# Bronchodilator and steroid use for the management of bronchiolitis in Canadian pediatric emergency departments

Amy C. Plint, MD, MSc*; Renee Grenon†; Terry P. Klassen, MD, MSc‡; David W. Johnson, MD§


## ABSTRACT

**Objective:** Given the recent publication of several large trials and systematic reviews, we undertook a study of the current management of bronchiolitis in Canadian pediatric emergency departments (EDs) and explored physicians' rationale for their treatment decisions. The overarching purpose of this study was to assist in planning a future trial of combined epinephrine and dexamethasone for bronchiolitis.

**Methods:** Physicians in the Pediatric Emergency Research Canada (PERC) database received an 18-item electronic survey. A modified Dillman method was used.

**Results:** Of the 271 physicians surveyed, 191 (70.1%) responded. The majority (120 of 271; 66.5%) reported ''typically'' giving a bronchodilator trial in the ED, with respondents almost evenly divided between treatment with salbutamol ($n = 62$) and treatment with epinephrine ($n = 61$). Of those who use salbutamol, 77.4% indicated that they prefer it because it can be prescribed for home use. Of those who use epinephrine, 80.3% indicated that they believe the medical literature supports its benefit over salbutamol. Few participants (2.6%) reported ''always'' using steroids, whereas the majority (62.8%) reported ''sometimes'' using them. The most common factor reported to influence steroid use was illness severity (73.3%). The majority (60.5%) reported that if corticosteroids were beneficial in bronchiolitis, they prefered treatment with a single dose in the ED as opposed to a multiday course.

**Conclusions:** Our results indicate that physicians practicing in Canadian pediatric EDs commonly use bronchodilators to manage bronchiolitis but use corticosteroids less commonly. They appear to be uncomfortable using corticosteroids, particularly longer courses, and have a stated preference for a single dose. Any future trial examining the role of corticosteroids in bronchiolitis should carefully consider the issue of steroid dosage.

## RÉSUMÉ

**Objectifs:** Devant la publication récente de résultats de plusieurs essais de grande taille et revues systématiques, nous avons décidé de mener une étude sur le traitement de la bronchiolite dans les services des urgences (SU) pédiatriques, au Canada, et d'examiner les arguments mis de l'avant par les médecins pour justifier leurs décisions relatives au traitement. L'étude avait pour but premier de faciliter la planification d'un essai futur associant l'épinéphrine et la dexaméthasone dans le traitement de la bronchiolite.

**Méthode:** Une enquête électronique, comptant 18 éléments, a d'abord été versée dans la base de données du Groupe de Recherche en Urgence Pédiatrique du Canada, après quoi nous avons appliqué une version modifiée de la méthode de Dillman.

**Résultats:** Deux cent soixante et onze médecins ont reçu le questionnaire; sur ce nombre, 191 (70.1%) y ont répondu. Une majorité (120 sur 271; 66.5%) de répondants a indiqué qu'ils faisaient «généralement» l'essai d'un bronchodilatateur au SU, essai réparti presque également entre le salbutamol ($n = 62$) et l'épinéphrine ($n = 61$). Parmi ceux qui utilisaient le salbutamol, 77.4% ont indiqué qu'ils préféraient ce médicament parce qu'il pouvait s'utiliser à domicile; quant à ceux qui utilisaient l'épinéphrine, 80.3% ont indiqué qu'à leur avis la documentation médicale plaidait en sa faveur. Un très faible pourcentage de participants (2.6%) a indiqué «toujours» utiliser des stéroïdes, tandis que la majorité (62.8%) a indiqué en faire «parfois» usage. Le facteur le plus souvent (73.3%) invoqué pour justifier le recours aux stéroïdes était la gravité de la maladie. Enfin, une majorité (60.5%) de répondants a indiqué que, si les corticostéroides avaient un effet bénéfique dans le traitement de la bronchiolite, ils préféraient en administrer une seule dose au SU plutôt que de prescrire un traitement prolongé sur plusieurs jours.


From the *Departments of Pediatrics and Emergency Medicine, University of Ottawa, and the Children's Hospital of Eastern Ontario, Ottawa, ON; †Department of Psychology, University of Ottawa, Ottawa, ON; ‡Manitoba Institute of Child Health, Department of Pediatrics, University of Manitoba, Winnipeg, MB; and §Departments of Pediatrics and Physiology and Pharmacology, University of Calgary, Calgary, AB.

**Correspondence to**: Dr. Amy C. Plint, Children's Hospital of Eastern Ontario, 401 Smyth Road, Ottawa, ON K1H 8L1; plint@cheo.on.ca.

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**Conclusions:** D'après les résultats de l'enquête, les médecins qui travaillent dans les SU pédiatriques, au Canada, utilisent souvent des bronchodilatateurs pour traiter la bronchiolite et moins souvent des corticostéroïdes. Ils semblent mal à l'aise devant le recours aux corticostéroïdes, notamment devant leur emploi prolongé, et ils ont une nette préférence pour les doses uniques. La question de la posologie des stéroïdes devrait donc être soigneusement examinée dans tout essai futur portant sur le rôle des corticostéroïdes dans la bronchiolite.

**Keywords:** bronchiolitis, children, emergency department

Bronchiolitis is the leading cause of infant hospitalization in North America and accounts for a rising and substantial burden of illness and health-related expenditures.[1–4] Hospitalizations for bronchiolitis almost doubled from the 1980s to the 1990s[1,2,4] and account for most of the estimated $534 million annual bronchiolitis-related expenditures in the United States.[3] In Canada, 35 per 1,000 infants under 1 year of age are hospitalized for bronchiolitis annually,[2] with an estimated cost of more than $23 million.[5] Bronchiolitis also exerts a significant outpatient burden, accounting for 8.75 million outpatient office visits[6] and almost 2 million emergency department (ED) visits annually in the United States.[7]

Despite the common nature of bronchiolitis, its treatment remains controversial. The 2006 American Academy of Pediatrics (AAP) Bronchiolitis Practice Guideline advised against routine use of bronchodilators but supported a limited trial of their use in an observed setting.[8] Corticosteroids are not recommended by the guideline.[8] Two noteworthy and large trials in bronchiolitis have been published since these guidelines were released. One trial published by the US-based Pediatric Emergency Care Network (PECARN) found no benefit of a single dose of dexamethasone in reducing hospital admissions.[9] The second trial, known as the Canadian Bronchiolitis Epinephrine and Steroid Trial or CanBEST, was carried out by the Pediatric Emergency Research Canada (PERC) network and found that combined treatment with epinephrine and dexamethasone may reduce hospital admissions and shorten the symptom duration.[10] This second trial prompted considerable controversy.[11–16]

Given the new evidence and questions raised by the two aforementioned trials, we undertook a review of the management of bronchiolitis in Canadian pediatric EDs. As part of this review, we also explored physicians' rationale for their decisions in treating bronchiolitis. The overarching purpose of this study was to assist in planning a future trial of combined epinephrine and dexamethasone for bronchiolitis and to determine potential facilitators and barriers to translating evidence from this trial into practice.

## METHODS

### *Study design*

We surveyed emergency physicians working in pediatric EDs across Canada about their current management of infants with bronchiolitis and the rationale for their management choices. The Research Ethics Board of the Children's Hospital of Eastern Ontario approved this study.

### *Study setting and population*

All physicians listed in the PERC physician database were surveyed. PERC is a collaborative Canada-wide pediatric emergency research group.[17] The PERC physician database includes approximately 70% of the physicians working in 15 pediatric EDs across Canada. The annual census for EDs that are participating PERC sites ranges from 17,000 to 82,000.

### *Survey instrument*

We developed a survey instrument consisting of 18 questions, 5 demographic and 13 regarding the management of bronchiolitis. The survey included both single-selection closed-ended questions and multiple-choice questions with additional options for text responses where appropriate. The investigators reviewed all free text responses for recurring themes. A convenience sample of four emergency physicians pilot tested the survey instrument for readability, face validity, and ease of use, and the survey instrument was revised based on their feedback. These four physicians were also allowed to participate in the study. The survey instrument was created in English and translated into French. Bronchiolitis was explicitly defined in the survey instructions as the first episode of wheezing in an infant less than 12 months of age with signs of an upper



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respiratory tract infection and presenting during a typical respiratory syncytial virus season. This definition is in keeping with the AAP bronchiolitis guideline[8] and the definition used in the two largest published randomized controlled trials on bronchiolitis.[9,10]

### Sampling procedure

A presurvey email announcement was sent to all physicians in the PERC database. The announcement provided an overview of the study and notified physicians that they would soon be invited to participate. An electronic survey was then sent to all eligible individuals between October and December 2010. A modified version of the Dillman total design survey method was used for contact and follow-up procedures.[18] Nonrespondents received a second and, if necessary, a third email of the survey. After three emails, nonrespondents received a direct mailing of the survey. To ensure the confidentiality of the responses, a survey number identified participants and sites, and investigators were blinded to this assignment.

### Key outcomes

Key outcomes of interest included participants' use of bronchodilators, oral corticosteroids, and combination therapy with epinephrine and corticosteroids when managing bronchiolitis in the ED. We explored the rationale for participants' management choices, the doses of corticosteroids used among those who reported using corticosteroids, and overall comfort with corticosteroid use in bronchiolitis.

### Sample size and analysis

The number of individuals in the PERC database (271) determined our study's maximal sample size. Data entry and analysis were performed using *SPSS-PC* version 21 (IBM Corp., Armonk, NY). Descriptive statistics were used for variables such as length of time since graduation from medical school, type of training, primary area of clinical practice, and academic appointments. Response rates were calculated, overall and by site. Frequencies of responses to questionnaire items regarding the use of bronchodilators and the use of steroids were generated, overall and by site. A priori we chose to explore whether site, type of training, primary clinical practice, academic appointment, and year of medical school graduation were associated with the following outcomes: use of bronchodilators and steroids, type of bronchodilator used, and use of combined therapy. As 8 of the 15 hospitals in this study were active recruitment sites for the CanBEST trial, we also undertook a post hoc analysis of whether being a study site was associated with the outcomes of interest. The statistical significance of observed differences in outcomes for each of the specified categorical variables was assessed using the Mantel-Haenszel chi-square test or Fisher exact test, as appropriate. All tests were two-sided, and $p$ values less than 0.05 were considered statistically significant.

## RESULTS

### Sample specification

A total of 271 physicians were surveyed, and 191 (70.1%) responded. The response rate across the 15 EDs ranged from 50 to 100%. Table 1 summarizes the demographic characteristics of the study participants.

### Bronchodilator use

The majority of respondents (127; 66.0%) reported "typically" treating infants with a trial of bronchodilators in the ED, with respondents almost evenly divided between treatment with salbutamol and treatment with

**Table 1. Demographic characteristics of study participants ($n$ = 190)***

| Characteristic | *n* (%) |
|---|---|
| Length of time since medical school graduation | |
| < 10 yr | 36 (19.3) |
| 10–20 yr | 93 (49.7) |
| > 20 yr | 58 (31.0) |
| Training (highest level) | |
| Pediatrics | 61 (32.1) |
| Pediatric emergency medicine fellowship | 88 (46.3) |
| Emergency medicine | 31 (16.3) |
| Other | 10 (5.2) |
| Academic appointment held | 146 (76.4) |
| Majority of clinical hours | |
| Pediatric emergency medicine | 138 (72.6) |
| Emergency medicine | 24 (12.6) |
| Equal split between pediatric emergency medicine/ emergency medicine | 5 (2.6) |
| Other | 23 (12.1) |

*One respondent did not complete the demographic questions.



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epinephrine (Table 2). The majority (77.4%) of respondents who reported using salbutamol in the ED indicated that they do so because it is possible to prescribe salbutamol for home use. Among respondents who typically use epinephrine in the ED, the majority (80.3%) reported choosing epinephrine because the medical literature supports its benefit over salbutamol.

### Oral corticosteroid use and comfort with use

Few respondents (5; 2.6%) reported "always" using oral corticosteroids in the ED in their management of infants with bronchiolitis (see Table 2). The majority of respondents (120; 62.8%) reported "sometimes" using corticosteroids, and among these respondents, the most common factor influencing their decision was illness severity. Physicians who "sometimes" or "always" use corticosteroids were asked if they used the previously published dose (1.0 mg/kg dexamethasone in the ED and 0.6 mg/kg of dexamethasone once per day for 5 days at home), and only 41.7% did. The remaining physicians described a wide variety of therapies, but the recurrent themes were of the use of lower dexamethasone doses both in the ED and at discharge (0.2–0.6 mg/kg/dose), overall shorter courses of corticosteroids, and the use of prednisone (at 1–2 mg/kg/day) in place of dexamethasone. Among physicians who "never" use steroids, about one-third of respondents were concerned with the size of the dose suggested in the medical literature as possibly beneficial, and about one-quarter were concerned with potential side effects.

Table 2 outlines the use of bronchodilators and corticosteroids among study participants. We asked all participants, if dexamethasone was proven effective in bronchiolitis, what courses of dexamethasone they would be comfortable using. The majority preferred a single ED dose to a multiday course. Preferred single doses of dexamethasone were 0.3 mg/kg (60.4%), 0.6 mg/kg (36.9%), and 1.0 mg/kg (2.7%), with an absolute maximum of 10 mg per dose. We also specifically asked if respondents would be more comfortable using a different corticosteroid instead of dexamethasone; the majority (69.5%) reported being comfortable with dexamethasone.

### Combined epinephrine and steroid use

We asked the 120 participants who reported "always" or "sometimes" using corticosteroids if they combined corticosteroid use with epinephrine therapy. The majority (70.2%) reported combining therapies, but only approximately half reported using the therapy as outlined in CanBEST (two doses of epinephrine 30 minutes apart and 1.0 mg/kg dexamethasone immediately before or after the epinephrine). Themes of text responses from those who did not use the therapy outlined in CanBEST included the use of lower doses of dexamethasone, the use of oral prednisolone in place of dexamethasone, or a perception that the relative timing of the two medications was unimportant.

### Factors associated with steroid and bronchodilator use

The only factor found to be significantly associated with the use of bronchodilators, bronchodilator preference, the use of corticosteroids, and the use of combined corticosteroids was site of practice (all associations $p < 0.005$). There were no significant associations between the aforementioned outcomes and type of training, type of primary practice, academic appointment, length of time since medical school graduation, or being a study site in CanBEST.

## DISCUSSION

The results of this study indicate that among pediatric emergency physicians, bronchodilator use remains common in the ED management of bronchiolitis. Corticosteroid use appears less common and appears to be influenced primarily by the severity of the illness. Among physicians who reported sometimes using corticosteroids, the use of combined therapy with epinephrine was fairly common, although the doses used were not consistent with those reported in the literature as possibly effective.[10] Most physicians' stated preference for corticosteroid dosing, if it were shown effective in bronchiolitis, was for a single dose given in the ED. To our knowledge, this is the first study to examine emergency physicians' rationale for their management choices in the treatment of bronchiolitis.

Our finding that the majority of participants reported typically initiating a trial of bronchodilators is in keeping with previous studies that document the widespread use of bronchodilators in North American ED settings.[7,9,19,20] Although the AAP guideline does not recommend routine use of bronchodilators, it does



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**Table 2. Use of bronchodilators and steroids in ED management of bronchiolitis**

| Survey questions and participants responses | *n* (%) |
|---|---|
| Current use of bronchodilators in the ED (*n* = 191) | |
| *In the ED, do you typically treat infants who present with bronchiolitis with a trial of bronchodilators (either on their own or in conjunction with steroids)?* | |
| Yes | 126 (66.0) |
| *If yes, typically initiate treatment with:* (*n* = 126) | |
| Salbutamol | 62 (49.2) |
| Epinephrine | 61 (48.4) |
| Other | 3 (1.6) |
| *If you typically use salbutamol, why do you prefer its use?** (*n* = 62) | |
| Medical literature supports its benefit over epinephrine | 3 (4.8) |
| Concerned about potential side effects of epinephrine | 4 (6.5) |
| Can send a child home on it | 48 (77.4) |
| Other | 17 (27.4) |
| *If you typically use epinephrine, why do you prefer its use?** (*n* = 61) | |
| Medical literature supports its benefit over salbutamol | 49 (80.3) |
| Not concerned about potential side effects of epinephrine | 29 (47.5) |
| Not concerned that it is not available for discharge use | 24 (39.3) |
| Other | 10 (16.4) |
| Use of oral corticosteroids in the ED (*n* = 191) | |
| *In the ED, do you use oral steroids (with or without bronchodilators) in treating patients with bronchiolitis?** | |
| Always | 5 (2.6) |
| Sometimes | 120 (62.8) |
| Never | 66 (34.6) |
| *''Sometimes'' uses oral steroids: What influences your decision?** (*n* = 120) | |
| Age of child | 65 (54.2) |
| Severity of illness | 88 (73.3) |
| Family history of atopy | 51 (42.5) |
| Family history of asthma | 65 (54.2) |
| Personal history of eczema | 54 (45.0) |
| Parental preference | 16 (13.3) |
| Other | 17 (14.2) |
| *''Never'' uses oral steroids: Is it because...?** (*n* = 66) | |
| Concerned about potential side effects | 16 (24.2) |
| Uncomfortable with dose that studies have suggested is beneficial | 20 (30.3) |
| Do not think they work | 8 (12.1) |
| More evidence is needed | 10 (15.5) |
| Use of combined epinephrine and oral corticosteroids (*n* = 124[†]) | |
| *Do you combine epinephrine with corticosteroid treatment?* | |
| Yes | 87 (70.2) |
| No | 37 (29.8) |
| *If yes to combined therapy: Do you use 2 doses of epinephrine 30 minutes apart and 1.0 mg/kg dexamethasone immediately before or after the epinephrine?*( *n* = 87) | |
| Yes | 51 (58.6) |
| No | 36 (32.4) |
| *If no to combined therapy: Is this because...?** (*n* = 34[‡]) | |
| Do not believe benefit to combination | 9 (26.5) |
| Do not use epinephrine | 12 (35.3) |
| Other | 13 (38.2) |
| Physician comfort with corticosteroid use | |
| *If corticosteroids were found to be beneficial, which course of dexamethasone would you be most comfortable using?* (*n* = 190[§]) | |
| Multidose/multiday courses | 62 (32.6) |



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**Table 2. Continued**

| Survey questions and participants responses | *n* (%) |
|---|---|
| Single dose in the ED | 115 (60.5) |
| Never comfortable with dexamethasone or any corticosteroid | 13 (6.8) |
| *If oral corticosteroids were beneficial for children with bronchiolitis, would you be more comfortable using a corticosteroid other than dexamethasone?* (*n* = 183[¶]) | |
| Yes, comfortable with dexamethasone | 130 (69.5) |

ED = emergency department.
*Participants could select more than one response.
[†]Only those who reported ''sometimes'' or ''always'' using corticosteroids were asked about their use of combined therapy. Of the 125 possible respondents, 1 did not complete this question.
[‡]Two respondents did not complete this question.
[§]One respondent did not complete this question.
[¶]Seven respondents reported never being comfortable with any corticosteroid use.

support a limited trial in an observed setting.[8] The bronchodilator use reported by participants in our study could be deemed to be in keeping with this guideline. No previous studies have found that clinicians preferentially choose salbutamol in bronchiolitis because they can send patients home on it. Concerns have been expressed that infants with bronchiolitis who are treated with epinephrine may simply improve temporarily, be discharged, and then return to the ED and ultimately be admitted.[21] The desire to send patients home on a medication may be consistent with this concern. We found that a higher proportion of participants indicate that they use epinephrine than previously reported,[1,7,20] the main cited reason for which was that the medical literature supported its benefit over salbutamol. Over the period in which our study was completed, the only available systematic review specifically examining epinephrine use in bronchiolitis concluded that epinephrine is superior to placebo in reducing admissions.[22] CanBEST, however, did not confirm this and found that only combined treatment with epinephrine and dexamethasone, not epinephrine or dexamethsone given individually, reduced admissions compared to placebo.[10] More recently, a comparative effectiveness review that included CanBEST data found epinephrine to be the only bronchodilator to reduce admissions when compared to placebo at the time of the ED visit.[23]

Many participants reported basing their decision to use corticosteroids on the child's severity of illness, age, and family and personal history of atopy. Presumably, physicians are hesitant to use corticosteroids in young children with mild illness and are more comfortable using these agents in a first episode of wheezing if patients have a history of atopy. Of note, subgroup analyses in bronchiolitis steroid trials have failed to show that children with a personal or family history of atopy receive any benefit from treatment.[9,10]

Eight of the 15 EDs where physicians were surveyed were sites in the CanBEST study. It might be expected that participation in the study would influence therapy decisions, with participating sites more likely to use combined epinephrine and corticosteroids, but we did not find any such relationship. This is perhaps not surprising given the uncertainty regarding interpretation of the CanBEST results, the high dose of dexamethasone used, the potential side effects of dexamethasone, and the subsequent controversy regarding the CanBEST results.[11–16]

Given the high burden of disease from bronchiolitis, the clinician concerns uncovered in our survey, and the controversy and uncertainty that remain regarding its management, a future trial of combined epinephrine and dexamethasone therapy is needed. Such a trial should seek to confirm or refute the suggestion of benefit to combined epinephrine and dexamethasone. It should examine not only the corticosteroid dose used in CanBEST (as this may be the dose needed for effectiveness) but also the lower-dose/shorter-course dexamethasone regimens with which physicians report higher comfort. If benefit is found from a lower dose/shorter course, the results of such a trial may be more easily and enthusiastically applied by physicians in their management of bronchiolitis. If only higher-dose therapy was found to be effective, physician concerns regarding the side effects and safety of such a dose likely need to be addressed before effective knowledge translation can occur.



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## LIMITATIONS

The main limitation of this study was the potential for recall bias of self-reported data. However, the data obtained, at least regarding bronchodilator use, were in keeping with those from a previous prospective study of bronchiolitis management in seven of the EDs participating in this study.[19] Although we did examine physician rationale for treatment choices, qualitative methodological approaches may have provided richer data in this area. Our study focused only on the management and rationale of physicians working in academic pediatric EDs. As a result, although it is known that bronchodilator use is common in community EDs,[24] the generalizability of our findings to other locations may be limited.

## CONCLUSIONS

Our results indicate that physicians practicing in Canadian pediatric EDs commonly use bronchodilators to manage bronchiolitis but use corticosteroids less commonly. They appear to be uncomfortable using corticosteroids, particularly longer courses, and have a stated preference for a single dose. Any future trial examining the role of corticosteroids in bronchiolitis should carefully consider the issue of steroid dosage. These findings should help guide the design of future bronchiolitis trials and inform knowledge translation strategies.

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