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Original Contributions

RATE OF AIRWAY INTERVENTION FOR CROUP AT A TERTIARY CHILDREN'S HOSPITAL 2015–2016

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☐ **Abstract—Background: Croup admission decision making is challenging because the rate of further interventions after stabilization is unclear. Objective: We sought to describe rates of inpatient racemic epinephrine (IRE) and additional inpatient airway interventions (IAI) (oxygen or heliox therapy, intubation, or transfer to an intensive care unit) among patients presenting to a tertiary children's hospital with croup. Methods: This was a retrospective descriptive study including patients (3 months to 8 years of age) with an emergency department (ED)/inpatient encounter for croup from January 1, 2015 to December 31, 2016 at a tertiary children's hospital. We excluded intensive care unit direct admissions and patients with bronchiolitis/asthma/pneumonia. We compared 3 groups (a weighted random 5% sample of patients evaluated in ED only, and those admitted with or without IRE/IAI) using Kruskal-Wallis, Pearson χ^2, or the Fischer exact test, where appropriate. We used multivariate analysis to compare demographics and preadmission racemic epinephrine (RE) with rates of IRE/IAI in admitted patients. Results: We included 588 patients (194 discharged from the ED, 394 admitted). In admitted patients, 20.8% (82/394) had IRE/IAI, most commonly IRE (20.0%, 79/394). Three admitted patients (0.76%) had IAI. Overall, patients with 2 outside hospital/ED doses of RE had a 12.1% rate of IRE/IAI (23.5% if ≥3 RE doses). Patients with ≥3 preadmission RE doses were more likely to have IRE/IAI compared with 2 RE (adjusted odds ratio = 2.08 [95% confidence interval 1.15–3.76]; $p = 0.02$); there were no other significant associations. Conclusions: We found a low rate of IRE/IAI after ED management in patients with croup and no significant associations aside from preadmission RE doses. These findings may be considered in admission decisions.**

☐ **Keywords—admission; airway intervention; croup; pediatric; shared decision making**

Reprints are not available from the authors.

INTRODUCTION

Croup, an upper airway infection manifested by barky cough and stridor, is a frequent reason for clinic, acute/urgent care, emergency department (ED) and hospital visits in young children (1–3). Around 1.5–6% of children with croup are hospitalized annually in the United States with an estimated yearly cost of approximately $56 million (4–6). While effective symptomatic treatments exist, including corticosteroids and nebulized racemic epinephrine (RE), there are no national guidelines for croup management (3,7–9).

Though there are no universal admission criteria for croup, receipt of RE (1–2 doses) has been cited as a reason for admitting patients with croup (10–13). The rate of additional inpatient RE (IRE) and inpatient airway

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interventions (IAIs) in patients with croup after initial management is unclear. Existing studies evaluating the association of preadmission RE and further airway intervention either did not address RE given at an outside facility/hospital (OSH) or did not include patients who received RE and were discharged from the ED (6,14,15). The primary objective of this study was to describe initial RE use, including doses at an OSH and the ED, and admission decisions for patients presenting with croup at a large children's hospital. Secondary objectives were to: 1) describe the rate of IRE/IAI in patients with croup in the ED and inpatient settings and 2) examine potential factors associated with IRE/IAI in admitted patients. Achievement of these objectives will provide a more comprehensive assessment of croup outcomes after initial stabilization at an OSH or ED to be used by clinicians in admission decision making.

METHODS

We conducted a retrospective descriptive study at a 430-bed tertiary children's hospital in the Midwestern United States with approximately 15,000 inpatient and 92,000 ED visits annually. The pediatric ED is staffed by pediatric emergency physicians and pediatric nurse practitioners. There was not a croup pathway/decision rule or standardized respiratory score in use at the hospital during our study. We included patients 3 months to 8 years of age with an ED, observation, or inpatient encounter (observation/inpatient hereafter referred to as "admitted" or "inpatient") and an *International Classification of Diseases, 9th* or *10th revision* diagnosis code for croup (acute laryngitis/tracheitis [464.×], acute croup [464.4], or acute obstructive laryngitis [J05.0]) between January 1, 2015 and December 31, 2016. Because of the large patient volume in the ED during this time period (n = 3838), we reviewed charts of a random 5% sample of patients discharged from the ED and charts from all admitted patients. We included only the first encounter in the primary analysis for patients with repeat encounters within 7 days. We excluded patients <3 months of age or with diagnoses of asthma/bronchiolitis/pneumonia because they may have had additional symptoms that could impact our outcomes of interest. We also excluded patients with an alternate primary reason for stridor (e.g., postextubation). While we included patients directly admitted from an OSH to the medical-surgical or observation units, we excluded patients directly admitted to the intensive care unit (ICU) because we suspected that they had signs of impending respiratory failure requiring hospital management.

We obtained data elements from a combination of electronic health record extraction (demographics, laboratory results, medications [including time of dose], and administrative data) and chart review by pediatric hospitalist coinvestigators (presentation to an OSH, documentation of OSH RE and steroids, medical history, time of transfer from ED, use of oxygen/heliox, procedures, and medications recommended after discharge).

We used 3 patient groups for analysis: ED discharge, admitted with no IRE/IAI, and admitted with IRE/IAI. Admitted patients were determined to have IRE if they received additional RE after time of transfer from the ED or OSH (if directly admitted). They were considered to have IAI if they received any of the following interventions after transfer from the ED or OSH (if directly admitted): oxygen or heliox therapy, intubation, or transfer to the ICU. Because our goal was describing need for further hospital treatment after OSH/ED management we elected to present rates of IRE/IAI as a combined outcome. In order to better understand the risks for more invasive airway intervention we also described patients requiring IAI. We used weighted estimates when applicable for ED patients. We used descriptive statistics (median, interquartile range [IQR]) to describe management and outcomes. We present the total direct hospital costs in the supplemental materials as median ratios because of organizational policy for publishing cost data. We made comparisons between patient groups using the Kruskal-Wallis test for continuous outcomes and the χ^2 test of homogeneity (or the Fisher exact test) for categorical outcomes, as indicated. $p < 0.05$ was considered significant for most comparisons and was adjusted for multiple comparisons using Holm-Sidak (p value 1 < 0.016, p value 2 < 0.025, and p value 3 < 0.05) when applicable. We performed univariate logistic regression to determine the association of preadmission RE with IRE/IAI. We presented associations using odds ratios (ORs) and 95% confidence intervals (CIs) and assessed significance using the Wald test ($p < 0.05$). We examined the potential for interaction of age, gender, race, and insurance with preadmission RE doses and IRE/IAI in a bivariate analysis. There were no significant interaction terms ($p \leq 0.10$) included in the adjusted model. We included all demographic covariates in the final adjusted model. Because it represented the largest group, we used 2 RE doses as the reference group in the multivariate model. For all analyses we used Stata software (version 14.0; StataCorp, LLC, College Station, Texas). This study was approved by the organization's institutional review board.

RESULTS

Study Sample

There were 4789 eligible encounters during the study period; after applying initial exclusion criteria, a total of 4307 encounters met study inclusion criteria (Figure 1) (16). Of the 3838 ED discharges in this group, we included

a random sample of 199 patients (5.2%) for chart review in addition to all 469 admissions. After this review, we included 588 encounters (194 discharged from ED, 394 admitted) in the final analysis. OSH encounters occurred in 33.2% (195/588) of patients before arrival at our children's hospital. Direct admissions from an OSH accounted for 3.6% (14/394) of admissions. We found a 9.0% (382/4260) weighted) ED admission rate.

Patient Demographics and Medical History

The overall median patient age was 18 months (IQR 11–30 months) and 65% were male (Table 1). Underlying airway anomalies or croup mimickers (e.g., laryngomalacia) were present in 2.3% (14/588) (Supplemental Table 1). We conducted comparisons between the 3 groups of interest, ED discharge (n = 194, 5% sample), admitted without IRE/IAI (n = 312), and admitted with IRE/IAI (n = 82). ED discharged patients were older than admitted patients with or without IAI (median age 24 months vs. 17 and 16.5 months, $p < 0.001$). Otherwise there were no significant differences in history of prematurity, stridor, intubation, or previous croup illness/hospitalization between the groups after adjusting for multiple comparisons.

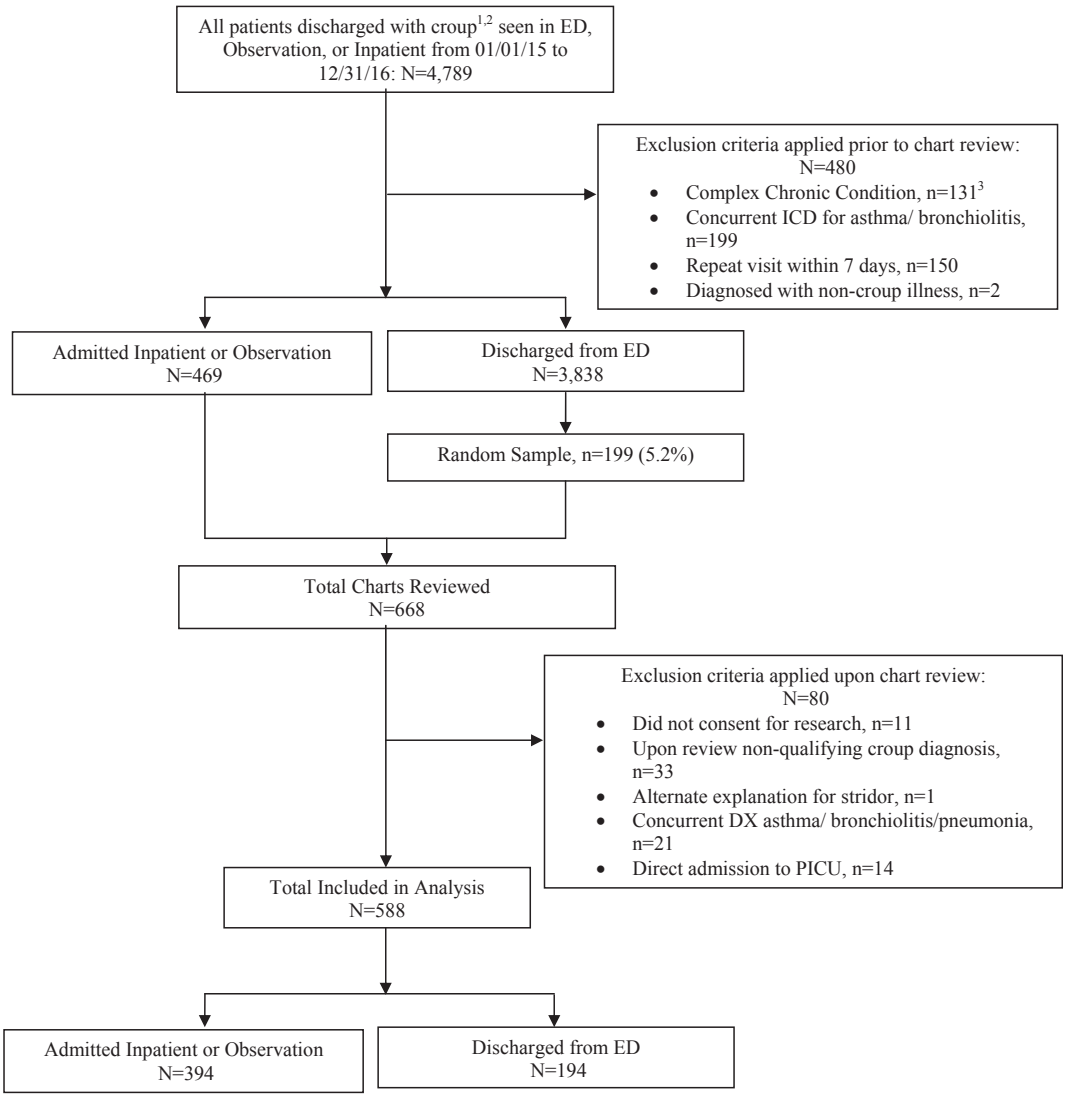

Figure 1. Flow diagram for study inclusion. [1]Croup: acute laryngitis/tracheitis (464.×), acute croup (464.4) or acute obstructive laryngitis (J05.0). [2]Approximately 1% of patients diagnosed with croup had a concurrent *International Classification of Diseases* (ICD) code for a croup-mimicking diagnosis, including tracheitis, supraglottitis, epiglottitis, airway or esophageal foreign body, laryngomalacia, tracheomalacia, vocal cord paralysis, or tumor (neoplasm, hemangioma, or papilloma) of the airway. [3]Complex chronic conditions were identified using published diagnosis codes (Feudtner et al. [16]). DX = diagnosis; ED = emergency department; PICU = pediatric intensive care unit.

Table 1. Preadmission Characteristics of Patients Treated for Croup (n = 588)

Demographics	Discharged from the ED, n = 194[a]	Patients Admitted to the Hospital, n = 394		p Value[b]
		No Inpatient Airway Intervention, n = 312	Additional Inpatient Airway Intervention, n = 82	
Age at discharge (months), median (IQR)	24 (14–43)[c]	17 (10.5–25)[d]	16.5 (11–25)[d]	<0.001
Age range	3 months–7 years	3 months–6 years	3 months–8 years	
Male, n (%)	129 (66.5)	205 (65.7)	48 (58.5)	0.41
Race, n (%)				
White	99 (51.0)	166 (53.2)	38 (46.3)	0.24
Black/African American	30 (15.5)	57 (18.3)	13 (15.9)	
Asian	15 (7.7)	34 (10.9)	15 (18.3)	
Hispanic/Latino	23 (11.9)	19 (6.1)	6 (7.3)	
Bi- or multiracial	13 (6.7)	17 (5.5)	5 (6.1)	
Other/declined	14 (7.2)	19 (6.1)	5 (6.1)	
Primary payer, n (%)				
Commercial	95 (49.0)	177 (56.7)	44 (53.7)	0.27
Medical assistance/Medicare	93 (47.9)	128 (41.0)	38 (46.3)	
Self-pay	6 (3.1)	7 (2.2)	0	
Medical history, n (%)				
History of croup illness	38 (19.6)	59 (18.9)	17 (20.7)	0.93
>1 previous croup illness	4 (2.1)	15 (4.8)	3 (3.7)	0.29
Previous croup hospitalization	14 (7.2)	26 (8.3)	7 (8.5)	0.89
History of stridor	31 (16.0)	52 (16.7)	15 (18.3)	0.90
Premature (<37 wks)	10 (5.2)[c]	36 (11.5)[d]	9 (11.0)[c,d]	0.05
Gestation if premature (wks), median (IQR)	34 (31–35)	35 (32.5–35.5)	33 (30–34)	0.36
History of intubation	7 (3.6)	14 (4.5)	3 (3.7)	0.96

ED = emergency department.
[a] Of 3838 patients discharged from the ED, we included a random sample of 199 (5.2%) for chart review, and 194 met inclusion criteria for the study. We used weighted estimates when applicable for ED patients.
[b] p Value for Kruskal-Wallis test for continuous outcomes and χ^2 test of homogeneity (or Fisher exact test, where appropriate) for categorical outcomes.
[c,d] Statistically significant differences in pairwise comparisons. Significance was adjusted for multiple comparisons using Holm-Sidak (p value 1 < 0.016; p value 2 < 0.025; p value 3 < 0.05).

Patient Outcomes

Of admitted patients, 20.8% (82/394) had IRE/IAI, most commonly additional RE (20.6%, 81/394). Only 3 patients (0.76%, 3/394) had IAI; 2 required oxygen and 1 required ICU transfer. No patients required heliox, intubation, or died.

Overall, 3 patients (3/588 [0.5%]) were treated with antibiotics for suspected concurrent bacterial tracheitis (Supplemental Table 1). Of the sample of patients initially discharged from the ED, 3 had ED revisits within 24 hours: 1 of whom received an additional single RE dose, 2 of whom received no further treatments, and none of whom were readmitted. Admitted patients without IAI had a 3.1 times greater median cost than patients discharged from the ED. Supplemental Table 2 shows resource utilization.

RE Administration

Of patients evaluated at an OSH, 59% (115/195) received ≥1 OSH RE dose. We found an overall increased rate of admission with IRE/IAI as the number of OSH/ED RE doses increased: 0.5% (8/1709) for 1 RE dose, 12.1% (42/348) for 2 RE doses, and 23.5% (24/102) for ≥3 RE doses (Table 2). Limiting to only patients who were admitted, the rate of IRE/IAI also increased with increased OSH/ED RE doses: 16.3% (8/49) for 1 RE, 16.9% (42/248) for 2 RE doses, and 29.3% (24/82) for ≥3 RE doses. For patients who received RE in both the ED and inpatient setting (n = 67), the median time between last RE dose in the ED and first RE dose on admitting unit was 5.2 h (IQR 2.8–83 h; range 1.1–22.6 h).

Association of Preadmission RE with IRE/IAI

We found no demographic factors, including age, sex, race, or insurance, to be significantly associated with IRE/IAI after admission (Table 3). Preadmission RE was associated with IRE/IAI in a univariate analysis (Wald χ^2 6.38, p = 0.04) as well as after adjusting for the aforementioned demographic characteristics (Wald χ^2 6.76, p = 0.03). In order to have adequate power for this analysis, we recategorized RE doses into 0–1 dose, 2 doses, and ≥3 doses. Patients who received 0–1 dose of preadmission RE did not differ from patients receiving 2 doses of RE (p = 0.11). Patients with ≥3 RE doses were more likely to have IRE/IAI than patients who received 2 previous RE doses (p = 0.02).

Table 2. Racemic Epinephrine Given Before Admission or Emergency Department Discharge for Croup

Preadmission Doses of RE	Discharged from the ED, Weighted n = 3880[a]	Patients Admitted to the Hospital		p Value[b]
		No Additional Inpatient RE or Airway Intervention, n = 312	Additional Inpatient RE or Airway Intervention, n = 82	
No RE, n (%)	2100 (99.3)[c]	7 (0.3)[d]	8 (0.4)[e]	<0.001
1 dose RE, n (%)	1660 (97.1)[c]	41 (2.4)[d]	8 (0.5)[d]	<0.001
0 OSH, 1 ED	1620	29	7	
1 OSH, 0 ED	40	12	1	
2 doses of RE, n (%)	100 (28.7)[c]	206 (59.2)[d]	42 (12.1)[e]	<0.001
0 OSH, 2 ED	100	161	35	
1 OSH, 1 ED	0	28	3	
2 OSH, 0 ED[e]	0	17	4	
3 doses of RE, n (%)	20 (22.5)[c]	48 (53.9)[d]	21 (23.6)[e]	<0.001
0 OSH, 3 ED[e]	0	20	11	
1 OSH, 2 ED	0	7	3	
2 OSH, 1 ED	20	16	7	
3 OSH, 0 ED	0	4	1	
≥4 doses of RE, n (%)	0[a]	10 (76.9)[d]	3 (23.1)[c,d]	0.04
0 OSH, 4+ED	0	3	1	
1 OSF, 3+ ED	0	2	0	
2 OSF, 2+ ED[e]	0	3	1	
3 OSF, 1+ ED	0	1	0	
≥4 OSF, 0 ED	0	1	1	

ED = emergency department; OSF = outside facility; OSH = outside hospital; RE = racemic epinephrine.
[a] Of 3838 patients discharged from the ED, a random sample of 199 (5.2%) were included for chart review and 194 met inclusion criteria for the study. Weighted n = 20*194.
[b] Significance was assessed using the χ^2 test of homogeneity.
[c,d] Different letters denote statistically significant differences in pairwise comparisons. Significance was adjusted for multiple comparisons using Holm-Sidak (p value 1 < 0.016; p value 2 < 0.025; p value 3 < 0.05). The p value presented in the table compares all 3 groups using the Kruskal-Wallis test or χ^2 test for homogeneity. If any 1 or 2 groups differ from the other groups significantly ($p < 0.05$), we performed secondary pairwise comparisons on factors with a significant p value in the initial test comparing all 3 groups. The results of these comparisons are denoted using letters.
[e] Patient admitted with inpatient airway intervention.

DISCUSSION

In our large, single-center retrospective study of patients seen in the ED or admitted with croup over a 2-year period, we found that IRE/IAI after ED or OSH management was uncommon. Of the admitted patients, only 20.8% had additional IRE/IAI, most frequently additional RE. Less than 1% of admitted patients had IAI. The number of preadmission RE doses was the only factor associated with IRE/IAI multivariate analysis.

Our admission rate (9.0%) is comparable to a Pediatric Health Information System database study of 26 children's hospitals showing a median croup admission rate of 9.1%, indicating the results of our study are likely to be generalizable to other children's hospitals despite the lack of decision support including croup pathways or standardized respiratory scoring at our hospital (6). While there is no national standard for croup admission criteria, a frequently cited reason for admission is to observe the patient for further airway interventions after receiving 1–2 or more doses of RE (10–13,17). A study of 95,403 patients at 45 U.S. children's hospitals from 2004–2014 found that patients were more likely to be admitted after receiving ≥2 doses of RE than after a single RE dose (70.5% vs. 10.7%, $p < 0.0001$) (18). Given that admission decisions are associated with number of doses of RE, the clarification of outcomes after different quantities of RE provided by our study may be helpful in creating evidence-based guidelines for croup.

We found that only 20.8% of admitted croup patients required IRE/IAI (16.3% after 1 RE dose, 16.9% after 2 RE doses, and 29.3% after ≥3 RE doses), lower than in 3 previous studies examining IAI (6,14,15). The first study included 200 patients admitted after receiving ≥2 doses of RE in a large tertiary children's ED and found that 36% had IRE/IAI (15). A second study of 327 patients admitted for croup at a tertiary children's hospital found that 49% had IRE/IAI. This study did not include OSH RE doses (seen in 19.6% of patients in our study), stratify based upon total preadmission RE doses, or exclude patients directly admitted to the ICU (14). A third study using the Pediatric Health Information System database of patients admitted at 26 children's hospitals for croup found that 18.0% of patients were admitted to the ICU and 18.3% required a third dose of RE (6). The administrative nature of the study precluded inclusion of OSH RE or use of oxygen/heliox in their outcomes (6). Differences in study design, regional or seasonal

Table 3. Association of Preadmission Racemic Epinephrine Doses and Postadmission Epinephrine/Airway Intervention in Admitted Pediatric Croup Patients

Demographic Characteristics	OR (95% CI)	*p* Value[a]	aOR	*p* Value[a]
Age (months)				
>12	1 (ref)		1 (ref)	0.98
≤12	1.05 (0.63–1.76)	0.85	1.01 (0.59–1.71)	
Sex		0.23		0.33
Female	1 (ref)		1 (ref)	
Male	0.74 (0.45–1.21)		0.78 (0.47–1.29)	
Race/ethnicity		0.58		0.55
White	1 (ref)		1 (ref)	
Black/African American	1.00 (0.50–2.00)		0.98 (0.42–2.28)	
Asian	1.93 (0.95–3.89)		2.00 (0.93–4.29)	
Hispanic/Latino	1.38 (0.52–3.69)		1.37 (0.47–4.05)	
Multiracial	1.28 (0.45–3.70)		1.28 (0.43–3.78)	
Other/declined	1.15 (0.40–3.27)		1.30 (0.44–3.81)	
Insurance		0.62		0.88
Commercial	1 (ref)		1 (ref)	
Medical assistance/Medicaid/self-pay	1.13 (0.69–1.85)		1.05 (0.57–1.95)	
Preadmission racemic epinephrine doses		0.04		0.03
2	1 (ref)		1 (ref)	
≤1	1.63 (0.85–3.15)		1.73 (0.88–3.37)	
3	2.03 (1.14–3.62)		2.08 (1.15–3.76)	

aOR = adjusted odds ratio; CI = confidence interval; OR = odds ratio.
[a] *p* Value for Wald χ^2.

variation in disease severity, and variation in admission and treatment decision making may have contributed to differences in the rate of airway interventions found in these studies.

None of these previous studies, however, included patients discharged home from the ED in their description of croup outcomes after initial management. Furthermore, OSH RE doses were not well described. By excluding these 2 factors, previous studies may overestimate risk for IRE/IAI in patients with croup after initial management. In our study, which included a weighted sample of patients discharged from ED to home, the rate of admission with IRE/IAI was only 0.5% for patients with 1 OSH/ED RE and 12.1% for patients after 2 RE doses. Our study was limited in that it did not include patients who received RE at a clinic or urgent care setting and were discharged home without referral to our children's hospital. Thus, even our study likely overestimates, though to a lesser degree than previous studies, the risk of IAI after initial RE in patients with croup.

As in a previous study, we elected to treat IRE/IAI as a composite outcome; however, alternate approaches may be reasonable (15). One might consider that because RE could be given at a clinic or urgent care center it should be treated as a separate outcome from other outcomes, such as heliox, oxygen, or ICU admission. Using this approach, we note that while 20% of patients needed additional inpatient RE, <1% needed oxygen or ICU transfer. In admitted patients who required further RE, the average time from last ED RE dose to first IRE dose was 5.2 h (IQR 2.8–8.3 h) which is comparable to a previous study that found a median time of 4 h to first IRE dose (15). Timing of RE interventions may assist ambulatory centers in designing observation parameters for patients with croup.

Not surprisingly, we found the number of preadmission RE doses to be associated with IRE/IAI in admitted patients. Patients who received ≥3 RE doses before admission were twice as likely to have additional IRE/IAI after hospital admission than those who received 2 preadmission RE doses. This may be reflective of several factors not captured in our study, including provider decision making (e.g., treatment bias), severity of illness, or the use and efficacy of systemic steroids.

Aside from preadmission RE, we found no significant associations with IRE/IAI. Notably age, gender, and history of prematurity were not statistically associated with IRE/IAI, despite these being commonly cited factors for observing patients with croup in the hospital (11,12,17). Previous studies have found receipt of multiple steroid doses and persistence of respiratory distress symptoms at admission to be associated with IRE/IAI (14,15). We did not examine preadmission steroid doses because we were unable to verify OSH dosing, which could impact outcomes. Absence of a standardized respiratory score precluded the use of respiratory distress symptoms as a variable in our study, which may have impacted admission rates and treatments.

There are potential value implications to the findings of this study as we found a 3.1 times higher median total

hospital cost for patients admitted with no IRE/IAI compared with ED discharge. While we were unable to determine the reason for admission in this retrospective study, it is likely that a substantial number of patients were admitted to observe for IRE/IAI and no other indication. Though croup mortality is low, respiratory distress requiring airway intervention may develop quickly (6). A shared decision-making approach with families of patients not meeting objective admission criteria that incorporates rates of IRE/IAI, barriers to outpatient management, and costs associated with hospital observation is warranted.

Limitations

Our study has several limitations. It reflects practice at a single tertiary children's hospital and thus results may not be generalizable. We included 2 consecutive years of data to minimize impact of annual variation in disease severity. We were unable to incorporate standardized respiratory scores (e.g., Westley score); therefore, indications for RE or admission were unknown (19,20). Alternate reasons for admission, such as dehydration, or family preferences were not assessed. Patients discharged from the ED were, by definition, not able to have an outcome of IRE/IAI. However, the low rate of ED revisit and readmissions in all groups in our study suggest that few discharged patients required additional IRE/IAI unless they presented to a different hospital. Dosing for OSH medications was not verified. This study was underpowered to detect differences in variables of low frequency, such as certain demographic or medical history categories. Finally, in order to focus on patients whose disposition decision in the ED was discharge vs. hospital admission, we excluded patients whose initial disposition was ICU. These study results should not be applied to critically ill patients. Notably, our organization does not have a policy requiring that patients with croup be directly admitted to the ICU if coming from an OSH and 3.6% of the admitted patients were directly admitted to the inpatient unit. It is unlikely that our study failed to identify non–critically ill patients at risk for IRE/IAI from croup.

CONCLUSION

Our study provides clarification of outcomes for patients with croup after initial management with RE and steroids, including successful discharge home from the ED as well as IRE/IAI. We found a low rate of IRE/IAI (20.8%) after OSH/ED management in patients admitted for croup and <1% rate of IAI. Only 12.1% of patients receiving 2 preadmission doses of RE required admission with IRE/IAI. Three preadmission doses of RE, but no other potential risk factors, such as age, was associated with IRE/IAI in multivariate analysis. Further multicenter prospective studies should be considered to determine risk factors for IRE/IAI. The rate of IRE/IAI may be incorporated into shared decision making with families surrounding admission decisions for croup.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jemermed.2019.06.005.

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ARTICLE SUMMARY

1. Why is this topic important?

Croup is a common reason for emergency department (ED) visits in young children; however, admission criteria are unclear. Receipt of 2 doses of racemic epinephrine (RE) has been commonly cited as a reason for hospital admission.

2. What does this study attempt to show?

This study clarified the rate of further RE or airway intervention after initial ED or outside hospital management in patients presenting with croup to a tertiary children's hospital over a 2-year period.

3. What are the key findings?

This study found a low rate of further airway interventions after initial management in patients presenting with croup. There was an increased rate of admission with additional intervention with increased doses of RE: 0.5% (8/1709) for 1 RE dose, 12.1% (42/348) for 2 RE doses, and 23.5% (24/102) for ≥3 RE doses. Limiting to only patients who were admitted, the rate of additional interventions also increased with increased RE doses: 16.3% (8/49) for 1 RE dose, 16.9% (42/248) for 2 RE doses, and 29.3% (24/82) for ≥3 RE doses.

4. How is patient care impacted?

Clinicians may use the findings of our study in shared decision making with families of patients with croup regarding admission vs. discharge from the ED.