Pediatric Airway — CICO Reference

Steven McGaughey, MD MCI · OHSU Department of Emergency Medicine, Pediatric EM

CICO decision pathway

The first decision is anatomic, not by age. The second is which technique your kit and training actually support — name it as a choice and have the other ready as Plan B.

CICO in a child = failed intubation + failed BVM/LMA

↓

Decision (anatomy, not age): is the cricothyroid membrane palpable and large enough to accept a 4.0+ ETT?

Roughly school-age and larger; varies by build, neck size, and the kit you have.

↓

ADULT-SIZED CTM

Scalpel-finger-bougie cricothyroidotomy through the CTM — adult algorithm, same gear, same technique.

SMALLER CHILD / NON-ADULT CTM

Literature unresolved. Pick the pathway your kit and training support; have the other ready as Plan B. See fork below.

TRADITIONAL PATHWAY	EMERGING PATHWAY
DAS-PAEDIATRIC 2015 + TEXTBOOK TEACHING **Needle cric + jet ventilation** 14–16G angiocath through the CTM (largest practical) → connect to a manual jet ventilator (regulated wall O_2) *or* BVM via a 3.0 ETT adapter (Cole technique). Watch chest rise. Convert if no rise or barotrauma develops. **Scalpel reserved for needle failure.**	BERGER-ESTILITA 2021 · MORGENSTERN 2025 **Surgical tracheotomy** Driven by ~50% needle-cric failure in simulation. Vertical midline skin incision *below* the cricoid → expose trachea → vertical cut through 2 (max 3) tracheal rings → bougie → small ETT. **Avoid the lower 25% of the neck** (innominate vessels).

THREE ANCHORS FOR EITHER FORK

1. A second provider keeps oxygenating from above (BVM / LMA) the entire time.
2. Capnography confirms placement. Non-negotiable, both procedures.
3. Brief, time-limited attempt — *"about 45 sec"* is a useful heuristic, not a validated threshold. If oxygenation is not establishing, convert.

Sizing & equipment by age

Operational starting points. Fit, operator familiarity, and what's stocked matter more than the age label. Cross-check with Broselow under stress.

Age	Wt (kg)	ETT cuffed	Depth (cm)	Blade	LMA / i-gel	Bougie	Needle gauge†
Neonate	3	3.0–3.5	9–10	Miller 0–1	1	6F	14–16G
6 mo	6	3.5	11	Miller 1	1.5	8F	14–16G
1 yr	10	4.0	12	Miller 1–1.5	1.5	10F	14–16G
2–3 yr	13	4.5	13–14	Mil 1.5 / Mac 2	2	10F	14–16G
5 yr	20	5.0	15	Mac 2	2	10F	14–16G
8 yr	25	5.5	17	Mac 2–3	2.5	10–14F	14G
>12 yr	≥40	6.0+	18–20	Mac 3–4	3	14F	14G

† Needle gauge. Use the largest practical catheter your kit and anatomy support. 14G preferred when feasible; 16G acceptable; 18G acceptable if kit-limited or very small infant. Avoid 20G as default — flow resistance dominates oxygenation. Berger-Estilita 2021 endorses 14–18G as a range; Stacey 2012 showed no significant success-rate difference 14G vs 18G in pediatric simulation.

Quick formulas. Cuffed ETT size = (age/4) + 3.5. Depth at lip = ETT × 3.

Oxygenating through the cannula — what your kit actually has

Most ED clinicians do not have a manual jet ventilator on hand. BVM-via-3.0-ETT-adapter (Cole) is the realistic default.

Method	Pressure	Volume / flow	When / caveats
BVM via 3.0 ETT adapter (Cole technique) Default for most ED kits	Limited by BVM peak ~30 cmH_2O (~0.4 PSI)	100–300 mL delivered per 600 mL squeeze; high resistance through 14–16G	Safer, less barotrauma. Oxygenates; barely ventilates — accept rising CO_2. Watch chest rise; allow long expiration (I:E ≥ 1:4). **Hold the catheter manually — it will kink.**
Manual jet ventilator (regulated wall O_2) Manujet, ENK Oxygen Flow Modulator, equivalent	<5 yr: 5–10 PSI 5–8 yr: 15–25 PSI >8 yr: 25–50 PSI*	High flow per breath; effective tidal delivery	More effective ventilation but real barotrauma risk in kids. Numbers extrapolated from adult/cadaver — not evidence-anchored. Need a patent upper-airway exit (NPA/OPA, retry SGA) or pneumothorax / arrest.

*** Pediatric jet-pressure ranges** are extrapolated from adult work and cadaver setups; treat as starting points, not targets.

Delivering breaths through the cannula

Operator-controlled in both methods.

Step	BVM (Cole)	**Manual jet ventilator** (Manujet / ENK / equiv.)
Set	n/a — BVM peak ~30 cmH_2O is fixed	Dial regulator to age-appropriate PSI **before** connecting
Inspiration	Squeeze gently, ~⅓ of 600 mL bag, ~1 sec	Press trigger (Manujet) or occlude side ports (ENK), ~1 sec
Expiration	Release. Wait 3–4 sec for passive chest fall	Release trigger / unblock ports. Wait 4–5+ sec
I:E ratio	≥ 1:4	≥ 1:4 (longer in smaller children)
Watch	Chest rise on squeeze; **full** chest fall before next squeeze	Chest rise on trigger; **full** chest fall before next breath

WHY 1:4? — AND WHEN IT RELAXES

The 1:4 floor assumes **complete upper-airway obstruction** — the catheter is the only path in *and* out. With a patent upper-airway exit (NPA / OPA, retried SGA, jaw-thrust BVM from above), exhalation preferentially follows the native airway and you can ventilate more aggressively — mostly by raising rate, not by squeezing harder. The catheter is flow-limited; harder squeezes mostly raise peak pressure. **Chest-fall rule still applies.**

⚠ THE FAILURE MODE

Operator timing *is* the procedure. Inadequate expiration through a high-resistance catheter → intrathoracic pressure climbs → pneumothorax / arrest. If the chest is not fully falling between breaths, slow down or stop.

Key sources

1. Berger-Estilita J, et al. A primer for pediatric emergency front-of-the-neck access. A&A Pract 2021;15(4):e01444. doi:10.1213/XAA.0000000000001444
2. Morgenstern J. Pediatric front of neck access. First10EM, Apr 2025.
3. Disma N, et al. Airway management in neonates and infants (ESAIC/BJA). Eur J Anaesthesiol 2024;41:3–23. doi:10.1097/EJA.0000000000001928
4. Black AE, Flynn PER, et al. APA/DAS Paediatric Difficult Airway Guidelines. Paediatr Anaesth 2015;25:346–362. doi:10.1111/pan.12615
5. Doctor JR, et al. AIDAA 2025 — Paediatric unanticipated difficult airway. Indian J Anaesth 2025;69:1167–1186. doi:10.4103/ija.ija_1096_25
6. Frerk C, et al. DAS 2015 guidelines — unanticipated difficult intubation in adults. Br J Anaesth 2015;115:827–848. doi:10.1093/bja/aev371
7. Navsa N, Tossel G, Boon JM. Cricothyroid membrane in neonates. Paediatr Anaesth 2005;15:402–406. doi:10.1111/j.1460-9592.2005.01470.x
8. Fiadjoe JE, et al. PeDI-C registry: pediatric difficult intubation outcomes. Lancet Respir Med 2016;4:37–48. doi:10.1016/S2213-2600(15)00508-1
9. Stacey J, et al. Pediatric CICO simulation. Paediatr Anaesth 2012;23:107–113. doi:10.1111/pan.12048
10. Humphreys S, et al. THRIVE in children (RCT). Br J Anaesth 2017;118:232–238. doi:10.1093/bja/aew401
11. Chrimes N. The Vortex approach to CICO. Br J Anaesth 2016;117(Suppl 1):i20–i27. doi:10.1093/bja/aew175
12. EMCrit 184 — Duggan L. Trans-tracheal jet ventilation.

Pediatric Airway — Reference Card · Version 6 · April 2026

Steven McGaughey, MD MCI · OHSU Department of Emergency Medicine

airway.mcgaughey.dev