Rapid Sequence Intubation & Post Intubation, Sedation and Analgesia
Emergency Department

Nationwide Children's — When your child needs a hospital, everything matters.

Center for Clinical Excellence

Inclusion Criteria

All patients undergoing endotracheal tube intubation (ETI) using rapid sequence intubation

Exclusion Criteria

Intubations not using standard RSI approach

Concern for respiratory failure or inability to protect airway
Definition & Diagnosis

↓

Consider
Signs and Symptoms of Hypoxia & Hypercapnia

↓

Consider
Diagnostic Testing

↓

Clinical indications for endotracheal intubation?

No → **Off Pathway**

Yes ↓

- NPO
- Cardiac monitor
- Continuous pulse oximetry
- Capnography

↓

Rapid Sequence Intubation Agents for Medical Patients

Rapid Sequence Intubation Agents for Trauma Patients

Post Intubation Medications

↓

Prepare for intubation and post intubation sedation and analgesia by using **Intubation Order Set**

Optimize hemodynamics prior to intubation

↓

Utilize
Rapid Sequence Intubation Checklist

↓

After successful intubation

- Portable Chest Xray
- NG/OG placement (as needed for GI decompression)
- Mechanical Ventilation

↓

Admit to ICU

ED Rapid Sequence Intubation Checklist

Team Preparation

Call ED "Second Attending" to room

Verbalize:
- Difficult airway?
- Patient potentially unstable for procedure?
- Discuss medications with pharmacist and team

Designate roles:
- Monitor duration of intubation and oxygen saturations
- External laryngeal manipulation
- Hand ETT to intubator
- Visualize ETT through cords on monitor

If concern for difficult airway, consider contacting Anesthesiology or ENT

Simultaneously

Patient & Equipment Preparation

Pre-oxygenation via NRB/BiPAP/BVM
- 3 + minutes flush flow oxygen
- HOB 30° / reverse Trendelenburg
- 2-hand BVM as needed

Apneic oxygenation via NC

Equipment
- Yankauer & catheter-tip suction
- CMAC® turned on and in optimal position
- Cuffed ETT with stylet & 1 size smaller with stylet
- Capnography ready to use (ETCO2)
- LMA at bedside
- OPA/NPA ready
- BVM with oxygen turned on

Laryngoscopy Preparation
- Ear-to-sternal notch positioning
- Manual C-spine if trauma patient
- Confirm team readiness
- RN to administer sedative & paralytic in rapid succession
- Pause (until apneic or for 45 seconds to allow medication to take effect)

Intubation
- *Duration of laryngoscopy should not exceed 30 seconds*
- Consider stopping attempt:
  - > 30 seconds laryngoscopy
  - O2 sats < 92%

Successful placement of ETT?

No

Unsuccessful Attempt
- Team Leader verbalizes change in approach
- Re-oxygenate via BVM until highest achievable oxygen saturation and then maintain for 1 minute
- Consider OPA/LMA
- Consider placing NG/OG tube
- Re-dose sedative/paralytic if
  - 10 minutes since dose
  - 2 failed attempts
  - Patient movement

Yes

Confirmation
- ETT visualized through cords on CMAC® monitor
- ETCO2 waveform present within 20 seconds

Post-intubation tasks
- Call for portable CXR
- Place on vent ASAP
- Ensure post intubation sedation ordered (see ED PIAS Order Set)

Abbreviations:
ETT = Endotracheal tube
LMA = Laryngeal mask airway
BVM = bag-valve-mask
OPA= Oropharyngeal airway
NPA = Nasopharyngeal airway
NG/OG = nasogastric/orogastric

Return to Algorithm

Signs & Symptoms of Hypoxia and Hypercapnia

Severity Level	Hypoxia	Hypercapnia[a]
Mild	• None or depressed efficiency	• Flushed skin • Headaches
Moderate	• Dyspnea • Headaches, dizziness • Fatigue • Pallor • Tachycardia, cardiac arrhythmias • Hypertension • Mood swings: euphoria, disorientation, or depression • Ataxia, tingling	• Tachypnea • Tachycardia • Dyspnea • Muscle twitches, depressed tendon reflexes • Drowsiness, confusion • Hypertension
Severe	• Cyanosis • Hypotension • Bradycardia • Visual impairment • Loss of consciousness, seizures, coma	• Papilledema • Coma

[a]In chronic hypercapnia, signs and symptoms of hypercapnia are observed when P_{CO_2} increases above baseline level.

Vo P, Kharasch K. Respiratory Failure. Pediatrics in Review. 2014;35(11):476-486.

Return to Algorithm

Definition & Diagnosis

Respiratory failure occurs when the respiratory system fails in oxygenation or carbon dioxide elimination or both.

2 types of respiratory failure:

- Hypoxemic = Pao2 < 60 mm hg with normal or low Paco2
- Hypercapnic = Paco2 > 50 mm hg

Vo P, Kharasch K. Respiratory Failure. Pediatrics in Review. 2014;35(11):476-486.

Return to Algorithm

Indications for Intubation

- Failure to ventilate
- Failure to oxygenate
- Inability to protect airway
  - The absence of a gag reflex is not sensitive or specific as an indicator of a loss of airway reflexes.
  - Spontaneous or volitional swallowing better illustrates the patient's ability to protect the airway.
  - Pooled secretions in the posterior oropharynx suggest an inability to protect the airway.
- Anticipated clinical deterioration
- Airway protection needed for further evaluation or transport

Brown CA, Sackles JC, Mick NW. The Walls Manual of Emergency Airway Management. 5th Edition. Wolters Kluer, 2018.

Return to Algorithm

Diagnostic Testing

Interpretation of Blood Gas Results[a]			
Condition	**pH**	**$Paco_2$**	**Base Excess**
Acute respiratory acidosis or acute hypoventilation	↓	↑	↔
Acute respiratory alkalosis or acute hyperventilation	↑	↓	↔
Acute or chronic respiratory acidosis	↓	–/↑	↑
Acute metabolic acidosis with respiratory compensation	↓	↓	↓
Chronic respiratory acidosis with metabolic compensation	Normal/slightly ↓	↑	↑

[a] *In chronic hypercapnia, signs and symptoms of hypercapnia are observed when P_{CO_2} increases above baseline level.*

↓=decrease; ↑=increase; ↔=no change

Vo P, Kharasch K. Respiratory Failure. Pediatrics in Review. 2014;35(11):476-486.

Return to Algorithm

Rapid Sequence Intubation Agents for Medical Patients

DRUG	DOSE	ROUTE	ONSET	DURATION	USE/BENEFIT	WARNING/COMMENTS
Premedication Agents						
Atropine	0.01-0.02 mg/kg No minimum dose; max 0.5 mg	IV, IM	1-5 min	> 30 min	Infants <1 year of age; bradycardia; copious secretions	
Lidocaine	1 mg/kg	IV	1-2 min	10-20 min		No longer recommended to prevent ICP increase due to conflicting/limited data
Analgesic Agents						
Fentanyl	1-2 mcg/kg (max 100 mcg)	IV, IM	Immediate	30-60 min	Desire blunting of the sympathetic response	Chest wall rigidity with rapid administration
Sedation Agents						
Etomidate	0.3 mg/kg (max 30 mg)	IV	30 sec	5 min	Hemodynamic instability	Suppresses cortisol – caution in sepsis; myoclonus – avoid in seizure disorders Hemodynamically neutral
Ketamine	1-2 mg/kg IV (max 100 mg) 4-10 mg/kg IM	IV, IM	IV: 30 sec IM: 3-4 min	5-10 min 12-25 min	Hemodynamic instability, sepsis, asthma	Bronchodilator; increases secretions, BP, HR
Midazolam	0.1-0.2 mg/kg (max 5-10 mg)	IV, IM	IV: 1.5-2 min IM: 15min	10-30 min		Monitor for hypotension
Propofol	1-2 mg/kg (max 100 mg)	IV	30-45 sec	3-10 min	Bronchospasm, head injuries, elevated ICP	Monitor for hypotension
Neuromuscular Blocking Agents						
Succinylcholine	IV: 1-2 mg/kg IM: 4 mg/kg (max 150 mg)	IV, IM	IV:30-60 sec IM: ~3 min	IV: 4-10 min IM: 10-30 min		Increases ICP, hyperkalemia, fasciculation, ↑IOP, ↓HR Monitor for malignant hyperthermia
Rocuronium	1.2 mg/kg (max 100 mg)	IV	60 sec	25-40 min		
Vecuronium	0.1 mg/kg (max 10 mg)	IV	2-3 min	45-60 min		

Return to Algorithm

Rapid Sequence Intubation Agents for Trauma Patients

Patients < 1 year of age

- Premedication: Atropine (0.02 mg/kg, max 0.5 mg) to prevent reflex bradycardia
- Sedation : Ketamine (2 mg/kg*, max 100 mg)
- Paralytic: Rocuronium (1.2 mg/kg, max 100 mg)

Patients greater than 1 year of age

- Sedation: Ketamine (2 mg/kg*, max 100mg)
- Paralytic: Rocuronium (1.2 mg/kg, max 100mg)

*Ketamine can worsen hypotension and exacerbate myocardial depression in patients who are catecholamine depleted. This would include patients who have had prolonged hypotension; a maximum dose of 1.5 mg/kg, up to 100mg, is recommended in these patients

Return to Algorithm

Post Intubation Medications

Recommendations:

- Use PRN IV medications prior to continuous infusion arriving
- Initiate **ONE** continuous infusion
  - Fentanyl infusion is preferred at MCED
  - If at LCED, Dexmedetomidine is preferred
- Fentanyl and Versed:
  - Start the infusion by giving a bolus off the drip, then start the infusion rate
  - Bolus dosing is the same as the continuous infusion dosing
- Dexmedetomidine
  - Bolus 0.2 mg/kg over 2-3 minutes
  - Only bolus once

If unable to maintain appropriate sedation, recommend using PRN IV medications before ordering a second continuous infusion medication

Patients ≤ 50 kg				
Medication	**Starting Dose** (Initial Dosing Range)	**Titrate by** Q30 minutes PRN	**Max Dosing**	**Side Effects & Other Information**
Fentanyl	1 mcg/kg/hr (0.5-1 mcg/kg/hr)	0.5 mcg/kg/hr	3-4 mcg/kg/hr	Rapid, onset. lipophilic with adipose deposition, withdrawal symptoms after prolonged infusion
Dexmedetomidine (Precedex)	0.4 mcg/kg/hr (0.3-0.7 mcg/kg/hr)	0.2 mcg/kg/hr	1.2 mcg/kg/hr	Bradycardia, hypotension, loss of airway reflexes
Midazolam (Versed)	0.1 mg/kg/hr (0.05-0.1 mg/kg/hr)	0.05 mg/kg/hr	0.15 mg/kg/hr	Respiratory depression, hypotension

For patients > 50 kg, dosing depends on Ideal Body Weight and/or Adjusted Body Weight. Please consult pharmacy for dosing

Return to Algorithm

References

1. Patel SB, Kress JP. Sedation and analgesia in the mechanically ventilated patient. *Am J Respir Crit Care Med.* 2012;185(5):486-497. doi:10.1164/rccm.201102-0273CI

2. Fuller BM, Roberts BW, Mohr NM, et al. The ED-SED Study: A Multicenter, Prospective Cohort Study of Practice Patterns and Clinical Outcomes Associated With Emergency Department SEDation for Mechanically Ventilated Patients. *Crit Care Med.* 2019;47(11):1539-1548. doi:10.1097/CCM.0000000000003928

3. Pappal RD, Roberts BW, Mohr NM, et al. The ED-AWARENESS Study: A Prospective, Observational Cohort Study of Awareness With Paralysis in Mechanically Ventilated Patients Admitted From the Emergency Department. *Ann Emerg Med.* 2021;77(5):532-544. doi:10.1016/j.annemergmed.2020.10.012

4. Bhat R, Goyal M, Graf S, et al. Impact of post-intubation interventions on mortality in patients boarding in the emergency department. *West J Emerg Med.* 2014;15(6):708-711. doi:10.5811/westjem.2014.7.22292

5. Watson RS, Beers SR, Asaro LA, et al. Association of Acute Respiratory Failure in Early Childhood With Long-term Neurocognitive Outcomes. *JAMA.* 2022;327(9):836-845. doi:10.1001/jama.2022.1480

6. Kendrick DB, Monroe KW, Bernard DW, Tofil NM. Sedation after intubation using etomidate and a long-acting neuromuscular blocker. *Pediatr Emerg Care*. 2009;25(6):393-396. doi:10.1097/PEC.0b013e3181a7923b

7. Weingart GS, Carlson JN, Callaway CW, Frank R, Wang HE. Estimates of sedation in patients undergoing endotracheal intubation in US EDs. *Am J Emerg Med*. 2013;31(1):222-226. doi:10.1016/j.ajem.2012.05.015

8. Lembersky O, Golz D, Kramer C, et al. Factors associated with post-intubation sedation after emergency department intubation: A Report from The National Emergency Airway Registry. *Am J Emerg Med*. 2020;38(3):466-470. doi:10.1016/j.ajem.2019.05.010

9. Berg K, Gregg V, Cosgrove P, Wilkinson M. The Administration of Postintubation Sedation in the Pediatric Emergency Department. *Pediatr Emerg Care*. 2021;37(11):e732-e735. doi:10.1097/PEC.0000000000001744

10. Irwin WW, Berg KT, Ruttan TK, Wilkinson MH, Iyer SS. Initiative to Improve Postintubation Sedation in a Pediatric Emergency Department. *J Healthc Qual*. 2022;44(1):31-39. doi:10.1097/JHQ.0000000000000324

11. Epstein J, Breslow MJ. The stress response of critical illness. *Crit Care Clin*. 1999;15(1):17-v. doi:10.1016/s0749-0704(05)70037-3

12. Freeman CL, Evans CS, Barrett TW. Managing sedation in the mechanically ventilated emergency department patient: a clinical review. *J Am Coll Emerg Physicians Open*. 2020;1(3):263-269. Published 2020 Apr 10. doi:10.1002/emp2.12045

13. Tanaka LM, Azevedo LC, Park M, et al. Early sedation and clinical outcomes of mechanically ventilated patients: a prospective multicenter cohort study. *Crit Care*. 2014;18(4):R156. Published 2014 Jul 21. doi:10.1186/cc13995

14. Foley TM, Philpot BA, Davis AS, et al. Implementation of an ED-based bundled mechanical ventilation protocol improves adherence to lung-protective ventilation. *Am J Emerg Med*. 2021;43:186-194. doi:10.1016/j.ajem.2020.02.053

15. Bennett BL, Scherzer D, Gold D, et al. Optimizing Rapid Sequence Intubation for Medical and Trauma Patients in the Pediatric Emergency Department. *Pediatr Qual Saf.* 2020;5(5):e353. Published 2020 Sep 25. doi:10.1097/pq9.0000000000000353.

16. Korinek JD, Thomas RM, Goddard LA, St John AE, Sakles JC, Patanwala AE. Comparison of rocuronium and succinylcholine on postintubation sedative and analgesic dosing in the emergency department. *Eur J Emerg Med.* 2014;21(3):206-211. doi:10.1097/MEJ.0b013e3283606b89

17. Vo P, Kharasch VS. Respiratory failure. *Pediatr Rev*. 2014;35(11):476-486. doi:10.1542/pir.35-11-476

18. Brown CA, Sackles JC, Mick NW. *The Walls Manual of Emergency Airway Management*. 5th ed. Wolters Kluwer; 2018.

19. Nationwide Children's Hospital Trauma Program. Guideline: Rapid Sequence Intubation (RSI) for Trauma Patients. 2023.

Return to Algorithm

Quality Metrics

Goal:

- To improve, standardize, and optimize post-intubation care for all patients requiring intubation in the Pediatric Emergency Department.

Process Measures:

- Pathway Visualization
- Post Intubation Medication Order Set utilization

Outcome measures:

- Patients receiving post intubation sedation within 10 minutes of intubation

Return to Algorithm

Pathway Team & Process

Pathway Development Team:

Leaders:

Emergency Medicine:

Celia Ligorski, MD
Bridget Bonaventura, MD
Berkeley Bennett, MD, MS

ED Pharmacy:

Kimberly Jones, PharmD, BCPPS

Members:

Emergency Medicine & Clinical Informatics:

Laura Rust, MD, MPH

Emergency Medicine:

Dan Cohen, MD

PICU Pharmacy:

Cheryl Sargel, PharmD, BCCCP

Clinical Pathways Program:

Medical Director – Emergency Medicine:

Berkeley Bennett, MD, MS

Medical Director – Clinical Informatics & Emergency Medicine:

Laura Rust, MD, MPH

Medical Director – Surgery:

Dana Noffsinger, CPNP-AC

Business & Development Manager:

Rekha Voruganti, MBOE, LSSBB

Program Coordinators:

Tahje Brown, MBA
Tara Dinh, BS

Clinical Pathway Approved:

Medical Director – Associate Chief Quality Officer, Center for Clinical Excellence:

Ryan Bode, MD, MBOE

Advisory Committee Date: *September, 2023*

Origination Date: *March, 2024*

Next Revision Date: *March, 2027*

Clinical Pathway Development

This clinical pathway was developed using the process described in the NCH Clinical Pathway Development Manual Version 6, 2022. Clinical Pathways at Nationwide Children's Hospital (NCH) are standards which provide general guidance to clinicians. Patient choice, clinician judgment, and other relevant factors in diagnosing and treating patients remain central to the selection of diagnostic tests and therapy. The ordering provider assumes all risks associates with care decisions. NCH assumes no responsibility for any adverse consequences, errors, or omissions that may arise from the use or reliance on these guidelines. NCH's clinical pathways are reviewed periodically for consistency with new evidence; however, new developments may not be represented, and NCH makes no guarantees, representations, or warranties with respect to the information provided in this clinical pathway.

For more information about our pathways and program please contact:
ClinicalPathways@NationwideChildrens.org

Return to Algorithm