Asthma is a chronic respiratory disease that is characterized by periods of relative control and episodes of deterioration, which are referred to as exacerbations. Exacerbations range in severity from mild to severe (status asthmaticus), and can result in visits to health-care providers and emergency departments (EDs), and may at times require hospitalization. While rare, intubations, admissions to the ICU, and deaths from severe acute asthma still occur. In most people, even though the serious consequences are avoided, the prevention and treatment of asthma exacerbations are an important consideration of their disease. Due to this impact on lifestyle, the costs to the patient and the health-care...
system, and the potential for adverse outcomes, asthma is responsible for a significant personal and social burden.

Acute episodes of bronchoconstriction caused by airway inflammation are a hallmark of the exacerbation. These episodes generally result in increased requirements for inhaled β₂-agonist therapy. Unfortunately, in acute asthmatic episodes, this is often not enough to relieve the bronchospasm and reduce inflammation. The shortcomings of β₂-agonist therapy have resulted in the use of a variety of other treatments in the management of acute asthma. For example, evidence has suggested that systemic corticosteroids, anticholinergic agents, delivery of β₂-agonist via metered-dose inhalers with holding chambers, and inhaled corticosteroids are effective in the short-term treatment of the disease. Other therapies, such as IV methylxanthine agents, are less effective and possibly harmful, so they are no longer recommended. In adults, evidence supporting the use of IV β₂-agonists is limited, so these agents are reserved for selected patients (e.g., intubated patients and those with severe disease). Finally, there are insufficient data to assess the effectiveness of antibiotic treatment in patients with acute asthma.

MgSO₄ is an agent that has been proposed as a possible additive treatment in patients with acute asthma and has been shown to be effective in patients with severe acute asthma when delivered parenterally. Magnesium may be effective in acute asthma through one or more of a variety of mechanisms. Magnesium has been shown to relax the smooth muscle and may be involved with the inhibition of smooth muscle contraction. This theory has been proposed as an explanation for the effects of MgSO₄ in patients with acute asthma; however, this explanation may be too simplistic. Magnesium is also involved with cellular homeostasis through its role as an enzymatic cofactor, as well as being involved in acetylcholine and histamine release, from cholinergic nerve terminals and mast cells, respectively. Investigators have proposed that the effect of MgSO₄ is related to its ability to block the calcium ion influx to the smooth muscles of the respiratory system. Finally, the role of MgSO₄ as an antiinflammatory has been identified in adults with asthma.

The potential clinical benefits of inhaled MgSO₄ have been studied and research publications have produced conflicting results. Consequently, this agent is not currently recommended as part of the current guidelines and has not been used widely in most acute settings. Until now, there has been no attempt made to examine this effect in a systematic fashion. The few times that inhaled magnesium has been mentioned, it has been as a minor part of larger reviews. This systematic review is designed to examine this question and to provide summary estimates of the effect of aerosolized MgSO₄ in the treatment of acute asthma.

**Materials and Methods**

**Criteria for Inclusion**

Only randomized controlled trials (RCTs), or quasi-RCTs, were considered for inclusion. Studies had to have restricted enrollment to patients with acute asthma treated in the ED (i.e., studies of patients with chronic or “stable” asthma were excluded) with asthma defined using several accepted clinical and guideline based criteria (e.g., those of the British Thoracic Society, the National Asthma Education and Prevention Program, and the Canadian Thoracic Society). There was no age restriction for patients included in the studies, and where possible the data were categorized into groups of patients 2 to 16 years old (the pediatric group) and > 16 years old (the adult group). Randomized interventions had to compare aerosolized MgSO₄ to a control treatment. That is, studies comparing the efficacy of therapy with aerosolized MgSO₄ and a β₂-agonist vs a β₂-agonist alone, or therapy with aerosolized MgSO₄ vs a β₂-agonist were included. Cointerventions were permitted, and information pertaining to cointerventions received was recorded. The primary outcome was defined as a change in pulmonary function testing results from baseline. Secondary outcomes considered the proportion of patients requiring hospital admission, clinical severity scores, duration of symptoms, vital signs, and side effects.

**Search Strategies**

The “Asthma and Wheezez RCT” register of the Cochrane Airways Review Group was searched for the following terms: magnesium OR MgSO₄ OR Mg OR MS OR magnesium sulfate or magnesium sulfate. This registry is compiled through a comprehensive search of the EMBASE, MEDLINE, and CI-NAHIL databases, which was supplemented by the manual searching of 20 key respiratory journals. The results of this search were screened to omit studies that clearly involved only IV or...
parenteral administration of magnesium. In addition, the reference lists of trials identified through the registry were examined, and supplemental searches of the Cochrane Clinical Trials Registry, Web of Science, Dissertation Abstracts, and the World Wide Web using the Google search engine were performed. Primary authors were contacted for information on additional trials (both published and unpublished). Clinicians, colleagues, collaborators, and trialists were contacted to identify potentially relevant studies. Since this agent is not currently commercially delivered, no industry sponsor was contacted.

**Study Selection**

The selection of studies involved two steps. First, to retrieve studies, the initial search of all databases and reference lists was screened by title, abstract, MeSH headings, and keywords by two independent investigators (M.B. and B.D.) to identify all citations that were RCTs or possible RCTs with potential relevance. The full text of the manuscripts of those selected articles was obtained for formal inclusion review. Second, another reviewer (B.R.) independently decided on trial inclusion using predetermined eligibility criteria (see above).

**Quality Assessment**

Assessments of quality were completed independently by two reviewers. First, using the Cochrane Database approach to the assessment of allocation concealment, all trials were scored using the following scale: grade A, adequate concealment; grade B, uncertain; and grade C, clearly inadequate concealment. Second, each study was also evaluated using the previously validated Jadad 5-point scale to assess randomization, double blinding, and study withdrawals and dropouts. Finally, whether the study used intention-to-treat analysis was recorded along with any sources of funding.

**Data Extraction**

Data were extracted independently by two reviewers (M.B. and B.D.) using a standardized collection form. When available, characteristics of the study (ie, design, methods of randomizations, and withdrawals/dropouts), of participants (ie, age and gender), of interventions (ie, type, dose, route of administration, timing and duration of therapy, and cointerventions), of control substances (ie, agent and dose), of outcomes (ie, types of outcome measures, timing of outcomes, and adverse events), and of results were recorded. Unpublished data were requested from the primary authors when necessary.

**Statistical Analysis**

All data were entered into a database (RevMan, version 4.2.2; Cochrane Collaboration; Oxford UK) by a single reviewer (S.B.). For dichotomous variables, both individual and pooled statistics were expressed as relative risk (RR) with 95% confidence intervals (CIs). For continuous data, individual data were reported as the standardized mean difference (SMD) with 95% CIs. Results were calculated using both fixed-effects and random-effects models. The Breslow-Day test was used to test for heterogeneity with significance set at < 0.10. Possible sources of heterogeneity were assessed by subgroup and sensitivity analyses.

**Subgroup and Sensitivity Analyses**

Two subgroup analyses were planned a priori to examine the effect of age (ie, pediatric or adult) and severity of asthma, as measured by pre-drug administration spirometric deviation from percent predicted values (baseline FEV₁ or peak expiratory flow [PEF] < 50% predicted). Sensitivity analyses were planned to assess the effect of the methodological quality of included trials and intention-to-treat status.

**Search Results**

The initial search, which was completed in January 2004, yielded 145 references that were at least potentially relevant controlled trials. Two additional RCTs were identified from a bibliographic search of relevant studies. The author for one study that was originally identified as an abstract was contacted, and the conditionally accepted article was provided to the reviewers for data extraction. Six trials, which included 296 patients, were incorporated into the review (Table 1).

**Description of Studies**

All of the studies included in this review had been published since 1995. The research in the included studies was based in the United States, India, New Zealand, Turkey, and Argentina. Three of the six included studies involved adults exclusively, and one study included adults and pediatric patients. The remaining two studies had enrolled pediatric patients. The severity of disease varied among the studies. Two studies had specific lung function criteria, while the other four studies had enrolled patients who had previously received a

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**Table 1—Characteristics of Studies**

<table>
<thead>
<tr>
<th>Study/Year</th>
<th>Country</th>
<th>Intervention</th>
<th>Pulmonary Function</th>
<th>Time, min From baseline</th>
<th>Subgroup Definition</th>
<th>Sensitivity Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bessmertny et al 2002</td>
<td>United States</td>
<td>MgSO₄ + β₂-agonist</td>
<td>FEV₁ % predicted</td>
<td>60</td>
<td>Adult Moderate</td>
<td>3</td>
</tr>
<tr>
<td>Hughes et al 2003</td>
<td>New Zealand</td>
<td>MgSO₄ + β₂-agonist</td>
<td>FEV₁ % predicted</td>
<td>60</td>
<td>Adult Severe</td>
<td>5</td>
</tr>
<tr>
<td>Mahajan et al 2004</td>
<td>United States</td>
<td>MgSO₄ + β₂-agonist</td>
<td>FEV₁ % predicted</td>
<td>20</td>
<td>Pediatric Moderate</td>
<td>3</td>
</tr>
<tr>
<td>Mangat et al 1998</td>
<td>India</td>
<td>MgSO₄</td>
<td>PEF % predicted</td>
<td>60</td>
<td>Both Severe</td>
<td>3</td>
</tr>
<tr>
<td>Meral et al 1996</td>
<td>Turkey</td>
<td>MgSO₄</td>
<td>Ratio increase in PEF</td>
<td>60</td>
<td>Pediatric Moderate</td>
<td>1</td>
</tr>
<tr>
<td>Nannini et al 2000</td>
<td>Argentina</td>
<td>MgSO₄ + β₂-agonist</td>
<td>PEF</td>
<td>20</td>
<td>Adult Severe</td>
<td>3</td>
</tr>
</tbody>
</table>
diagnosis of asthma using accepted clinical standards. Based on the baseline demographic data and/or enrollment criteria, three studies19–21 had enrolled patients with severe asthma (ie, FEV₁ or PEF < 50% predicted at baseline).

Five studies enrolled patients presenting to the ED. Meral et al23 described only patients who had received asthma medication within the previous 12 h. A third study20 excluded patients who had received oral or parenteral corticosteroids in the previous 7 days. Another study22 excluded patients who had received steroids, theophylline, or ipratropium bromide within 3 days of presenting to the ED. In three studies,19,21,22 parenteral steroids were administered to all patients, although the timing (ie, before or after nebulized treatment) varied. In one study,18 parenteral steroids were administered if there had been no improvement after the patient received three doses of the study treatment. Two studies20,23 did not report information on the use of parenteral steroids. All studies used a nebulized β₂-agonist (with or without normal saline solution) as the control treatment, but the total dose varied depending on the number of nebulizations (Table 2). When the information was available, most included studies used MgSO₄ of a similar concentration, but the dose per nebulization and the number of nebulizations varied. All but two studies21,23 described the MgSO₄ solution as either isotonic or isosmolar with pleural fluid.

The magnesium was uniformly delivered via a nebulizer rather than a metered-dose inhaler. All studies used a control substance that was similar in appearance to the treatment drug and was most often described as saline solution. One study19 collected data on patients’ ability to distinguish between the treatment and control substances, and noted no ability to discern this difference. Even when not expressly stated, it can reasonably be assumed that the control substance (ie, placebo) would be similar in appearance to the treatment drug (especially if administered in a β₂-agonist vehicle).

Comparisons

Four studies18–20,22 compared therapy with a β₂-agonist with MgSO₄ to therapy with a β₂-agonist with a placebo (normal saline solution), while two studies21,23 compared therapy with MgSO₄ to that with a β₂-agonist. Due to the heterogeneity of interventions, a post hoc subgroup analysis based on intervention (therapy with a β₂-agonist with MgSO₄ or therapy with MgSO₄ alone) was conducted.

<table>
<thead>
<tr>
<th>Study/Year</th>
<th>init</th>
<th>Duration, min of Treatment</th>
<th>Delivery of MgSO₄</th>
<th>Dose of MgSO₄</th>
<th>SCs (IV/po)</th>
<th>Anticholinergic Dose</th>
<th>Others</th>
<th>Cointerventions‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bessmertny et al2002</td>
<td>Not reported</td>
<td>60 min</td>
<td>Nebulized</td>
<td>2.5 mL 3.5% solution</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hughes et al2003</td>
<td>30 min</td>
<td>60 min</td>
<td>Nebulized</td>
<td>10 mg (2.5 mg every 30 min)</td>
<td></td>
<td></td>
<td>2.5 mg</td>
<td>None reported</td>
</tr>
<tr>
<td>Mahajan et al2004</td>
<td>Not reported</td>
<td>80 min</td>
<td>Nebulized</td>
<td>10 mg (2.5 mg every 20 min)</td>
<td></td>
<td></td>
<td>2.5 mg</td>
<td>None reported</td>
</tr>
<tr>
<td>Mangat et al2005</td>
<td>Not reported</td>
<td>10–15 min</td>
<td>Nebulized</td>
<td>50 mg (12.5 mg every 4 × 1)</td>
<td></td>
<td></td>
<td>None reported</td>
<td></td>
</tr>
<tr>
<td>Nanni et al2000</td>
<td>Not reported</td>
<td>25 mg</td>
<td>Nebulized</td>
<td>25 mg</td>
<td></td>
<td></td>
<td>None reported</td>
<td></td>
</tr>
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<tr>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

SCS = systemic corticosteroids. Time from arrival in ED.

In the first 3 h.
Outcomes

All studies report results from pulmonary function tests as an outcome. However, one study reported lung function outcome data as a relative change from baseline. As it was not appropriate to combine these data with the other studies (which are not reporting lung function results as a change from baseline), data from this study are not currently included in the pooled analysis. Attempts to secure the end-of-study data have failed so far.

Most studies did not report a change in pulmonary function, and the pooled results from all studies failed to identify a difference in baseline pulmonary function between the treatment and control groups. There was variation in the specific pulmonary function measure reported (i.e., the percentage predicted PEF or FEV₁ and the raw PEF or FEV₁) as well as the time after treatment when pulmonary functions were recorded. Two studies reported pulmonary function measures only up to 20 min after treatment. For these reasons, the results are reported using fixed effects, with the SMD in pulmonary function measured at or before 60 min after treatment. Based on the studies that measured pulmonary function for longer durations, we noted that the largest change in pulmonary function appeared to be early after treatment. Consequently, we were satisfied with grouping the 20-min and 60-min pulmonary function test results as the outcome of interest.

Four studies also reported admission to the hospital as an outcome. All studies mentioned serious adverse events; however, details on mild-to-moderate adverse events were sparse. None of the studies reported a specific clinical severity score or duration of symptoms. Most studies reported vital signs at baseline but not at follow-up. These outcomes were not investigated in the systematic review.

Quality

Overall, the methodological quality of the included studies was uniformly high. All studies were randomized and placebo-controlled. Only one investigator did not explicitly state that the study was double-blinded. All included studies used intention-to-treat analyses; therefore, the planned sensitivity analysis to determine the effect of intention-to-treat status was not required. One study scored 5 on the Jadad scale, and rated an A on concealment of allocation. The other investigators did not specify their methods for randomization or double-blinding. Due to the lack of information provided, all but one study rated a B in the concealment of allocation.

Pulmonary Function Effects

Therapy with MgSO₄, with or without a β₂-agonist, was superior to therapy with a β₂-agonist alone (SMD, 0.30; 95% CI, 0.05 to 0.55; p = 0.02) with no between-study heterogeneity identified (Fig 1). Notably, the effect was similar in a comparison of therapy with a β₂-agonist and MgSO₄ compared to that with a β₂-agonist and normal saline solution (SMD, 0.37; 95% CI, 0.10 to 0.63; p = 0.006). However, there was no evidence of an advantage for therapy with MgSO₄ alone compared to therapy with a β₂-agonist alone (SMD, −0.17; 95% CI, −0.85 to 0.52; p = 0.63 [one study]).

In subgroup analyses, the advantage of any use of MgSO₄ with or without a β₂-agonist over the use of a β₂-agonist alone was demonstrated in adults (SMD, 0.37; 95% CI, 0.06 to 0.69; p = 0.02) but not in children (SMD, 0.36; 95% CI, −0.14 to 0.86; p = 0.16 [one study]). The treatment effect was similar in patients with severe asthma at presentation where the SMD in this group was 0.31 (95% CI, −0.05 to 0.68; p = 0.09; heterogeneity, p = 0.26; heterogeneity statistic, 25.9%). In patients with mild-to-moderate asthma at presentation it was 0.29 (95% CI, −0.05 to 0.63, p = 0.10, heterogeneity, p = 0.71; heterogeneity statistic, 0%). The results were similar when random-effects methods were employed.

Admissions

Of the four studies that reported hospital admission status, therapy with nebulized MgSO₄ (alone or in combination with a β₂-agonist) failed to demonstrate a clear reduction in the probability of hospital admission compared to therapy with a β₂-agonist alone (RR, 0.67; 95% CI, 0.41 to 1.09; p = 0.11) using a fixed-effects model (Fig 2). In subgroup analyses, the results were similar for the comparison of therapy with MgSO₄ in combination with a β₂-agonist to therapy with a β₂-agonist with normal saline solution (RR, 0.69; 95% CI, 0.42 to 1.12; p = 0.13), but were not similar for therapy with nebulized MgSO₄ alone compared to therapy with a β₂-agonist alone (RR, 0.53; 95% CI, 0.05 to 5.31; p = 0.59 [one study]). In addition, this result was statistically significant in the adult severe-asthma population (RR, 0.61; 95% CI, 0.37 to 1.00; p = 0.05), but not in the pediatric moderate-asthma population (RR, 2.0; 95% CI 0.19 to 20.93; p = 0.56 [one study]).

Adverse Effects

No studies reported serious adverse events in either arm, and reporting varied for other adverse
## Figure 1

Effect of aerosolized MgSO₄ on posttreatment lung function. df = degrees of freedom.

![Figure 1](image1.png)

**Study or subcategory** | **Treatment** | **Control** | **SMD (fixed)** | **Weight** | **SMD (fixed)**
--- | --- | --- | --- | --- | ---
Mangat 1998 | 16 | 66.70 (27.30) | 17 | 70.80 (20.60) | 13.09 -0.17 [-0.85, 0.52]
Bossermeyt 2002 | 37 | 68.00 (22.50) | 37 | 63.00 (20.60) | 29.30 0.23 [-0.23, 0.69]
Mahajan 2004 | 31 | 75.40 (26.00) | 31 | 67.30 (18.00) | 24.30 0.36 [-0.14, 0.86]
Nannini J 2000 | 19 | 332.00 (119.00) | 16 | 282.00 (107.00) | 13.50 0.43 [-0.24, 1.10]
Hughes 2003 | 28 | 1.87 (0.72) | 24 | 1.46 (0.75) | 19.80 0.55 [-0.01, 1.11]

Total (95% CI) | 131 | 125 | 100.00 | 0.30 [0.05, 0.55]

Test for heterogeneity: Chi² = 2.85, df = 4 (P = 0.58), P = 0%
Test for overall effect: Z = 2.37 (P = 0.02)

## Figure 2

Effect of aerosolized MgSO₄ on hospital admissions. See the legend of Figure 1 for abbreviation not used in the text.

![Figure 2](image2.png)

**Study or subcategory** | **Treatment** | **Control** | **RR (fixed)** | **Weight** | **RR (fixed)**
--- | --- | --- | --- | --- | ---
Mangat 1998 | 1/16 | 2/17 | 8.68 0.53 [0.05, 5.31]
Hughes 2003 | 12/28 | 17/24 | 81.98 0.61 [0.37, 1.00]
Nannini J 2000 | 1/19 | 1/16 | 4.86 0.84 [0.06, 12.42]
Mahajan 2004 | 2/31 | 1/31 | 4.48 2.00 [0.19, 20.93]

Total (95% CI) | 94 | 88 | 100.00 | 0.67 [0.41, 1.09]

Total events: 16 (Treatment), 21 (Control)
Test for heterogeneity: Chi² = 0.76, df = 3 (P = 0.76), P = 0%
Test for overall effect: Z = 1.60 (P = 0.11)
effects that may have been related to treatment. Due to this heterogeneity, a treatment effect was not estimated. When it was reported, the rate of adverse effects was low.

**Discussion**

This systematic review attempted to synthesize the best available evidence for the use of inhaled MgSO$_4$ in the treatment of patients with acute asthma. From six RCTs involving nearly 300 patients, the results of this review provide somewhat weak and conflicting conclusions. First, based on the available data, it appears that therapy with nebulized isotonic MgSO$_4$ with or without a $\beta_2$-agonist can be safely administered at a variety of doses to patients with acute moderate-to-severe asthma. Since it is readily available and inexpensive, its role in acute asthma deserves more scrutiny. Used alone, it appears to be of little advantage compared to therapy with more familiar $\beta_2$-agonists in improving pulmonary function and reducing hospital admissions. The evidence for therapy with MgSO$_4$ administered in combination with $\beta_2$-agonists is more convincing than that for MgSO$_4$ therapy alone. In this review, therapy with MgSO$_4$, when combined with $\beta_2$-agonists (usually salbutamol), improved pulmonary function but did not reduce the number of hospital admissions. Evidence$^2$ has suggested that adding ipratropium bromide to $\beta_2$-agonist therapy is effective in improving pulmonary function and in reducing the number of hospital admissions in the acute setting, especially in severe cases of acute asthma. Most of the included studies in our review did not routinely employ this strategy, and the additive benefit of MgSO$_4$ in the face of combination therapy with ipratropium bromide and $\beta_2$-agonists remains unclear.

These results are similar to those from the IV magnesium review.$^9$ From four trials involving 133 patients, therapy with IV MgSO$_4$ improved pulmonary function in patients with severe disease and reduced the number of hospital admissions. Given these findings, it is perhaps surprising that the present review did not demonstrate a benefit in patients with severe asthma; however, the number of trials and the total number of patients was lower for this subset of patients in this review, and this conclusion may be the result of a type II error. The data suggest that if a type II error had occurred, the benefit among patients with severe asthma at presentation would be similar to that of patients with less severe disease.

The results from a recent survey$^{24}$ of 103 North American EDs indicated that while 92% had access to inhaled or nebulized MgSO$_4$, 4% had access to inhaled or nebulized MgSO$_4$. Moreover, the authors reported that only 2.5% of patients received IV MgSO$_4$ in a sample of nearly 3,000 patients seen across a network of North American EDs. The survey was conducted prior to the publication of the results of one half of the studies included in this review. We can only speculate that there may currently be more access to and use of inhaled MgSO$_4$ in patients with acute asthma; however, it is highly unlikely that it has reached the same level of use as the IV compound, which may be appropriate given the state of the evidence.

There are several possible limitations to the study. First, there is a possibility of study selection bias. However, we employed two independent reviewers and feel confident that the reasons for the exclusion of studies were consistent and appropriate. Our search was comprehensive and has been updated, so it is unlikely that there are any published trials that were missed.

In addition, publication bias may have influenced the result of this metaanalysis. For example, by missing unpublished negative trials we may be overestimating the effect of magnesium treatment. However, in order to reduce bias, a comprehensive and systematic search of the published and unpublished literature for potentially relevant studies was conducted. This was followed by attempts to contact corresponding and first authors. One unpublished trial was identified, and several negative trials were uncovered; however, we recognize that more of these types of trials may exist. Finally, due to the emergence of inhaled MgSO$_4$ treatment, there are possibly more small trials that have been conducted that, for one reason or another, remain unknown to us and unpublished. Without a central trial registry, we may never find these results, and in a review of this nature, made up of smaller studies, these small studies may make an important difference in our conclusions.

Finally, the investigations in this field are limited by the heterogeneity of both treatments and outcome measures. Unfortunately, despite adequate evidence for the use of standardized approaches to therapy for acute asthma, such as systemic corticosteroids,$^1$ anticholinergic agents,$^{2,25}$ IV MgSO$_4$, and repeated $\beta_2$-agonist use,$^3$ the control groups in the included studies were surprisingly heterogeneous. A trial in which systemic corticosteroids, $\beta_2$-agonists, and anticholinergic agents are administered to both groups, and inhaled MgSO$_4$ or placebo is added to the treatment regimen in a double-blind manner is needed. Furthermore, there is a lack of consensus among researchers regarding the most appropriate pulmonary function outcome measure to report. The aforementioned trial should insist on both pulmo-
nary function data as well as hospital admission status at the conclusion of the ED treatment period.

CONCLUSION

The role of nebulized MgSO₄ in the treatment of asthma exacerbations has not been conclusively resolved by this review. Nebulized MgSO₄ appears to be effective and safe to administer to patients experiencing asthma exacerbations. Further, we have demonstrated that therapy with MgSO₄ and β₂-agonists improved lung function when compared with therapy using a β₂-agonist alone; however, the difference was small and of limited clinical benefit. Consequently, this effect did not translate into a significant reduction in the number of patients admitted to the hospital. There was no treatment benefit observed in comparisons of therapy with MgSO₄ alone and that of β₂-agonists alone. Thus, treatment with nebulized MgSO₄ should be considered as an addition to that with inhaled β₂-agonists in patients experiencing asthma exacerbations. Further research in this area should be encouraged.

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