Original Investigation

Nebulized Hypertonic Saline for Bronchiolitis
A Randomized Clinical Trial

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IMPORTANCE Bronchiolitis is one of the most common and costly respiratory diseases in infants and young children. Previous studies have shown a potential benefit of nebulized hypertonic saline; however, its effect in the emergency department (ED) setting is unclear.

OBJECTIVE To compare the effect of nebulized 3% hypertonic saline vs 0.9% normal saline on admission rate and length of stay in infants with bronchiolitis.

DESIGN, SETTING, AND PARTICIPANTS We conducted a double-blind, randomized clinical trial during 3 consecutive bronchiolitis seasons from March 1, 2008, through April 30, 2011. We recruited a convenience sample of patients younger than 24 months with a primary diagnosis of viral bronchiolitis presenting to the ED of 2 urban free-standing tertiary children’s hospitals. We excluded patients who were premature (gestational age, <34 weeks) or who had chronic pulmonary disease, immune deficiency, cardiac disease, or previous episodes of wheezing or inhaled bronchodilator use. Of eligible patients who were approached, 161 (26.6%) declined to participate.

INTERVENTIONS Patients received 4 mL of 3% sodium chloride (hypertonic saline [HS group]) or 0.9% sodium chloride (normal saline [NS group]) inhaled as many as 3 times in the ED. Those admitted received the assigned medication every 8 hours until discharge. All treatment solutions were prem edicated with albuterol sulfate.

MAIN OUTCOMES AND MEASURES Hospital admission rate, length of stay for admitted patients, and Respiratory Distress Assessment Instrument score.

RESULTS A total of 197 patients were enrolled in the NS group and 211 in the HS group. Admission rate in the 3% HS group was 28.9% compared with 42.6% in the NS group (adjusted odds ratio from logistic regression, 0.49 [95% CI, 0.28-0.86]). Mean (SD) length of stay for hospitalized patients was 3.92 (5.24) days for the NS group and 3.16 (2.11) days for the HS group (P = .24). The Respiratory Distress Assessment Instrument score decreased after treatment in both groups; however, we found no significant difference between groups (P = .35).

CONCLUSIONS AND RELEVANCE Hypertonic saline given to children with bronchiolitis in the ED decreases hospital admissions. We can detect no significant difference in Respiratory Distress Assessment Instrument score or length of stay between the HS and NS groups.

TRIAL REGISTRATION clinicaltrials.gov Identifier: NCT00619918
Bronchiolitis is responsible for approximately 150,000 hospitalizations each year at an estimated cost of $500 million, making it the most common and costly lower respiratory tract infection in infants and young children. 1-2 Despite the high prevalence and morbidity caused by bronchiolitis, most studied interventions have no significant effect on the severity of clinical course, admission rate, or length of stay. 3-7 Standard care in the emergency department (ED) and inpatient settings remains largely supportive, emphasizing adequate oxygenation and hydration. 8

More recent studies have shown inhaled hypertonic saline to be a promising therapy. Respiratory syncytial virus causes edema, necrosis, and sloughing of the respiratory epithelium, leading to obstruction of the small and medium airways. Hypertonic saline may draw fluid from the submucosal and adventitial spaces, thereby decreasing airway edema. The increased fluid may loosen inspissated mucous and improve mucociliary clearance. Studies in patients with cystic fibrosis and non-cystic fibrosis bronchiectasis 9-12 affirm a significant decrease in sputum viscosity and increase in weight of expectorated sputum. In addition, nasal hypertonic saline may alleviate chronic rhinosinusitis symptoms. 13-15 This finding is relevant for infants with bronchiolitis, who often have symptoms from nasal obstruction. Hypertonic saline may also have an immunomodulatory effect by decreasing neutrophil CD11b/CD18 expression, elastase release, superoxide production, and cytokine response. 16-18 During the past decade, several studies have shown the benefit of hypertonic saline in decreasing length of stay 19-24 and respiratory distress 20,21,24-27 in hospitalized infants with bronchiolitis. However, their protocols vary in regard to pretreatment medications, medication frequency, and study population. The few ED studies conducted have shown no difference in hospital admission rates; however, these studies have been small and underpowered. 28-30

The objective of this study was to compare the efficacy of inhaled hypertonic saline vs normal saline on admission rate, length of stay, and respiratory distress in infants and young children 24 months or younger with bronchiolitis. Secondary outcomes include use of adjunctive therapies (ie, oxygen, nebulized treatments, diuretics, and corticosteroids).

Methods

Study Design

We conducted a double-blind, randomized clinical trial comparing 3% hypertonic saline (HS group) with 0.9% normal saline (NS group) from March 1, 2008, through April 20, 2011. The full trial protocol is available online (Supplement [eMethods]).

Participants

Patients were eligible if they were younger than 24 months with a primary diagnosis of viral bronchiolitis during bronchiolitis season (November through April). They were recruited from the ED at 2 tertiary free-standing urban children’s hospitals in California. Patients were excluded if they had a prior illness with wheezing or bronchodilator use, if they were premature (gestational age, <34 weeks), or if they had cyanotic congenital heart disease, chronic lung disease, or tracheostomy.

Study personnel were available to enroll patients for 70 hours per week. Once a diagnosis of bronchiolitis was made by the treating physician, study staff screened patients for eligibility and obtained parental consent. Baseline demographics, vital signs, and laboratory results were obtained from the medical record. Additional patient history was recorded on standardized case report forms.

Intervention and Procedures

Patients were allocated by simple randomization to the HS or the NS group by the investigational pharmacy, using a computer-generated random number table stratified by site (Figure 1). Families, clinical staff, and study personnel were blinded to treatment allocation. Study medication was identical in color, odor, and labeling. Patients enrolled in the ED received 2.5 mg of nebulized albuterol sulfate, followed by 4 mL of normal saline or hypertonic saline via a small-volume wall nebulizer. The ED physicians could order 2 additional treatments every 20 minutes to a maximum of 3 inhaled doses. Other care was provided per local clinical practice guidelines.

Criteria for admission in these guidelines included a persistent oxygen saturation level of less than 92%, increased work of breathing, or inadequate oral intake. Ultimately, the ED attending physician determined whether the patient could be discharged or required admission. Admitted patients continued receiving study medication at a dosage of 4 mL every 8 hours until discharge. Because previous studies showed a potential risk for bronchospasm from hypertonic saline in patients with underlying asthma, all doses of study medication were pretreated with albuterol.

All other treatments and testing were ordered at the discretion of the treating physician. The decision to discharge the patient was also left to the discretion of the treating physician per standard practice, with no required minimum or maximum time for observation. Study investigators monitored for adverse events with oversight by an external data safety monitoring board. This study was approved by the institutional review boards at both institutions, and written informed consent was obtained from the legal guardians of all participating patients.

Outcome Measures

Admission rate was calculated as the number of patients requiring inpatient hospitalization divided by the total number of patients randomized. Length of stay was calculated as an integer value by subtracting the admission date from the discharge date. The Respiratory Distress Assessment Instrument (RDAI) score was assigned by a study investigator before and 30 minutes after each treatment in the ED and once each morning of hospitalization (Supplement [eTable]). 31 This score was converted into the Respiratory Assessment Change Score, which is calculated by adding together the change in RDAI score from before to after treatment, plus a point for each 10% change in respiratory rate above 5% (eg, −1 for a decrease of 6%-15% and −2 for a decrease of 16%-25%; negative values signify improve-
ment). Previous studies have determined a change in RDAI of 4 points or greater or a change in Respiratory Assessment Change Score of 2 points or greater to be clinically significant. \textsuperscript{29,31-33} Data on additional treatments were abstracted from the medical record. Patients were considered to have tobacco smoke exposure if a parent reported that any person living in the home where the child spent most of their time smoked. Patients were considered to have atopy if a parent reported that the child ever had allergic rhinitis, hay fever, or eczema.

**Statistical Analysis**

We conducted data analysis with intention-to-treat principles using commercially available software (SPSS, version 19; IBM). Descriptive statistics were calculated for all study variables; \( \chi^2 \) analysis (for admissions) and 2-tailed t tests (for length of stay and RDAI score) provided initial bivariate estimates of treatment effects. Logistic regression was used to investigate treatment effects on admission rate, and multiple linear regression analysis was used to model treatment effects on length of stay and RDAI score, controlling for demographic variables and potentially related clinical factors. For the posttreatment RDAI score, the pretreatment RDAI score was also statistically controlled. To investigate potential differences between treatment groups in the rate of change in the RDAI score, a repeated-measures analysis of variance was also conducted. The trial ended after 3 years when grant funding was completed. The study was originally designed to enroll 350 ED patients into each arm, giving 80% power to detect a 30% change in admission rate. We estimated that these numbers would yield 124 admitted patients in each arm, giving the study 80% power to detect a 0.5-day difference in length of stay. Based on previous studies, only 5 patients in each arm would be needed to detect a difference in the RDAI score of 3 points or more between groups (80% power, significance at 2-sided \( P < .05 \)). \textsuperscript{33}

**Results**

Descriptive statistics for subject demographics are presented in Table 1. We found no significant differences between treatment groups. Subject demographics were also similar by site of recruitment, although more Hispanic/Latino patients were recruited in Los Angeles (86.2%) than Oakland (46.9%; \( P < .001 \)), and more patients in Los Angeles had atopy (9.4% vs 3.7%; \( P = .03 \)).

A total of 3447 patients with a principal diagnosis of bronchiolitis were seen in the ED at both institutions during the study period. Of these, 1254 (36.4%) underwent screening for eligibility. A total of 408 patients were enrolled in the study (Figure 1). An additional 39 patients were enrolled after admission and not included in this analysis. Seven patients in each group left or were transferred before receiving any study medication. One patient in the NS group received the HS group treatment and underwent analysis in the originally allocated group. Seven patients were withdrawn owing to parental request, and 3 were withdrawn by the investigator owing to a change in diagnosis (ie, pertussis, obstructive sleep apnea, and congenital lobar emphysema). The mean (SD) number of study medication doses given was 3.36 (5.12) in the HS group and 4.56 (7.08) in the NS group. In the NS group, 54.5% received only 1 treatment, and in the HS group, 66.2% received only 1 treatment. Of patients discharged from the ED, 88.7% in the NS group and 88.7% in the HS group received only 1 treatment.

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**Figure 1. Patient Enrollment Flowchart**

- 3447 ED encounters with primary diagnosis of bronchiolitis during study period
- 1254 Underwent assessment for eligibility
- 807 Excluded
- 606 Did not meet inclusion criteria
- 161 Declined participation
- 40 Investigator not available

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<table>
<thead>
<tr>
<th>408 Randomized</th>
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<tbody>
<tr>
<td>197 Allocated to NS group</td>
</tr>
<tr>
<td>13 Discontinued intervention</td>
</tr>
<tr>
<td>7 Left without receiving treatment</td>
</tr>
<tr>
<td>113 Discharged from ED</td>
</tr>
<tr>
<td>84 Admitted</td>
</tr>
<tr>
<td>211 Allocated to HS group</td>
</tr>
<tr>
<td>11 Discontinued intervention</td>
</tr>
<tr>
<td>7 Left without receiving treatment</td>
</tr>
<tr>
<td>150 Discharged from ED</td>
</tr>
<tr>
<td>61 Admitted</td>
</tr>
</tbody>
</table>

Thirty-nine patients who were enrolled after admission to the hospital are not included in this figure. ED indicates emergency department; HS, hypertonic saline; ICU, intensive care unit; LOS, length of stay; and NS, normal saline.
significant (χ²/Lemeshow goodness-of-fit test for the final model was not needed to treat to prevent 1 hospitalization was 8 patients. Other statistically significant predictors of admission included site, male sex, patient weight, baseline respiratory rate, and baseline oxygen saturation (Table 2). The Hosmer-Lemeshow goodness-of-fit test for the final model was not significant (χ² = 6.5; P = .59), and the model pseudo-multivariate coefficient of variation for admission rate (Nagelkerke R² statistic) was 0.41; both statistics indicated very good model fit.

Length of Stay
One hundred forty-five patients were admitted from the ED. Ten of these patients required admission to the intensive care unit, 7 withdrew owing to parent request, and 3 had a change in diagnosis (Figure 1). The mean (SD) length of stay for the NS group was 3.92 (5.24) days; for the HS group, 3.16 (2.11) days (P = .24). This difference was not statistically significant even after controlling for sociodemographic and baseline clinical variables. We found a significant difference between sites for mean length of stay (Los Angeles: 2.22 [1.34]; Oakland: 3.91 [4.58]; β = −0.223 [95% CI, −4.558 to −0.334]; P = .01).

Respiratory Score
The RDAI score had high intrarater reliability (intraclass correlation, 0.95 [95% CI, 0.91-.1.00]). We compared pretreatment and posttreatment scores for the first study treatment. The mean (SD) pretreatment RDAI score was 6.16 (2.91) in the NS group and 5.96 (3.08) in the HS group. The mean posttreatment RDAI scores were 5.32 (3.14) and 4.88 (2.95), respectively. We found no significant difference between groups in a repeated-measures analysis of variance (P = .35), likely because the scores decreased significantly from before to after treatment in both groups (time main effect, F₁,₃₂₂ = 51.53; P < .001). Using linear regression to predict the posttreatment score while controlling for the pretreatment score, only male sex remained a significant predictor of RDAI score (β = −0.07 [95% CI, 0.06-0.85]; P = .02). The full regression model-adjusted R² statistic for the posttreatment RDAI score was 0.64; however, if we excluded the pretreatment score, the adjusted R² statistic was only 0.11. We were able to calculate the Respiratory Assessment Change Score for 366 cases. We found no difference between the mean (SD) Respiratory Assessment Change Score for the NS (−0.35 [2.98]) and HS (−0.85 [3.14]) groups (t₉₆₄ = 1.576; P = .12). We found no significant change when adjusting for the baseline RDAI score.

Supplemental Therapies
No significant differences were found in supplemental treatment use between groups. Among admitted patients, those in the NS group received a mean of 27.3 hours of oxygen administration vs 28.6 hours in the HS group. In the NS group, 15 patients received supplemental albuterol and 8 received inhaled epinephrine; in the HS group, 15 received albuterol and 3 received epinephrine. Systemic corticosteroid use was infrequent, including 3 patients in the NS group and 7 in the HS group. Only 1 patient in the NS group and no patient in the HS group received diuretics. No patients in either group received leukotriene receptor antagonists.

Adverse Events
Six patients in the NS group and 4 in the HS group required transfer to the pediatric or the neonatal intensive care unit.

### Admission Rate

Of the 408 patients who were recruited in the ED, 84 patients (42.6%) required admission in the NS group compared with 61 (28.9%) in the HS group (odds ratio, 0.55 [95% CI, 0.36-0.83]). This difference was statistically significant even after controlling for other sociodemographic and baseline clinical predictors (adjusted odds ratio, 0.49 [95% CI, 0.28-0.86]) (Figure 2). The number needed to treat to prevent 1 hospitalization was 8 patients. Other statistically significant predictors of admission included site, male sex, patient weight, baseline respiratory rate, and baseline oxygen saturation (Table 2). The Hosmer-Lemeshow goodness-of-fit test for the final model was not significant (χ² = 6.5; P = .59), and the model pseudo-multivariate coefficient of variation for admission rate (Nagelkerke R² statistic) was 0.41; both statistics indicated very good model fit.

### Length of Stay
One hundred forty-five patients were admitted from the ED. Four of these patients were missing length-of-stay data because they were transferred to outside facilities owing to lack of beds. An additional 20 patients were withdrawn from the study before discharge but were still included in analysis. Ten of these patients required admission to the intensive care unit, 7 withdrew owing to parent request, and 3 had a change in diagnosis (Figure 1). The mean (SD) length of stay for the NS group was 3.92 (5.24) days; for the HS group, 3.16 (2.11) days (P = .24). This difference was not statistically significant even after controlling for sociodemographic and baseline clinical variables. We found a significant difference between sites for mean length of stay (Los Angeles: 2.22 [1.34]; Oakland: 3.91 [4.58]; β = −0.223 [95% CI, −4.558 to −0.334]; P = .01).

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Nebulized Hypertonic Saline for Bronchiolitis

Original Investigation Research

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tility within 1 to 5 minutes after intranasal administration of several studies have shown improvement in nasal ciliary motility, and lasting 20 to 60 minutes. In addition, controlled patients receiving 14.4% saline compared with no aerosol and 0.9% saline. The effect was relatively short, peaking during the inhalation, and lasting 20 to 60 minutes. In addition, several studies have shown improvement in nasal ciliary motility within 1 to 5 minutes after intranasal administration of hypertonic saline.13,14

A major limitation of the present study was the failure to achieve planned sample size. Although we fell far short of reaching our goal of 350 patients in each arm, we were still able to find a significant difference in admission rate. However, only 145 patients underwent analysis for the length-of-stay outcome, which is underpowered to detect differences in length of stay of less than 1 day. This sample size is still a larger sample than those of previous studies comparing length of stay for HS vs NS groups; Mandelberg et al included 52 patients, Kuzik et al included 96 admitted patients, and Luo et al included 93 and 112 patients in 2011 and 2010, respectively.

Contrary to previous studies, our study found no difference in length of stay between treatment groups. A recent Cochrane meta-analysis found that hypertonic saline decreases length of stay by 1.15 days. The mean lengths of stay in the 6 included studies ranged from 3.5 to 7.4 days, which were longer than in our study. Also, patients who received treatment in the ED and responded positively to therapy might have been discharged and never required admission, thus biasing our length-of-stay analysis to include primarily patients who did not respond to treatment.

Another possible reason we did not find a difference in length of stay is that the doses given in this study were suboptimal. Although the original studies followed a dosing interval of every 8 hours, subsequent studies used more frequent regimens. Another study conducted by Al-Ansari et al randomized infants to receive 5 mL of 0.9% saline or 3% or 5% hypertonic saline mixed with epinephrine. These investigators found no significant difference in length of stay; however, they found a statistically significant difference in severity score, with 5% performing best and 3% in between. This finding suggests a dose-response relationship.11,20,24,26 Further studies need to be conducted to establish the optimal concentration, frequency, and delivery method of hypertonic saline and to evaluate for toxic effects, which may limit dosing.

We found significant differences in admission rate and length of stay by site. Although both sites had clinical protocols for treatment of bronchiolitis, our study did not assess compliance with the protocols and allowed the treating physicians to treat patients per their routine practice. Practice variation likely accounts for the differences between sites and limits the ability of this study to assess the true efficacy of hypertonic saline. Also, discharge disposition is affected by many factors, including rounding times, hospital efficiency, parent availability, and transportation. Our study did not use medical readiness for discharge as standard criteria; therefore, the length-of-stay outcome may not accurately reflect clinical status.

Table 2. Regression Results From ITT Analysis by Outcome

<table>
<thead>
<tr>
<th>ITT Analysis</th>
<th>Admission Rate, OR (95% CI) (n = 408)</th>
<th>Length of Stay, β (95% CI) (n = 145)*</th>
<th>RDAI Score, β (95% CI) (n = 386)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment group</td>
<td>0.49 (0.28 to 0.86)</td>
<td>−0.11 (−0.32 to 0.09)</td>
<td>−0.05 (−0.12 to 0.01)</td>
</tr>
<tr>
<td>Site</td>
<td>0.19 (0.09 to 0.38)</td>
<td>−0.22 (−0.42 to −0.03)</td>
<td>−0.06 (−0.14 to 0.01)</td>
</tr>
<tr>
<td>Age ≤6 mo</td>
<td>0.72 (0.30 to 1.76)</td>
<td>−0.04 (−0.35 to 0.27)</td>
<td>−0.06 (−0.16 to 0.04)</td>
</tr>
<tr>
<td>Male sex</td>
<td>2.54 (1.43 to 5.53)</td>
<td>−0.03 (−0.24 to 0.17)</td>
<td>0.07 (0.01 to 0.14)</td>
</tr>
<tr>
<td>Latino</td>
<td>1.08 (0.57 to 2.03)</td>
<td>0.16 (−0.03 to 0.38)</td>
<td>−0.04 (−0.11 to 0.04)</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>0.70 (0.57 to 0.85)</td>
<td>−0.25 (−0.58 to 0.05)</td>
<td>−0.04 (−0.14 to 0.06)</td>
</tr>
<tr>
<td>Tobacco exposure</td>
<td>0.56 (0.21 to 1.46)</td>
<td>0.07 (−0.12 to 0.28)</td>
<td>−0.02 (−0.09 to 0.04)</td>
</tr>
<tr>
<td>Atopy</td>
<td>1.01 (0.31 to 3.32)</td>
<td>0.05 (−0.14 to 0.24)</td>
<td>−0.01 (−0.07 to 0.05)</td>
</tr>
<tr>
<td>Baseline temperature</td>
<td>0.77 (0.53 to 1.14)</td>
<td>−0.10 (−0.32 to 0.12)</td>
<td>−0.05 (−0.12 to 0.03)</td>
</tr>
<tr>
<td>Baseline heart rate</td>
<td>1.02 (1.00 to 1.03)</td>
<td>0.15 (−0.05 to 0.38)</td>
<td>0.06 (−0.02 to 0.14)</td>
</tr>
<tr>
<td>Baseline respiratory rate</td>
<td>1.02 (1.00 to 1.04)</td>
<td>0.00 (−0.21 to 0.20)</td>
<td>0.03 (−0.04 to 0.09)</td>
</tr>
<tr>
<td>Baseline oxygen saturation</td>
<td>0.78 (0.70 to 0.87)</td>
<td>0.01 (−0.19 to 0.20)</td>
<td>−0.04 (−0.11 to 0.03)</td>
</tr>
<tr>
<td>Pretreatment RDAI</td>
<td>0.78 (0.72 to 0.85)</td>
<td></td>
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</tbody>
</table>

Abbreviations: ITT, intent-to-treat; OR, odds ratio; RDAI, Respiratory Distress Assessment Instrument.

*a includes only patients recruited in the emergency department.

Three patients in the NS group and 4 in the HS group withdrew owing to parent request. Of these parent requests, 1 in the NS group and 2 in the HS group were attributed to worsening cough. For these 3 patients, pretreatment and posttreatment vital signs and RDAI score were the same or improved, and no intervention or additional treatment was necessary.

Discussion

To our knowledge, this study is the largest to evaluate the efficacy of hypertonic saline treatment of bronchiolitis. We found that nebulized hypertonic saline significantly reduced the hospital admission rate when given in the ED; however, we did not find a difference in length of stay. This study is the first to show a statistically significant reduction in admission rates. Kuzik et al performed a similar trial in the ED setting using 3% saline solutions with albuterol. Although the findings did not reach significance, they detected a trend toward increased discharges in the HS group.

Most of the patients in our study received only 1 dose of study medication, which suggests that the onset of action for hypertonic saline is fairly rapid. Daviskas et al noted a profound increase in mucociliary clearance in asthmatic and control patients receiving 14.4% saline compared with no aerosol and 0.9% saline. The effect was relatively short, peaking during the inhalation, and lasting 20 to 60 minutes. In addition, several studies have shown improvement in nasal ciliary motility within 1 to 5 minutes after intranasal administration of hypertonic saline.13,14

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This study has several additional limitations. Most of the participants were Hispanic, which limits the generalizability of our findings to other populations. We excluded patients with previous wheezing and bronchodilator use and those with underlying cyanotic heart disease and pulmonary disease, so the results cannot be generalized to those populations. Also, we did not establish minimum or maximum severity criteria for study entry. Hypertonic saline may have a differential effect at varying severity levels; our study’s mean pretreatment RDAI score was 6.01, which correlates with mild to moderate disease. Furthermore, although the RDAI score has been used in several bronchiolitis studies, whether the score itself is predictive of important clinical outcomes remains unclear. Destino et al27 prospectively studied the validity of the RDAI score and the Children’s Hospital of Wisconsin Respiratory Score. They found that the area under the receiver operating characteristic curve on the plot for the RDAI score predicting ED admission was only 0.51. Furthermore, they found no correlation between the change in RDAI score in the first 24 hours of hospitalization and length of stay. An additional limitation is the interpretation of null effects of the hypertonic saline treatment on length of stay and RDAI score, which may have been owing to low statistical power, particularly for the length-of-stay analysis. Furthermore, our study allowed the treating physician to order additional therapies at their discretion. Theoretically, each of these therapies may modulate the effect of HS. For example, a recent large trial showed a benefit of using dexamethasone sodium phosphate with epinephrine despite multiple studies showing no benefit of either drug alone.38 However, only a small minority of patients received additional medications other than the study drug, making this benefit unlikely to be the case. Because of the theoretical risk of bronchospasm, we pretreated every dose of study medication with albuterol. Previous studies have combined hypertonic saline with epinephrine and terbutaline sulfate, and several studies administered hypertonic saline safely without a concomitant bronchodilator.20,25,26,39 Additional trials should compare each of these combinations for efficacy and safety outcomes.

Conclusions

Our study of infants and children younger than 24 months with bronchiolitis found that hypertonic saline nebulization given in the ED setting decreases rates of admission. However, we found no differences in respiratory score or length of stay. Further studies should investigate the optimal dosing and administration regimen and the patient-level factors that may affect response to hypertonic saline.

ARTICLE INFORMATION

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Correction: This article was corrected on August 29, 2014, to fix the unadjusted odds ratio and 95% CI for hospital admission in the Results section and to fix Figure 2.

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