Children's Mercy KANSAS CITY
Evidence Based Practice

Critically Appraised Topic (CAT): Observation Time Post-Racemic Epinephrine Dosing In Children with Croup

Specific Care Question

Does observation time after a single dose of racemic epinephrine (RE) administration of 2 hours versus 3 or more hours result in similar treatment failure in children with croup?

Recommendations from the Croup Clinical Pathway Committee

*A **conditional** recommendation is made **for** a 2-hour observation period following the administration of a racemic epinephrine dose (0.5 ml of 2.5% solution via nebulizer) in the emergency department or urgent care clinic, based on the literature and clinical expertise.*

Because RE has a short half-life, guidelines recommend observing patients for 1 to 3 hours after each dose to monitor for rebound stridor.[1-3] Prolonged length of stay, driven by required observation periods, strains urgent care clinics' (UCC) and emergency departments' (ED) workflow and places an added burden on families.[4] Many acute care settings routinely transfer children who receive more than one RE treatment to a higher level of care, despite most receiving no additional interventions after transfer or admission.[1,5-8] Recent studies indicate that children who receive one to two doses of RE with observation may be safely discharged from the outpatient setting.[7,9-12]

This evidence led the Croup Clinical Pathway Committee to affirm the 2-hour observation period following RE administration. Additionally, the committee provides clinicians with guidance on using clinical reasoning and shared decision-making to tailor the observation time to address the patient's individual needs.

Rationale for Question Asked

For children with croup, signs of respiratory distress associated with moderate to severe illness warranting medical attention include inspiratory stridor at rest, tachypnea, moderate to severe retractions, and hypoxemia in severe cases.[1] For children with moderate to severe illness, the administration of corticosteroids, specifically dexamethasone, has proven to be an effective treatment. RE can also provide short-term improvement, particularly before the corticosteroid takes effect; however, there is debate about the appropriate observation period following RE administration.[7] Rudinsky et al. (2015) suggested that a minimum 2-hour observation period following RE administration, before discharge, be considered in the ED or an urgent care clinic. However, a longer observation period prior to discharge may reduce the need for hospitalization.[4] The committee is most interested in those patients who were discharged from the ED but returned for care within 24 – 48 hours, as this would be a more reliable measure for an effective observation time. This review will summarize the identified literature to answer the specific care question.

Overview of the Evidence

Two retrospective cohort studies (N = 593) evaluated the duration of observation following single-dose RE administration in the ED, and the outcome of interest for this review: treatment failure.[3,13]

Treatment Failure

Smith et al. (2018), a retrospective cohort study (n = 299), analyzed the comparison of observation times (2.1 - 3 hours to 3.1 - 4 hours) of RE and its impact on treatment failure (measured as hospital admission, child requiring a second dose of RE resulting in hospital admission, return for follow-up care within 24 hours following discharge). For the outcome of treatment failure, the intervention of 2.1 to 3 hours of observation time following RE dose administration was unfavorable compared with the comparator of 3.1 to 4 hours of observation time following RE dose administration, OR = 2.42, 95% CI [1.37, 4.29], p = .002 (see Table 1). However, this difference was driven by treatment failure as defined by requiring a second dose of RE during the same visit. When analyzing only patients who returned within 24 hours and required additional treatment, there was no difference between observation times, OR = 0.83, 95% CI [0.12, 5.99], p = 0.86.

Udoh et al. (2022), a retrospective cohort study (n = 294), compared observation times (2.1 – 3 hours vs. 3.1 – 4 hours) for RE and its impact on treatment failure (measured as return with persistent croup symptoms within 48 hours of discharge). For the outcome of treatment failure, the

intervention of 1- to 2- hour observation times following RE dose administration was not different from the comparator of greater than 2-hour observation times following RE dose administration, *OR* = 0.59, 95% CI [0.16, 2.20], *p* = 0.43 (see Table 1). When analyzing only patients who returned within 48 hours and received additional treatment, there was no difference between observation times, *OR* = 1.28, 95% CI [0.14, 11.78], *p* = 0.83.

Certainty of the Evidence for Treatment Failure. The certainty of evidence was rated as very low. The evidence was assessed as having serious indirectness (varying observation times and different definitions of treatment failure) and serious imprecision due to the limited number of events (*n* = 94) and participants (*N* = 593).

Table 1

Author (year)	Study Type	Population	N	Intervention	Control	Results
Smith (2018)	Cohort, retrospective	Children diagnosed with croup who received one dose of RE	*N* = 428	Observation time after the initial dose of RE: 2.1 to 3 hours	Observation time after the initial dose of RE: 3.1 to 4 hours	**Treatment failure** (defined as requiring 2nd dose of RE, resulting in hospitalization or return visit within 24 hours following discharge): *OR* = 2.42, 95% CI [1.37, 4.29], *p* = .002 **Treatment failure** for patients who returned within 24 hours and received additional treatment: *OR* = 0.83, 95% CI [0.12, 5.99], *p* = 0.86
Udoh (2022)	Cohort, retrospective	Children ≤ 12 years of age, diagnosed with croup who received RE and were discharged from the ED	*N* = 294	Observation time after the initial dose of RE: < 2 hours	Observation time after the initial dose of RE: > 2 hours	**Treatment failure** (defined as a return within 48 hours following discharge): *OR* = 0.59, 95% CI [0.16, 2.20], *p* = 0.43 **Treatment failure** for patients who returned within 48 hours and received additional treatment: *OR* = 1.28, 95% CI [0.14, 11.78], *p* = 0.83

Study Characteristics
Version 1 (July 2022):
The search for suitable studies was completed on July 7, 2022. K. Berg, MD, and A. Melanson, OTD, OTR/L, reviewed the 42 titles and abstracts found in the search and identified[14] 10 single studies believed to answer the question. After an in-depth review of the single studies,[14] two answered the question.

Version 2 (February 2026):

An updated literature search (January 2022 – February 2026) using the same search strategy was conducted on February 3, 2026, in the PubMed database. K. Berg, MD, reviewed the 28 titles and/or abstracts found in the search and identified[14] two single studies believed to address the question. After an in-depth review of the single studies, none were identified to answer the question.

Identification of Studies

Search Strategy and Results (see Figure 1)

1) 'laryngotracheobronchitis'/exp OR laryngotracheobronchitis OR 'laryngotracheitis'/exp OR laryngotracheitis OR 'croup'/exp OR croup
2) 'emergency care'/exp OR 'emergency care' OR 'emergency ward'/exp OR 'emergency ward' OR 'urgent care'/exp OR 'urgent care' OR 'emergency health service'/exp OR 'emergency health service' OR 'emergency department'/exp OR 'emergency department' OR 'ambulatory care'/exp OR 'outpatient department'/exp OR 'ambulatory care" OR 'outpatient department"
3) 'racemic epinephrine' OR 'racephedrine'/exp OR racephedrine OR 'epinephrine'/exp OR epinephrine OR 'nebulized adrenaline'
4) #1 AND #2 AND #3
5) #4 AND ([child]/lim OR [infant]/lim OR [preschool]/lim) AND ('article'/lit OR 'article in press'/it OR 'review'/it) AND (2015:py OR 2016:py OR 2017:py OR 2018:py OR 2019:py OR 2020:py OR 2021:py OR 2022:py)

Search Dates: 2015-Current (2022); 2022-2026 (2026)

Records identified through either Embase or PubMed database searching: Embase, *n* = 42 (2022); PubMed, *n* = 28 (2026)
Additional records identified through other sources *n* = 0 (2022; 2026)

Studies Included in this Review

Citation	Study Type
Smith et al. (2018)	Retrospective cohort
Udoh et al. (2022)	Retrospective cohort

Studies Not Included in this Review with Exclusion Rationale [4-7,9,11,15-18]

Citation	Reason for exclusion
Bagwell et al. (2020)	Investigated RE dosing, not observation times
Bergmann et al. (2023)	Investigated variation and agreement in CPGs across US children's hospitals; not specific outcomes of RE observation times
Cuppari et al. (2022)	The background article describes the management of croup in children
Edler & Rao (2019)	Investigated nebulized adrenaline, not RE
Hester et al. (2019)	Investigated preadmission RE doses and additional intervention required
Maalouli & Hodges (2021)	Investigated possible predictors necessitating hospital intervention

Maalouli et al. (2022)	Investigated a predictive model for determining croup admission risk
McCans et al. (2022)	Described variation in pediatric prehospitalization respiratory distress management protocols
Rudinsky et al. (2015)	Investigated interventions and hospital courses among asymptomatic and symptomatic children admitted with croup
Wyly et al. (2025)	Investigated RE dosing, not observation times

Question Originator (2022; 2026)
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Findings were presented to the question originators and to A. Randall, RRT-ACCS, RTT-NPS, C-NPT, C-ELBW, CPPS on November 10, 2022.
The findings from the 2026 review were presented to the question originators and the Croup Clinical Pathway Committee on April 3, 2026.
Medical Librarian Responsible for the Search Strategy (2022; 2026)
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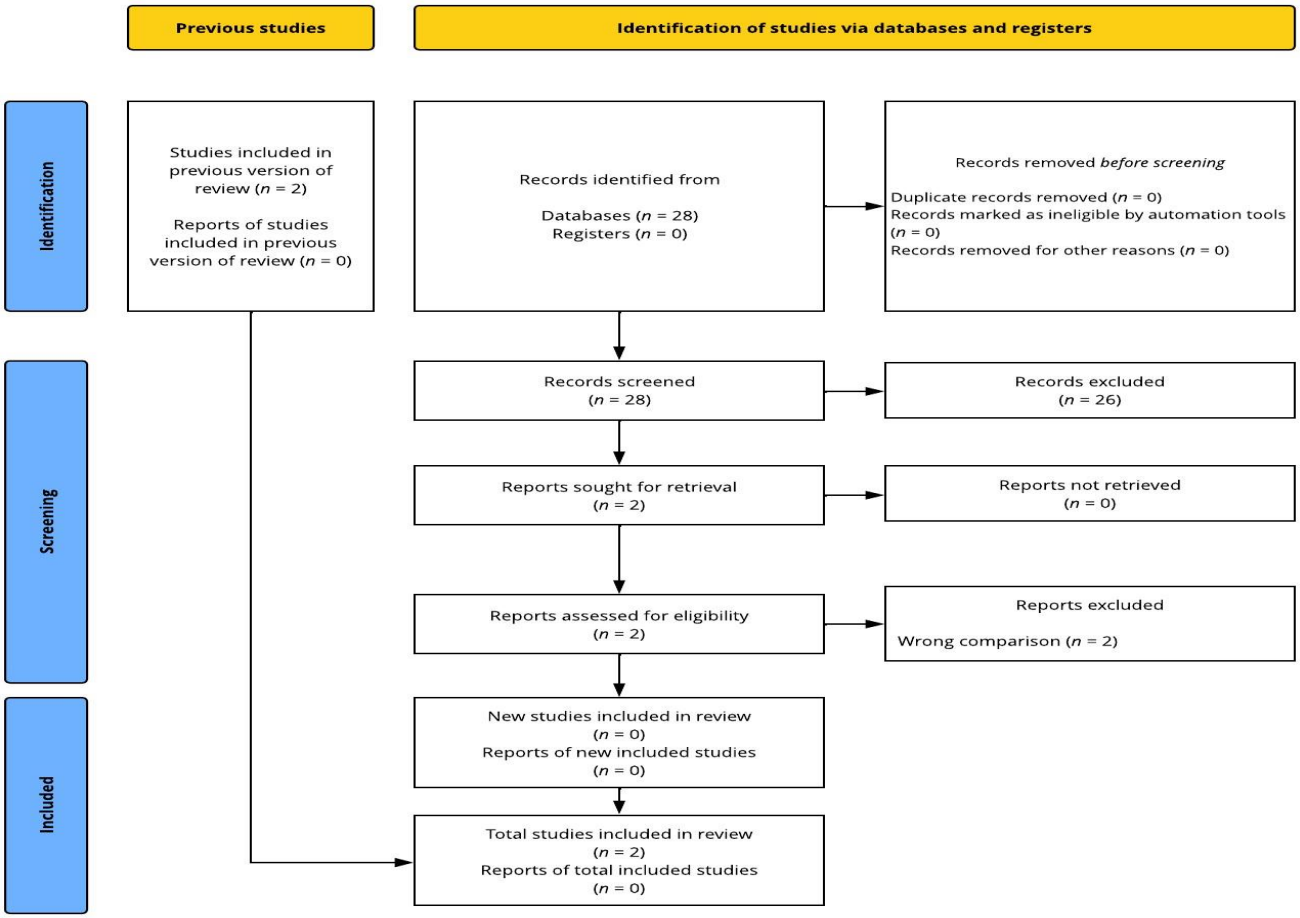
A. Melanson, OTD, OTR/L (2022; 2026)
K. Ott, OTD, OTR/L (2022)

Figure 1

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[19]



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Characteristics of Intervention Studies
Smith et al., 2018

Methods	**Cohort, retrospective**
Participants	**Participants**: Children with croup following a single racemic epinephrine (RE) dose between March 1, 2012, and May 31, 2014 **Setting**: Single pediatric emergency department (ED; Nemours/Alfred I. duPont Hospital for Children) **Number enrolled into study**: *N* = 428; specific subgroup based on primary analysis* (*N* = 299) • **Group 1**, **Observation period following RE dose of 2.1 to 3 hours*:** *n* = 163 • **Group 2**, **Observation period following RE dose of 3.1 to 4 hours*:** *n* = 136 • **Group 3**, **Observation period following RE dose less than or equal to two hours**: *n* = 92 • **Group 4**, **Observation period following RE dose greater than four hours**: *n* = 37 **Gender, males (%):** • **Group 1:** *n* = 90 (55%) • **Group 2:** *n* = 61 (45%) • **Group 3:** Not reported • **Group 4:** Not reported **Race/ethnicity or nationality:** • Not reported **Age, mean in months, (SD)** • **Group 1:** 35.2 (± 28) • **Group 2:** 32.5 (± 26) • **Group 3:** Not reported • **Group 4:** Not reported **Inclusion Criteria:** • Patients requiring RE between March 1, 2012, and May 31, 2014 • Patients who required RE for the diagnosis of croup **Exclusion Criteria:** • Patients with a history of prematurity (gestational age < 36 weeks) • Patients with underlying cardiopulmonary pathology • Patients with underlying airway disorders • Patients admitted to the hospital for a diagnosis other than croup **Covariates Identified:** None reported
Interventions	**Both:** All patients received steroids and RE within the pediatric ED • 294 of 299 patients received dexamethasone. Five patients received an unknown steroid. Dexamethasone was prescribed per institutional practice of 0.6 mg/kg/dose (maximum dose of 10 mg) orally • A 2.25% solution/dose diluted to 3 ml with normal saline; prescribed as 0.25 ml of RE for patients weighing less than 5 kg and 0.5 ml RE for patients weighing greater than 5 kg within the ED for medical treatment All patients were observed for treatment failure following a single RE dose administration until either discharge or a hospital admission order was placed. • **Group 1**: Observed for treatment failure from 2.1 to 3 hours • **Group 2:** Observed for treatment failure from 3.1 to 4 hours • **Group 3:** Observed for treatment failure for less than or equal to two hours • **Group 4:** Observed for treatment failure greater than four hours
Outcomes	**Primary outcome(s):** • Second dose of RE required (treatment failure); two or more doses of RE required hospital admission based on hospital practices • Return to ED within 24 hours following discharge* (treatment failure)

	• Comparison of success (discharge following one dose of RE and no readmission to ED within 24 hours) and failure rates (see above) between observation time periods (2.1 to 3 hours; 3.1 to 4 hours) * **Secondary outcome(s):** • None reported **Safety outcome(s):** • None reported *Outcomes of interest to the CAT development team
Notes	**Results:** • No statistically significant difference between subgroups analyzed (Group 1 and Group 2) regarding treatment success (discharge following one RE dose) • Higher rate of treatment failure (*n* = 54; treatment failure in the ED, second dose of RE required, or return to the ED within 24 hours following discharge) reported in Group 1 (2.1 to 3 hours observation time) * • While limited data is reported, 76 patients in Group 3 (Observation time of less than or equal to two hours) were admitted to the hospital, and 12 were discharged home and did not return to the ED within 24 hours. • While limited data is reported, 12 patients in Group 4 (Observation time greater than four hours) required a second dose of RE for which hospital admission was required, and 25 patients were discharged home and did not return to the ED within 24 hours. • Of the eight patients returning for follow-up care within the 24-hour period, one required hospital admission and was discharged within 24 hours after admission **Limitations:** • Two or more doses of RE in the ED resulted in hospital admission • Patients with observation times less than or equal to two hours and greater than four hours were considered separately; limited data were reported for these groups • The investigators were only able to analyze patient data from their personal institution; data regarding follow-up care received at other institutions could not be obtained • The investigators were not able to assess and compare the symptom severity of patients prior to the initiation of treatment *Contacted the author to clarify information reported in the Results section and Table 3 of the article. Additional information reported is based on clarification obtained

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Udoh et al., 2022

Methods	Cohort, retrospective
Participants	**Participants:** Children diagnosed with croup who received racemic epinephrine (RE) and discharged from the ED from February 2010 through June 2018 **Setting:** Three regional EDs in central Wisconsin (Marshfield Medical Center-Marshfield, Marshfield Medical Center-Eau Claire, and Marshfield Medical Center-Rice Lake) **Number enrolled into study**: *N* = 294; unique patients: *N* = 276 • **Group 1, Observed for less than one hour following RE dose***: n* = 132 • **Group 2, Observed for 1 to 2 hours following RE dose**: *n* = 123 • **Group 3, Observed for more than two hours following RE dose:** *n* = 39 **Gender, males (%):** • **Group 1:** *n* = 85 (64%) • **Group 2:** *n* = 82 (67%) • **Group 3:** *n* = 24 (62%) **Race/ethnicity or nationality:** • Not reported **Age, mean in years, (SD):** • **Group 1**: 2.7 (± 2.1) • **Group 2:** 3.0 (± 2.2) • **Group 3:** 2.8 (± 2.2) **Inclusion Criteria:** • Patients less than or equal to 12 years of age • Patients diagnosed with croup (International Classification of Diseases, Ninth Revision [ICD-9] code 464.4) in the ED • Patients discharged from the ED from February 2010 through June 2018 **Exclusion Criteria:** • Patients diagnosed at the same time with asthma, bronchiolitis, and/or pneumonia **Covariates Identified:** • Of the 294 visits identified, all were individual visits and not repeat visits within the 48-hour time following discharge for one episode of croup
Interventions	**Both:** RE dosing used was 11.25 mg solution nebulizer. Observation time was defined as the time from administration of the first dose of RE until the time of discharge by the clinician • **Group 1:** Observed for less than one hour following RE dose prior to discharge from ED • **Group 2:** Observed for one to two hours following RE dose prior to discharge from ED • **Group 3:** Observed for greater than two (2.1+) hours following RE dose prior to discharge from ED
Outcomes	**Primary outcome(s):** • Treatment failure resulting in return for additional care within 48 hours from discharge with persistent symptoms between groups (observation less than or equal to two hours versus observation greater than two hours*) **Secondary outcome(s):** • Returned patient (within 48 hours following discharge) was treated with steroids, regardless of return to ED, an outpatient clinic, or urgent care • Returned patient (within 48 hours following discharge) was treated with another dose of RE, regardless of return to ED, an outpatient clinic, or urgent care **Safety outcome(s):** • None reported *Outcomes of interest to the CAT development team
Notes	**Results:** • There was no association between return rates and observation times determined for mild cases of croup (p = .538) or for moderate cases of croup (p = .905)

	• Average length of observation time in the patient population of the study sample (*N* = 276 patients or 294 visits) was 1.3 hours (45% observed less than one hour; 42% observed for 1 to 2 hours; and 13% observed for greater than two hours) • Of all the visits (*N* = 294), the maximum length of observation time was 4.6 hours • Most patients (93%) had mild croup symptoms, whereas patients with moderate croup symptoms (7%) were fewer in number • There were no patients identified with severe croup symptoms • Dexamethasone (0.6 mg/kg) treatment was used with 93% of the patients (87% for those observed less than one hour; 98% for those observed 1 to 2 hours, and 100% for those observed greater than two hours) who returned within 48 hours following discharge for follow-up care **Limitations:** • Limited observational data reported, retrospective study dependent upon chart review • Croup severity score was not assigned/standardized prior to treatment; information was extrapolated based on presenting symptoms documented in the charts • Limited numbers to provide a recommendation for generalization to other populations • RE treatment was not standardized

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