fasting — IV dextrose, including before surgery

WHY · USE INSTEAD

Why: can precipitate an acute attack.
Use instead: opioids, benzodiazepines, phenothiazines, levetiracetam, gabapentin, lamotrigine and vigabatrin are considered safe; check a porphyria drug database (NAPOS / APF) before any new drug.[682,683,684]

Acute kidney injury · dehydration/hypovolemia · CKD

AVOID — MOST TO LEAST FREQUENTLY USED

⚠ NSAIDs — ibuprofen · diclofenac · ketorolac (⛔ with volume depletion or advanced renal impairment)
Highest risk when also on diuretics and ACE inhibitors/ARBs

WHY · USE INSTEAD

Why: NSAID-induced AKI occurs even at correct doses; children < 5 y more often need dialysis or PICU.
Use instead: correct the volume deficit first.[384,685,686,687,688]

Adrenal insufficiency (CAH, hypopituitarism, chronic steroids)

AVOID — MOST TO LEAST FREQUENTLY USED

Never omit stress-dose hydrocortisone — crisis: 50 mg/m² IV, then 50–100 mg/m²/24 h; fever > 38.5 °C, gastroenteritis, surgery, trauma = increase the dose

Never stop chronic steroids abruptly

△ Etomidate — use with caution (see Why)

WHY · USE INSTEAD

Why: adrenal crisis. A single dose of etomidate blocks cortisol production (11β-hydroxylase) for up to 48 h in critically ill patients and can trigger a crisis in a child who cannot raise cortisol.

Use instead: another induction agent; if etomidate must be used, give stress-dose hydrocortisone and discuss with endocrinology.[177,178,689,690,691]

Asthma / history of bronchospasm

AVOID — MOST TO LEAST FREQUENTLY USED

⛔ Propranolol (tablets; Hemangeol) · ⛔ timolol eye drops · △ metoprolol, atenolol (β1-selective) only with caution

⛔ Ibuprofen and other NSAIDs only in a child who has reacted to an NSAID before

Hemangioma propranolol: give with/after feeds; skip the dose if not eating or vomiting (hypoglycemia); interrupt for lower-respiratory infection with wheeze

WHY · USE INSTEAD

Why: β-blockers cause bronchospasm and mask hypoglycemia. NSAID-induced bronchospasm is uncommon in children (about 2% of school-age children with asthma on challenge), and as-needed ibuprofen did not increase attacks in young children with mild persistent asthma.

Use instead: acetaminophen at standard doses for a child who has reacted to an NSAID; if a β-blocker is essential, a β1-selective one at the lowest dose, with a bronchodilator at hand.[687,692,693,694,695,696,697,698,699,700]

Burns · major trauma · denervation (spinal cord injury, spinal muscular atrophy, Guillain–Barré) · upper-motor-neuron injury

AVOID — MOST TO LEAST FREQUENTLY USED

⛔ Succinylcholine after the acute phase of injury — risk rises over time, peaks day 7–10

△ Great caution in chronic abdominal infection, subarachnoid hemorrhage, neurodegenerative disease

WHY · USE INSTEAD

Why: hyperkalemic cardiac arrest.

Use instead: rocuronium (sugammadex available).[649]

Chickenpox (varicella)

AVOID — MOST TO LEAST FREQUENTLY USED

⚠ Ibuprofen and other NSAIDs

⛔ Aspirin and other salicylates, including bismuth subsalicylate

WHY · USE INSTEAD

Why: ibuprofen — in observational studies, children who took NSAIDs during chickenpox had more severe group A streptococcal skin and soft-tissue infection, including necrotizing fasciitis; this does not prove the NSAID caused it, but the UK product information advises avoiding ibuprofen during chickenpox. Aspirin — Reye syndrome (see Age-based rules).

Use instead: acetaminophen for fever or pain.[701, 702,703,704]

Cockayne syndrome

AVOID — MOST TO LEAST FREQUENTLY USED

⛔ Metronidazole — FDA contraindication

WHY · USE INSTEAD

Why: acute, irreversible liver failure with very rapid onset — 8 of about 100 patients in a cohort, 3 deaths, 6–11 days after the first dose.

Use instead: an antibiotic from another class — the contraindication also covers tinidazole and other nitroimidazoles, including topical and vaginal forms.[705,706,707]

Dravet syndrome (SCN1A)

AVOID — MOST TO LEAST FREQUENTLY USED

Maintenance: ⚠ carbamazepine · ⚠ lamotrigine · ⚠ oxcarbazepine · ⚠ phenytoin (all contraindicated as maintenance therapy by international consensus — not a label contraindication) · △ vigabatrin, rufinamide (review level)

WHY · USE INSTEAD

Why: sodium-channel blockers typically make seizures worse.

Use instead: in status epilepticus, a benzodiazepine → IV valproate or levetiracetam → IV phenytoin/fosphenytoin may be considered (not contraindicated — strong consensus).[708,709]

Duchenne/Becker muscular dystrophy and other myopathies

AVOID — MOST TO LEAST FREQUENTLY USED

⛔ Succinylcholine — boxed warning: hyperkalemic rhabdomyolysis → ventricular dysrhythmia, cardiac arrest, death (most often undiagnosed Duchenne, boys ≤ 8 y)
⚠ Volatile (inhalational) anesthetics

WHY · USE INSTEAD

Why: in children succinylcholine is reserved for emergency intubation.
Use instead: rocuronium, with sugammadex for reversal.[328,649,710]

Fatty acid oxidation disorders (MCAD; VLCAD, LCHAD/TFP, CPT II)

AVOID — MOST TO LEAST FREQUENTLY USED

Never fast — when feeds stop give ≥ 10 % dextrose at ≥ 1.5 × maintenance (10–12 mg/kg/min glucose)
Long-chain defects: ⚠ propofol · ⚠ etomidate (lipid load) · high long-chain fat · dehydration · myocardial irritation (e.g., catheterization)
MCAD: ⚠ aspirin · MCT-based formula/coconut oil

WHY · USE INSTEAD

Why: fasting or illness → hypoglycemia, coma and death; long-chain defects also → rhabdomyolysis, cardiomyopathy and arrhythmias.
Use instead: ≥ 10 % IV dextrose with electrolytes whenever feeds stop, and an anesthetic plan agreed in advance with the metabolic center.
Note: MCT oil is *treatment* in long-chain defects but must be avoided in MCAD. Valproate: case reports only.[711,712,713]

G6PD deficiency

AVOID — MOST TO LEAST FREQUENTLY USED

⛔ rasburicase (boxed warning) · ⛔ primaquine in severe deficiency (test G6PD first) · ⚠ dapsone · ⛔ methylene blue (also ineffective) · ⛔ tafenoquine · ⚠ nitrofurantoin (CPIC medium risk — avoid when an alternative exists) · △ Co-trimoxazole (CPIC 2023: low-to-no risk at standard doses — may be used; label caution: dose-related hemolysis, monitor at high dose, e.g., PJP treatment)
Non-drug: fava beans, naphthalene (mothballs)

WHY · USE INSTEAD

Why: acute hemolysis ± methemoglobinemia.
Use instead: for tumor lysis, allopurinol instead of rasburicase (CPIC, strong) — allopurinol is less effective than rasburicase, so weigh the tumor-lysis risk with oncology.[21,256,714,715,716,717,718,719,720,832]

Hemophilia and other bleeding disorders

AVOID — MOST TO LEAST FREQUENTLY USED

⚠ Ibuprofen, diclofenac, aspirin and other NSAIDs (selective COX-2 inhibitors excepted)
⚠ No intramuscular analgesia
Vaccines preferably subcutaneous; if IM is unavoidable: factor dose, 25–27 G needle, ice 5 min before, firm pressure ≥ 10 min

WHY · USE INSTEAD

Why: platelet inhibition; intramuscular injection → muscle hematoma.
Use instead: acetaminophen or opioids for pain.
Note: ITP: ASH 2019 makes no NSAID/IM statement — expert practice.[263]

Hereditary angioedema (C1-inhibitor deficiency)

AVOID — MOST TO LEAST FREQUENTLY USED

⛔ ACE inhibitors — captopril, enalapril, lisinopril (label contraindication; guideline: strictly avoid)
⚠ Estrogen-containing contraceptives / HRT

WHY · USE INSTEAD

Why: ACE inhibitors and estrogens can trigger attacks or make them more frequent (ACE normally breaks down bradykinin, which causes the swelling).
Use instead: progestin-only pills for contraception; treat an attack with IV C1-inhibitor, icatibant or ecallantide.
Note: attacks do **not** respond to antihistamines, corticosteroids or epinephrine.[477,721,722]

Hereditary fructose intolerance · classical galactosemia

AVOID — MOST TO LEAST FREQUENTLY USED

HFI: sucrose · fructose · sorbitol · sucralose · polysorbate — enteral *or* parenteral — can be fatal: ⛔ IV sorbitol/fructose-containing medicines (EMA: "must not receive"); check oral syrups, enemas, some immunoglobulin solutions
Galactosemia: lactose and galactose

WHY · USE INSTEAD

Why: hypoglycemia, lactic acidosis and liver failure (HFI).
Use instead: galactosemia — soy, casein-hydrolysate or elemental formula from the time it is suspected.[723,724,725]

Hypertrophic cardiomyopathy — obstructive

AVOID — MOST TO LEAST FREQUENTLY USED

⚠ Verapamil — Class 3: Harm with rest dyspnea, hypotension, resting gradient > 100 mmHg, or **any infant < 6 weeks**

Stop/avoid: ACE inhibitors, ARBs, amlodipine/nifedipine (dihydropyridines), digoxin (Class 2b)

WHY · USE INSTEAD

Why: these drugs worsen dynamic outflow obstruction.

Use instead: for hypotension unresponsive to fluid, IV phenylephrine (vasoconstrictor without inotropy) — not inotropes (Class 1).[726,727]

Infant botulism

AVOID — MOST TO LEAST FREQUENTLY USED

⚠ Aminoglycosides (gentamicin, amikacin) — respiratory failure, deaths

△ Clindamycin, magnesium, calcium, tetracycline only after careful consideration with monitoring

WHY · USE INSTEAD

Why: aminoglycosides potentiate the paralysis; antibiotics do not treat the botulism itself.

Use instead: BabyBIG (human botulism immune globulin), started on clinical suspicion.[728,729,730,731]

Inherited arrhythmia syndromes — long QT syndrome · Brugada syndrome · catecholaminergic polymorphic ventricular tachycardia (CPVT)

AVOID — MOST TO LEAST FREQUENTLY USED

Long QT syndrome (Class I): ⚠ QT-prolonging drugs — ondansetron · azithromycin, clarithromycin, erythromycin · ciprofloxacin, levofloxacin · domperidone · fluconazole · haloperidol, droperidol · citalopram, escitalopram · methadone (CredibleMeds known-risk list); correct K^+/Mg^{2+} losses in vomiting/diarrhea

Brugada syndrome (Class I): ⚠ propofol · tricyclic antidepressants · oxcarbazepine · lithium · flecainide, propafenone · procainamide (brugadadrugs.org); treat fever promptly with antipyretics

CPVT: ⚠ digoxin · limit/avoid competitive sports and strenuous exercise (Class I)

WHY · USE INSTEAD

Why: long QT syndrome — torsades de pointes. Brugada syndrome — sodium-channel blockers and fever unmask the Brugada pattern and can trigger ventricular fibrillation. CPVT — adrenaline surges with exercise or emotion trigger polymorphic ventricular tachycardia; digoxin promotes the same arrhythmia mechanism.

Use instead: a drug that is not on the CredibleMeds (long QT) or brugadadrugs.org (Brugada) list; if none is suitable, prescribe only with cardiology advice.[732,733,734,735,736]

Ketogenic diet (epilepsy)

AVOID — MOST TO LEAST FREQUENTLY USED

⚠ Glucose-containing IV fluids — use 0.45–0.9 % saline or Ringer's lactate; carbohydrate only for hypoglycemia or excess ketosis
Prefer tablets/sugar-free formulations; count carbohydrate in medicines
△ Topiramate, zonisamide, acetazolamide (carbonic-anhydrase inhibitors): monitor bicarbonate and stones · △ propofol

WHY · USE INSTEAD

Why: loss of ketosis → seizures; acidosis.
Use instead: tablets rather than liquid or chewable medicines, choosing formulations without added carbohydrate.
Note: check glucose and ketones often when unwell. The diet can be stopped abruptly in an emergency (preferably inpatient).[737,738]

Malignant hyperthermia susceptibility (RYR1/CACNA1S; central core disease, King–Denborough; family history)

AVOID — MOST TO LEAST FREQUENTLY USED

⛔ Sevoflurane, isoflurane, desflurane, halothane (all volatile anesthetics) · ⛔ succinylcholine

WHY · USE INSTEAD

Why: these are malignant hyperthermia triggers.
Use instead: total intravenous anesthesia, with dantrolene immediately available.
Note: do not combine dantrolene with calcium-channel blockers (life-threatening hyperkalemia).[649,739]

Mitochondrial disease

AVOID — MOST TO LEAST FREQUENTLY USED

⚠ Aminoglycosides (gentamicin, amikacin, tobramycin) with MT-RNR1 m.1555A>G, m.1494C>T or m.1095T>C — irreversible deafness — unless no safe alternative

⛔ Valproate in POLG-related disease (boxed warning — fatal liver failure) and in children < 2 y clinically suspected of a mitochondrial disorder

△ Linezolid: monitor lactate

Never fast — give IV glucose

WHY · USE INSTEAD

Why: aminoglycosides → permanent deafness in carriers of the listed MT-RNR1 variants; valproate → fatal liver failure in POLG disease.

Use instead: generally safe by international consensus (De Vries 2020): metformin, propofol (including ≤ 48 h infusion), volatile agents, ketamine, levetiracetam, NSAIDs, steroids and ceftriaxone.[740,741,742,743]

Myasthenia gravis (including juvenile MG)

AVOID — MOST TO LEAST FREQUENTLY USED

⚠ Fluoroquinolones — ciprofloxacin, levofloxacin (boxed warning: exacerbation, ventilation, deaths) · △ macrolides (azithromycin, clarithromycin) · △ aminoglycosides (gentamicin, amikacin) · ⚠ IV magnesium only if absolutely necessary · △ β-blockers · ⚠ botulinum toxin · △ hydroxychloroquine, procainamide · ⚠ D-penicillamine · telithromycin (withdrawn)
Anesthesia: profound sensitivity to non-depolarizing blockers (reduce dose); resistance to succinylcholine. Corticosteroids may worsen weakness in the first 2 weeks

WHY · USE INSTEAD

Why: myasthenic crisis / respiratory failure.
Use instead: an alternative outside these drug classes when one exists; if a listed drug is essential, give it and watch closely for worsening weakness or breathing.[333,334,744,745,746,747]

Pheochromocytoma / paraganglioma (suspected catecholamine crisis)

AVOID — MOST TO LEAST FREQUENTLY USED

Never give β-blockers (propranolol, labetalol) before α-blockade — unopposed α-stimulation → hypertensive crisis

Crisis-precipitating drugs: metoclopramide · corticosteroids (dexamethasone, prednisolone, hydrocortisone) · pseudoephedrine, ephedrine (decongestants) · morphine, tramadol, pethidine · succinylcholine · glucagon · methylphenidate · droperidol, prochlorperazine, chlorpromazine · tricyclics · ACTH

WHY · USE INSTEAD

Why: hypertensive crisis / arrhythmia.

Use instead: α-blockade first (phenoxybenzamine or doxazosin), adding a β-blocker for tachycardia only after α-blockade.

Note: the Hemangeol label lists pheochromocytoma as a contraindication.[693,748,749]

Phenylketonuria

AVOID — MOST TO LEAST FREQUENTLY USED

⚠ Aspartame (E951) — a phenylalanine source: choose aspartame-free medicines and drinks (labels must state "contains phenylalanine")

WHY · USE INSTEAD

Why: aspartame is broken down in the gut to phenylalanine, which builds up in PKU.

Use instead: aspartame-free medicines; if none exists, give the needed medicine (e.g., an antibiotic) rather than withhold treatment.[724,750,751]

SCID / severe T-cell immunodeficiency (incl. complete DiGeorge) · high-dose immunosuppression (prednisone ≥ 2 mg/kg/day or ≥ 20 mg/day for ≥ 14 days, chemotherapy, HSCT)

AVOID — MOST TO LEAST FREQUENTLY USED

⛔ All live vaccines — rotavirus (label contraindication in SCID) · BCG · MMR · varicella · OPV · LAIV · yellow fever · oral typhoid

Irradiated cellular blood components in suspected/confirmed SCID (start while tests are pending), after intrauterine transfusion (to 6 months post-EDD), donations from relatives or HLA-selected, Hodgkin lymphoma, purine analogues, allogeneic HSCT

WHY · USE INSTEAD

Why: vaccine-strain disease; transfusion-associated GvHD.

Use instead: non-live vaccines, which are safe in these children, and full vaccination of household contacts.

Note: irradiation is not required for HIV, solid-organ transplant, routine chemotherapy or immunocompetent DiGeorge > 2 y.[642,752,753,754]

Sickle cell disease — vaso-occlusive crisis

AVOID — MOST TO LEAST FREQUENTLY USED

⚠ Meperidine (pethidine) — do not use unless it is the only effective opioid for that patient (normeperidine → seizures)
IV fluids at no more than the maintenance rate · NSAIDs only as a short course (5–7 days) after assessing renal risk

WHY · USE INSTEAD

Why: normeperidine accumulates (seizures); over-hydration → acute chest syndrome.
Use instead: another parenteral opioid, started promptly and given by patient-controlled analgesia or scheduled doses rather than as needed.[257,259,755]

Urea cycle disorders / known hyperammonemia

AVOID — MOST TO LEAST FREQUENTLY USED

⛔ Valproate · ⚠ L-asparaginase/pegaspargase
△ Also associated with hyperammonemic decompensation: furosemide · phenobarbital · phenytoin · carbamazepine · topiramate · salicylates · hydrochlorothiazide · primidone
Avoid fasting, protein loads, chemotherapy and high-dose glucocorticoids

WHY · USE INSTEAD

Why: these drugs, fasting and protein loads can raise ammonia → encephalopathy, coma and death.
Use instead: in a crisis, stop protein and give IV glucose to prevent catabolism; ammonia scavengers/dialysis per the metabolic team.[194,740]

Williams syndrome

AVOID — MOST TO LEAST FREQUENTLY USED

⚠ Multivitamins containing vitamin D in early childhood · △ vitamin D supplements with caution later · calcium at the reference daily intake — do not exceed, do not restrict without supervision
Sedation/anesthesia: risk of myocardial ischemia, hemodynamic collapse and sudden death — plan with pediatric anesthesia and cardiology

WHY · USE INSTEAD

Why: hypercalcemia; supravalvar aortic stenosis / coronary ostial narrowing.
Use instead: no substitute needed — give vitamin D only for a proven deficiency, and monitor calcium during treatment.[756,757]

Wolff–Parkinson–White with pre-excited atrial fibrillation (irregular wide-complex tachycardia)

AVOID — MOST TO LEAST FREQUENTLY USED

Class III — Harm: IV/oral β-blockers · IV digoxin · IV amiodarone · verapamil (⛔ label: AF/flutter with an accessory pathway) · diltiazem
△ Adenosine: avoid when the resting ECG shows pre-excitation and the tachycardia is pre-excited (ESC 2019)

WHY · USE INSTEAD

Why: AV-nodal block accelerates conduction down the accessory pathway → ventricular fibrillation.
Use instead: unstable → synchronized cardioversion; stable → IV procainamide or ibutilide (Class I — adult ACC/AHA/HRS and ESC grades; pediatric use is extrapolated).[758,759,760]

B Avoid because of the child's age

Find the drug — 12 rules

Aspirin / salicylates (incl. bismuth subsalicylate)

AGE LIMIT

⛔ Children or teenagers with, or recovering from, chickenpox or flu-like illness — Reye syndrome (FDA-mandated label warning)

WHY · USE INSTEAD

Why: Reye syndrome — encephalopathy with fatty liver, fatal in about a third of reported US cases.
Use instead: acetaminophen for fever or pain; ibuprofen is an alternative except in chickenpox.
Note: Kawasaki disease and rheumatic indications are the exception (treating team; see the IVIG/vaccine interaction).[112,701,761,762]

Benzocaine · viscous lidocaine (teething)

AGE LIMIT

⚠ OTC benzocaine gels/liquids: not < 2 years (methemoglobinemia) · ⛔ viscous lidocaine 2 %: never for teething (boxed warning — seizures, severe brain injury, deaths)

WHY · USE INSTEAD

Why: benzocaine → methemoglobinemia (can be fatal); swallowed viscous lidocaine → seizures, brain injury, death.
Use instead: a chilled teething ring or gum massage.[763,764]

Codeine · tramadol

AGE LIMIT

⛔ < 12 years (pain or cough) · ⛔ < 18 years after tonsillectomy/adenoidectomy · ⚠ 12–18 y if obese, obstructive sleep apnea or severe lung disease

WHY · USE INSTEAD

Why: ultra-rapid CYP2D6 metabolism → fatal respiratory depression.
Use instead: acetaminophen, ibuprofen or both for pain, including after tonsillectomy.[134,460,765,766]

Cough-and-cold products (OTC antihistamine/decongestant/antitussive combinations)

AGE LIMIT

⚠ Not < 4 years (manufacturer labels; FDA: not < 2 y; AAP: not recommended < 4 y, unproven benefit at any age) · ⛔ codeine/hydrocodone cough products < 18 y

WHY · USE INSTEAD

Why: serious and fatal adverse effects; no efficacy data.
Use instead: saline nose drops with suction, fluids, a cool-mist humidifier, and honey for cough from 12 months.[134,767]

Diphenhydramine · dimenhydrinate (OTC)

AGE LIMIT

⚠ Diphenhydramine: do not use < 2 years; 2–5 y only if directed by a doctor; **never to make a child sleepy** · dimenhydrinate < 2 y only if directed by a doctor

WHY · USE INSTEAD

Why: paradoxical excitation, anticholinergic toxicity; infant deaths.
Use instead: a non-sedating (second-generation) antihistamine for allergy symptoms.
Note: OTC labeling limits, not formal contraindications.[768,769]

Honey

AGE LIMIT

⚠ Not for infants < 12 months (including in remedies or on pacifiers)

WHY · USE INSTEAD

Why: infant botulism (*C. botulinum* spores).
Use instead: for an infant's cold, saline nose drops with bulb suction and plenty of fluids — no honey before 12 months.[767,770]

Ibuprofen in young infants (licensing)

AGE LIMIT

UK: not suitable < 3 months or < 5 kg · US OTC from 6 months ("under 6 months: ask a doctor")

WHY · USE INSTEAD

Why: under 6 months, ibuprofen pharmacokinetics may differ and kidney function is still immature.
Use instead: acetaminophen below these ages.
Note: a licensing threshold, not a toxicity rule.[112,701,771]

Loperamide

AGE LIMIT

⛔ < 2 years · OTC 2–5 y only on medical advice · never exceed recommended doses

WHY · USE INSTEAD

Why: respiratory depression; torsades/cardiac arrest with high doses.
Use instead: oral rehydration solution for acute diarrhea; antidiarrheal drugs are not recommended.[184,772]

Metoclopramide

AGE LIMIT

⛔ < 1 year (EMA) · 1–18 y second-line only — established post-operative vomiting or prevention of delayed chemotherapy-induced vomiting — 0.1–0.15 mg/kg up to 3 ×/day, max 5 days · US label: not recommended in children at all

WHY · USE INSTEAD

Why: acute dystonia / extrapyramidal reactions (more common in children); neonatal methemoglobinemia.
Use instead: ondansetron — one oral dose reduces vomiting and helps oral rehydration in gastroenteritis (trial ages 6 months–10 years).[773,774,775]

Neonates (≤ 28 days)

AGE LIMIT

⛔ Ceftriaxone if calcium-containing IV fluids are needed (fatal ceftriaxone–calcium precipitates) and in hyperbilirubinemic or premature neonates (EU: up to 41 weeks postmenstrual age) · ⛔ co-trimoxazole < 2 months (kernicterus) · ⛔ benzyl-alcohol-preserved ("bacteriostatic") saline/flushes (gasping syndrome) · ⛔ nitrofurantoin < 1 month · ⚠ chloramphenicol (gray syndrome, fatalities)

WHY · USE INSTEAD

Why: immature drug clearance and red-cell enzymes (gray syndrome, benzyl-alcohol toxicity, nitrofurantoin hemolysis), and bilirubin displacement by ceftriaxone and sulfonamides (kernicterus).

Use instead: cefotaxime in place of ceftriaxone; preservative-free 0.9 % saline for flushes and dilution.[25,714,715,776,777,778,779,780]

Promethazine

AGE LIMIT

⛔ < 2 years (any route) — boxed warning · ≥ 2 y lowest dose, avoid with other respiratory depressants

WHY · USE INSTEAD

Why: fatal respiratory depression.

Use instead: ondansetron for vomiting in gastroenteritis (studied from 6 months); a non-sedating antihistamine for allergy.[769,775,781]

Tetracyclines < 8 years

AGE LIMIT

⚠ Use in children < 8 y only for severe/life-threatening infection without alternative (permanent tooth staining) — but **doxycycline is the drug of choice for suspected rickettsial disease at any age**; short courses have not caused staining

WHY · USE INSTEAD

Why: permanent yellow-gray-brown staining of developing teeth, and enamel hypoplasia.

Use instead: an antibiotic from another class when one is suitable; if a tetracycline is needed, doxycycline at the recommended dose and duration.

Note: tetracycline and minocycline are not covered by the doxycycline data.[782,783,784]

C Avoid these drug combinations

Find either drug — 20 interactions

β-Blocker therapy + anaphylaxis

COMBINATION — MOST TO LEAST FREQUENTLY USED

β-blockers may blunt the response to epinephrine. Epinephrine-refractory anaphylaxis with hypotension/bradycardia in a β-blocked patient: **IV glucagon 20–30 µg/kg (max 1 mg)**, repeat or infusion

WHY · NOTES

Why: β-blockers may worsen the outcome of anaphylaxis and its response to epinephrine (effect not fully established).
Use instead: intramuscular epinephrine first, as for any anaphylaxis; add IV glucagon only if the response is poor.
Note: very limited evidence (case reports); glucagon causes vomiting — protect the airway.[416, 785,786]

Carbamazepine

COMBINATION — MOST TO LEAST FREQUENTLY USED

Levels ↑ (toxicity — dizziness, drowsiness, ataxia): clarithromycin · erythromycin · fluconazole · itraconazole · voriconazole · ketoconazole · grapefruit juice (CYP3A4 inhibitors)
Carbamazepine lowers: hormonal contraceptives (unintended pregnancy) · itraconazole · ⛔ voriconazole is contraindicated with carbamazepine

WHY · NOTES

Why: potent CYP3A4 inducer.
Use instead: with an interacting drug, monitor carbamazepine levels and adjust the dose; for

contraception, an alternative or back-up method.[787,788]

Ceftriaxone + calcium-containing IV solutions (any age)

COMBINATION — MOST TO LEAST FREQUENTLY USED

⛔ Never mix, Y-site or give simultaneously (including parenteral nutrition) · beyond the neonatal period (> 28 days): sequential administration only after thoroughly flushing the line with 0.9 % NaCl or D5W · neonates: contraindicated (see age rules)

WHY · NOTES

Why: ceftriaxone–calcium precipitates in the lungs and kidneys (fatal cases in neonates).
Use instead: beyond 28 days, give them one after the other with the line flushed in between, or through separate lines at different sites; in neonates, choose another antibiotic.[25,776]

Clonidine · dexmedetomidine + β-blockers / digoxin / calcium-channel blockers

COMBINATION — MOST TO LEAST FREQUENTLY USED

△ Clonidine with β-blockers, digoxin, diltiazem/verapamil: monitor heart rate (bradycardia, AV block) · **abrupt clonidine withdrawal → rebound hypertension** — withdraw a β-blocker several days before tapering clonidine (missed doses in children on clonidine for ADHD/tics) · dexmedetomidine: bradycardia/sinus arrest with high vagal tone, bolus dosing or other negative chronotropes

WHY · NOTES

Why: additive slowing of heart rate and AV conduction; stopping clonidine suddenly → rapid rise in blood pressure, worse if a β-blocker is continued.

Use instead: if both are needed, monitor heart rate; to stop, withdraw the β-blocker several days first, then taper clonidine over 2–4 days (immediate-release; the extended-release label advises steps of no more than 0.1 mg/day every 3–7 days)[789].

Note: the labels advise monitoring and caution; these are not contraindications.[790]

Colchicine (familial Mediterranean fever)

COMBINATION — MOST TO LEAST FREQUENTLY USED

Strong CYP3A4 inhibitors — clarithromycin · itraconazole · ketoconazole · ritonavir — or the **P-gp inhibitor ciclosporin**: fatal toxicity — ⛔ with renal or hepatic impairment; otherwise reduce or interrupt colchicine

Moderate inhibitors — erythromycin · fluconazole · verapamil · diltiazem · grapefruit juice: dose reduction · azithromycin: no adjustment

WHY · NOTES

Why: fatal colchicine toxicity at therapeutic doses.

Use instead: azithromycin when a macrolide is needed (no colchicine dose change); with the other listed inhibitors, reduce or interrupt colchicine.[58,791,792]

Digoxin

COMBINATION — MOST TO LEAST FREQUENTLY USED

Levels ↑ > 50 % — amiodarone · clarithromycin · erythromycin · verapamil · itraconazole · propafenone · quinidine: measure the level first, **reduce digoxin 30–50 %** · spironolactone ↑ 25 % (reduce 15–30 %)

Hypokalemia/hypomagnesemia (e.g., diuretics) predispose to toxicity · ⚠ rapid IV calcium → serious arrhythmias in digitalized patients

WHY · NOTES

Why: narrow therapeutic index.

Use instead: if the combination is needed, measure the digoxin level first, cut the dose by about 30–50 % and keep monitoring.[727]

Immunoglobulin (IVIG) + live vaccines · aspirin + varicella vaccine

COMBINATION — MOST TO LEAST FREQUENTLY USED

After IVIG defer **measles- and varicella-containing vaccines: 8 months after 400 mg/kg, 10 months after 1 g/kg, 11 months after 2 g/kg** (Kawasaki disease); if given earlier, revaccinate or check seroconversion after the interval

⚠ Salicylates for 6 weeks after varicella vaccine · give annual *inactivated* influenza vaccine to children on chronic aspirin

WHY · NOTES

Why: antibody interference with vaccine take; Reye syndrome.

Use instead: non-live vaccines, which can be given at any interval before or after IVIG.[109,642,793]

Isotretinoin (adolescent acne)

COMBINATION — MOST TO LEAST FREQUENTLY USED

⚠ Doxycycline, minocycline and other tetracyclines — intracranial hypertension (pseudotumor cerebri: headache, papilledema, visual change) · ⚠ vitamin A supplements (additive toxicity)

WHY · NOTES

Why: isotretinoin can cause intracranial hypertension, and some cases involved a tetracycline; vitamin A adds to its side effects.

Use instead: stop the oral tetracycline before starting isotretinoin, and avoid vitamin A–containing supplements.

Note: the label says "avoid", not "contraindicated".[794]

Linezolid · methylene blue · tramadol + serotonergic drugs (serotonin syndrome)

COMBINATION — MOST TO LEAST FREQUENTLY USED

⚠ Linezolid and IV methylene blue are MAO inhibitors: avoid with SSRIs (fluoxetine, sertraline, escitalopram), tramadol, other opioids, SNRIs, tricyclics, triptans unless urgent (methylene blue boxed warning; linezolid ⛔ within 2 weeks of an MAOI, monitor with other serotonergic drugs) · elective use: stop the serotonergic drug ≥ 2 weeks (fluoxetine 5 weeks) before

△ Tramadol + SSRIs/tricyclics: seizures and serotonin syndrome

WHY · NOTES

Why: serotonin syndrome (serious CNS reactions, deaths).

Use instead: another antibiotic or treatment when available; if linezolid or methylene blue is urgent, stop the serotonergic drug and monitor closely for CNS toxicity.[21,552,765,795]

Methotrexate (high-dose oncology; weekly low-dose rheumatology)

COMBINATION — MOST TO LEAST FREQUENTLY USED

⚠ Ibuprofen, aspirin and other NSAIDs · co-trimoxazole and other sulfonamides · amoxicillin, piperacillin and other penicillins · omeprazole and other proton-pump inhibitors · probenecid — reduce methotrexate clearance ("unexpectedly severe and fatal" toxicity, mainly high-dose methotrexate + NSAIDs): reconcile and hold before HD-MTX · ⚠ nitrous oxide anesthesia · co-trimoxazole prophylaxis in ALL: deferral during HD-MTX is protocol-dependent

WHY · NOTES

Why: reduced renal tubular secretion of methotrexate.

Use instead: a non-interacting alternative from the day before high-dose methotrexate until it has cleared.[796,797]

Ondansetron + other QT-prolonging drugs

COMBINATION — MOST TO LEAST FREQUENTLY USED

⚠ Avoid in congenital long QT syndrome · ECG monitoring with hypokalemia/hypomagnesemia, heart failure, bradyarrhythmias or other QT-prolonging drugs — azithromycin, clarithromycin, erythromycin · ciprofloxacin, levofloxacin, moxifloxacin · domperidone · fluconazole · haloperidol, droperidol · citalopram, escitalopram · methadone (known risk; hydroxyzine and other azoles: conditional risk) · **no single IV dose > 16 mg** (32 mg dose withdrawn 2012)

WHY · NOTES

Why: torsades de pointes.
Use instead: if both are needed, give ondansetron with ECG monitoring.[74,735]

Pimozide (Tourette)

COMBINATION — MOST TO LEAST FREQUENTLY USED

⛔ Clarithromycin, erythromycin, azithromycin · itraconazole, ketoconazole · sertraline, citalopram, escitalopram, paroxetine, fluvoxamine · protease inhibitors · nefazodone (QT prolongation, sudden death) · clarithromycin and voriconazole are likewise contraindicated with pimozide and ergot alkaloids

WHY · NOTES

Why: sudden deaths reported when clarithromycin was added to pimozide.
Use instead: an antibiotic, antifungal or antidepressant that the pimozide label does not contraindicate, with an ECG at baseline and during dose adjustment.[788,791,798]

Propofol — prolonged infusion · PICU sedation · egg/soy allergy

COMBINATION — MOST TO LEAST FREQUENTLY USED

⚠ Propofol infusion syndrome (severe metabolic acidosis, hyperkalemia, rhabdomyolysis, lipemia, Brugada-like ECG, cardiac failure) — risk with > 5 mg/kg/h for > 48 h, reported below 4 mg/kg/h · **not indicated for PICU sedation** (trial mortality 9 % vs 4 %) · ⛔ after anaphylaxis to egg or soy (US label); non-anaphylactic egg/soy allergy is not a contraindication (adult data)

WHY · NOTES

Why: propofol infusion syndrome, which has caused deaths, and higher mortality when used for PICU sedation.

Use instead: an α_2-agonist (e.g., dexmedetomidine) as the main sedative for ventilated children; if propofol is used, keep it < 4 mg/kg/h for < 48 h.

Note: UK/EU product information has no egg contraindication but does contraindicate propofol in soya or peanut hypersensitivity, and contraindicates propofol for ICU sedation in children ≤ 16 years; follow the locally registered label.[799,800,801,802]

Rifampicin (enzyme inducer)

COMBINATION — MOST TO LEAST FREQUENTLY USED

Lowers: corticosteroids · ondansetron · fluconazole and other azoles (⛔ voriconazole) · clarithromycin · phenytoin · doxycycline · fluoroquinolones · tacrolimus/ciclosporin/sirolimus (rejection) · hormonal contraceptives (use a non-hormonal method) · warfarin and other coumarins · methadone; several antivirals contraindicated · re-titrate doses when starting *and* stopping rifampicin

WHY · NOTES

Why: potent CYP/P-gp induction.

Use instead: a non-hormonal method of birth control; adjust doses of other affected drugs when rifampicin starts and again when it stops.[788,803,804]

Sildenafil / tadalafil (pulmonary hypertension)

COMBINATION — MOST TO LEAST FREQUENTLY USED

⛔ Organic nitrates in any form (GTN, isosorbide; regular or intermittent) · ⛔ riociguat

WHY · NOTES

Why: profound hypotension.

Use instead: a non-nitrate alternative; after tadalafil, give no nitrate within 48 hours of the last dose.[805]

Tacrolimus / ciclosporin (transplant, nephrotic syndrome, autoimmune disease)

COMBINATION — MOST TO LEAST FREQUENTLY USED

Levels ↑ (nephro-/neurotoxicity): fluconazole · clarithromycin, erythromycin · voriconazole, posaconazole (give one-third tacrolimus dose) · itraconazole, ketoconazole · diltiazem, verapamil · grapefruit

Levels ↓ (rejection): rifampicin · phenytoin · carbamazepine · phenobarbital · St John's wort

△ Ciclosporin + ibuprofen/NSAIDs → renal dysfunction · ⚠ ciclosporin + spironolactone and other potassium-sparing diuretics (should not be used) · △ ACE inhibitors/ARBs → hyperkalemia · tacrolimus prolongs QT (avoid in congenital LQTS)

WHY · NOTES

Why: CYP3A4/P-gp substrates with a narrow therapeutic index.

Use instead: if both are needed, adjust the dose and check tacrolimus or ciclosporin trough levels frequently.[804,806]

Theophylline / aminophylline

COMBINATION — MOST TO LEAST FREQUENTLY USED

⚠ Ciprofloxacin: serious and fatal reactions (cardiac arrest, seizures, status epilepticus, respiratory failure) — avoid; if unavoidable, monitor theophylline levels and adjust · △ clarithromycin raises theophylline — monitor with high doses

WHY · NOTES

Why: CYP1A2 inhibition (ciprofloxacin-specific; levofloxacin/moxifloxacin have little effect).
Use instead: another antibiotic; if ciprofloxacin cannot be avoided, monitor theophylline levels and adjust the dose.[744,791]

Trimethoprim (co-trimoxazole) + ACE inhibitor/ARB or spironolactone (± renal impairment, potassium supplements, NSAIDs)

COMBINATION — MOST TO LEAST FREQUENTLY USED

△ Trimethoprim blocks the distal-nephron sodium channel (amiloride-like) → **hyperkalemia**, especially at high dose (PJP treatment), with renal insufficiency or other potassium-raising drugs: monitor potassium or choose another antibiotic

WHY · NOTES

Why: trimethoprim acts like amiloride and reduces renal potassium excretion, adding to the potassium rise from these drugs.
Use instead: an alternative antibiotic when appropriate; if co-trimoxazole is needed, monitor potassium closely.
Note: the sudden-death signal is from adults ≥ 66 y (BMJ 2014, CMAJ 2015); pediatric data are limited.[714,807,808,809]

Valproate + carbapenems (meropenem, imipenem, ertapenem)

COMBINATION — MOST TO LEAST FREQUENTLY USED

⚠ Valproate level falls **60–100 % within ~2 days** → breakthrough seizures — not recommended; increasing the valproate dose does not compensate: use a non-carbapenem antibiotic or add another anticonvulsant

WHY · NOTES

Why: inhibition of valproate-glucuronide hydrolysis.
Use instead: a non-carbapenem antibiotic; if a carbapenem is essential, consider adding another anticonvulsant.[740,810,811]

Valproate + lamotrigine

COMBINATION — MOST TO LEAST FREQUENTLY USED

Lamotrigine concentrations rise > 2-fold — lamotrigine dose with valproate is **less than half** the usual (label pediatric "with valproate" tables) · boxed warning: serious rash/SJS risk is higher in children (0.3–0.8 %) and with valproate or rapid escalation

WHY · NOTES

Why: inhibition of lamotrigine glucuronidation.
Use instead: if both are needed, follow the label's "with valproate" schedule — less than half the usual lamotrigine dose — and never exceed its starting dose or escalation.[812]

Report an Error FEEDBACK

⚠ REPORT AN ERROR

- Found a wrong dose, a broken link, or an out-of-date threshold? **Report it** — corrections are logged and issued between scheduled reviews.
- Email Ayalmajed@moh.gov.kw with the topic name and what needs correcting.

§

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Primary guidelines & landmark trials (Vancouver)

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Tap to view the full reference list.

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