Management of Bronchiolitis in the Emergency Department: Impact of Evidence-Based Guidelines?

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KEY WORDS
bronchiolitis, evidence-based guidelines, emergency department, NHAMCS

ABBREVIATIONS
AAP—American Academy of Pediatrics
AOR—adjusted odds ratio
CI—confidence interval
ED—emergency department
NHAMCS—National Hospital Ambulatory Medical Care Survey

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abstract

OBJECTIVE: Recent practice guidelines from the American Academy of Pediatrics recommend limiting use of bronchodilators, corticosteroids, antibiotics, and diagnostic testing for patients with bronchiolitis. We sought to determine the association of the evidence-based guidelines with bronchiolitis care in the emergency department (ED).

METHODS: We analyzed data from the National Hospital Ambulatory Medical Care Survey, a nationally representative sample of ED visits. We compared utilization for patient visits before and after the publication of the guidelines. We used logistic regression to determine the association of the availability of the guidelines with resource utilization.

RESULTS: Bronchodilators were used in 53.8% of patient visits with no differences noted after the introduction of the guidelines (53.6% vs 54.2%, $P = .91$). Systemic steroids were used in 20.4% of patient visits, and antibiotics were given in 33.2% of visits. There were no changes in the frequency of corticosteroid (21.9% vs 17.8%, $P = .31$) or antibiotic (33.6% vs 29.7%, $P = .51$) use. There was an associated decrease in use of chest x-rays (65.3% vs 48.6%, $P = .005$). This association remained significant after adjusting for patient and hospital characteristics with an adjusted odds ratio of 0.41 (95% confidence interval 0.26–0.67).

CONCLUSIONS: For patients seen in the ED with bronchiolitis, utilization of diagnostic imaging has decreased with the availability of the American Academy of Pediatrics practice guidelines. However, there has not been an associated decrease in use of nonrecommended therapies. Targeted efforts will likely be required to change practice significantly. *Pediatrics* 2013;131:S103–S109

Bronchiolitis is a leading cause of hospitalization for infants and toddlers and is one of the most common conditions for which this population is evaluated in the emergency department (ED).[1–3] Most children under age 2 will have at least 1 episode of bronchiolitis, and between 390 and 510 deaths are attributed to bronchiolitis each year.[4] Many commonly used therapies such as bronchodilators and corticosteroids have no proven efficacy in the treatment of bronchiolitis.[5–17] The American Academy of Pediatrics (AAP) released clinical practice guidelines in 2006 to assist in the management of bronchiolitis. These guidelines emphasized supportive care with oxygen and supplemental hydration, if needed, and recommended against routine use of bronchodilators, corticosteroids, antibiotics, and diagnostic testing.[1] We sought to determine the impact of the 2006 AAP bronchiolitis guidelines on the care of children treated in the ED. We hypothesized that medication usage and diagnostic testing would decrease after the release of the AAP practice guidelines.

METHODS

Sample

Data are from the 2001–2009 National Hospital Ambulatory Medical Care Survey (NHAMCS), a nationally representative sample of emergency department visits conducted annually by the National Center for Health Statistics, Centers for Disease Control. The survey utilizes a 4-stage probability sampling strategy and includes noninstitutional nonfederal general and short-stay hospitals. Additional details about survey methodology are available from the National Center for Health Statistics, http://www.cdc.gov/nchs/ahcd/about_ahcd.htm#NHAMCS. We defined bronchiolitis as having an *International Classification of Diseases, Ninth Revision* diagnosis of bronchiolitis (codes 466, 466.11, 466.19) and age under 2 years. All patients with bronchiolitis comprised our analytic sample.

Variable Selection

The dependent variables of interest were treatment with bronchodilators, corticosteroids, antibiotics, and utilization of chest radiographs. In the NHAMCS, up to 8 medications are recorded for each patient visit. We included all 8 medications in the construction of the variables for bronchodilators, corticosteroids, and antibiotics. For bronchodilators, patient visits with administration of any noncombination short-acting bronchodilator were classified as receiving bronchodilators. For corticosteroids, we classified all records with administration of systemic corticosteroids excluding inhaled corticosteroids. For antibiotics, we included any systemic antibiotics administered in the ED or given at the time of discharge. Information regarding radiographs varied throughout the study period. NHAMCS data from 2001 through 2004 included a separate data field regarding chest radiographs. However, for 2005 through 2009, the data field included radiographs generally, without information about the specific type of radiograph obtained. Because all patients in our sample had a diagnosis of bronchiolitis, we assumed that all radiographs were chest radiographs.

The primary independent variable of interest was the date of the visit dichotomized as before or after the publication of the bronchiolitis guidelines (October 2006). The NHAMCS captures both the month and year of the ED visit. We classified visits occurring during or before October 2006 as before the guidelines, and those visits during or after November 2006 as after the guidelines.

We considered several additional covariates in our analysis. The NHAMCS collects age in days for patients under 1 year of age, and age in years only for those aged >1 year. We created a 3-level variable for age with young infants (0–90 days), older infants (91–365 days), and toddlers (1–2 years of age). We used admission status as a proxy for severity of illness. Patients who were admitted for observation or inpatient status or who were transferred to another facility were characterized as requiring admission for this analysis. Race and ethnicity information were recorded somewhat differently throughout the study period. To preserve as much information as possible, we created a 4-level variable for all years comprising white and non-Hispanic, African American and non-Hispanic, Hispanic, and other. The publically available data files of the NHAMCS did not include all hospital characteristics of interest. Therefore, we defined a teaching ED as a site in which ≥10% of patient visits were seen by a physician-in-training. To determine the degree to which the EDs had a focus on the care of children, we determined the mean age for patient visits to each site and defined a site with a mean age of <18 years as a child-focused ED.[18] We used hospital ownership (a 3-level variable including not for profit, government-owned, and proprietary) and geographic region (a 4-level variable encompassing the 4 major census regions: Northeast, Midwest, South, West) as potential confounders.

Data Analysis

First, we assessed bivariate associations of resource utilization before and after the publication of the evidence-based guidelines. We selected both demographic variables and hospital characteristics a priori based on findings from previous studies and hypothesized

associations.[2,19–22] We also considered 2 approaches to limit the sample to determine the impact of other diagnoses. We first limited the sample to those visits with a primary diagnosis of bronchiolitis. In addition, for consideration of therapeutic interventions, we limited the sample to those without an additional diagnosis (asthma, bacterial infection) that would constitute an indication for the therapeutic modalities. For multivariable modeling, we considered each dependent variable in separate analyses. Nonsignificant variables were removed stepwise to create the most parsimonious model. Data management was conducted with SAS version 9.2 (Cary, NC). To account for the nonrandom sampling design of the survey, we determined weighted estimates and tests of association using SUDAAN 10.0 (Research Triangle Institute, Research Triangle Park, NC).

The protocol was evaluated by the Institutional Review Board at Texas Tech University Health Sciences Center.

RESULTS

There were 678 patients with bronchiolitis over the study period, providing a population estimate of ~250 000 patient visits per year. The characteristics of the sample are shown in Table 1. There was a male predominance (59.0%), and most patients were <1 year of age (78.6%). Consideration of the total sample, only those with a primary diagnosis of bronchiolitis or limited samples excluding diagnoses associated with the therapeutic interventions (excluding asthma for bronchodilators and steroids, excluding bacterial infections for antibiotics) did not alter the analysis. The use of medications for patients with bronchiolitis did not change significantly over the study period and did not decrease after publication of the evidence-based guidelines (Table 2). Use of radiography did decrease after the publication of the guidelines (65.3% before and 48.6% after, $P = .005$). The trend in radiograph use is shown in Fig 1.

TABLE 1 Characteristics of the Sample

	n (weighted %)
Total	678
Age	
0–90 d	157 (23.9)
91–365 d	375 (54.7)
1–2 y	146 (21.5)
Race/ethnicity	
White, non-Hispanic	297 (43.0)
African American, non-Hispanic	180 (26.2)
Hispanic	169 (26.4)
Other	32 (4.5)
Gender	
Male	394 (59.0)
Female	284 (41.0)
Admission status	
Admitted	111 (13.0)
Discharged from hospital	567 (87.0)
Region	
Northeast	114 (12.2)
South	252 (43.6)
Midwest	167 (23.7)
West	145 (20.6)
Teaching status	
Teaching ED	179 (16.6)
Nonteaching ED	499 (83.4)
Hospital ownership	
Not for profit	506 (73.6)
Government	90 (11.5)
Proprietary	82 (14.9)
ED type	
Children's facility	169 (23.7)
General ED	509 (76.3)
Diagnosis	
Primary bronchiolitis	515 (76.0)
Without asthma	644 (95.2)
Without bacterial infection	561 (81.1)

After adjusting for demographic and hospital characteristics, patient visits after the publication of the guidelines had 59% lower odds of receiving a radiograph than those visits occurring before the guidelines (Table 3). In addition, patients who were discharged from the hospital had lower odds of imaging compared with those who were admitted. Hospital characteristics associated with decreased imaging included geographic location in the Northeast and children's-focused EDs.

Factors associated with medication use are shown in Table 4. The multivariable analysis confirms the lack of association with the publication of evidence-based guidelines. Older patients (91–365 days, adjusted odds ratio [AOR] 1.65, 95% confidence interval [CI] 1.01–2.69; 1–2 years, AOR 2.21, 95% CI 1.14–4.30) and those seen in child-focused EDs (AOR 2.60, 95% CI 1.51–4.50) were more likely to receive bronchodilators. Patients 91–365 days of age were more likely to receive corticosteroids (AOR 2.45, 95% CI 1.16–5.16) compared with younger infants. Older infants (91–365 days) were also more likely to receive antibiotics (AOR 1.75, 95% CI 1.08–2.86). Patients seen in child-focused EDs were less likely to receive antibiotics (AOR 0.26, 95% CI 0.13–0.49).

DISCUSSION

For patients with bronchiolitis seen in the ED, there has been a decrease in chest radiography associated with the availability of evidence-based guidelines. The use of other nonrecommended treatments (bronchodilators, corticosteroids, antibiotics) has not changed significantly over the study period. We found similar frequencies of bronchodilator, steroid, and antibiotic use compared with those reported in other studies.[2,20,23] Mansbach et al reported radiography in 46% of patients using the NHAMCS from 1992 through 2000.[2] Our average utilization was 59% with significantly lower frequencies in the last 3 years of the study period. This suggests that radiography increased in the early 2000s with recent decline. Other authors have reported higher rates of radiography at several time points over the past 2 decades.[19,23] Although the decrease is associated with the availability of the evidence-based guidelines, we are unable to determine a causal relationship with this analysis.

Patients seen in child-focused EDs had different patterns of resource utilization

TABLE 2 Resource Utilization for Patients in the ED Before and After Availability of Evidence-Based Guidelines

	All Years	Before Guidelines	After Guidelines	*P* Value[a]
Corticosteroids				
Total sample	20.4%	21.9%	17.8%	.31
Primary diagnosis only	18.7%	21.4%	14.0%	.11
Limited sample[b]	18.0%	19.3%	16.0%	.42
Bronchodilators				
Total sample	53.8%	53.6%	54.2%	.91
Primary diagnosis only	57.0%	55.7%	59.3%	.59
Limited sample[b]	52.1%	51.6%	53.0%	.80
Antibiotics				
Total sample	33.2%	33.6%	29.7%	.51
Primary diagnosis only	28.6%	30.1%	24.6%	.35
Limited sample[c]	23.8%	24.9%	22.0%	.63
Chest x-ray				
Total sample	59.1%	65.3%	48.6%	.01
Primary diagnosis only	59.9%	66.3%	48.4%	.01

[a] χ^2.
[b] Sample limited to those without asthma.
[c] Sample limited to those without a bacterial infection.

than those seen in general EDs. Our findings are similar to those seen by Knapp et al who noted chest x-ray usage in 37% of patients seen in children's hospital EDs.[20] Antibiotics were used less frequently in children's EDs. However, patients seen in child-focused facilities had increased odds of receiving bronchodilators. This finding was unexpected given the lack of proven efficacy for bronchodilators and the recommendation that they not be routinely used and the expectation that facilities with a significant focus on the care of children would be more likely to follow those recommendations.

The lack of change in ED management of bronchiolitis after the publication of the AAP evidence-based guidelines highlights the difficulty in changing practice. Several authors have demonstrated success in changing local practice patterns regarding aspects of bronchiolitis care.[19,24–27] As demonstrated in this study, these changes are difficult to create and maintain and often require a team of dedicated individuals as well as institutional support to create lasting changes.[27,28] In Switzerland, evidence-based guidelines for bronchiolitis demonstrated a national impact on care measured by pediatrician self-reported medication use.[29] Guidelines were published and disseminated by the national pediatric society.[29] However, the relatively small

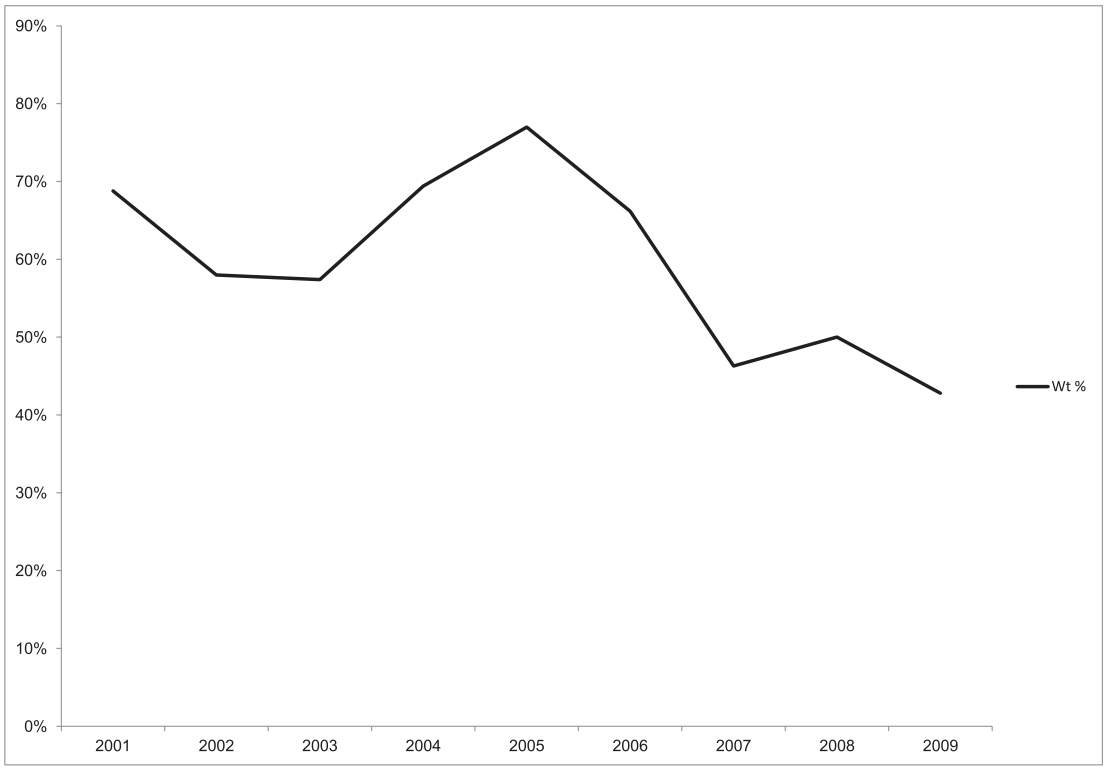

FIGURE 1
Weighted percentage of patient visits with chest radiographs obtained.

TABLE 3 Factors Associated With Obtaining Radiographs in Patients With Bronchiolitis

	AOR	(95% CI)
Timing of the visit		
Before guidelines	1.00	—
After guidelines	0.41	(0.26–0.67)
Age		
0–90 d	1.00	—
91–365 d	0.67	(0.38–1.17)
1–2 y	0.57	(0.27–1.22)
Race/ethnicity		
White, non-Hispanic	1.00	—
Black, non-Hispanic	1.12	(0.66–1.91)
Hispanic	0.57	(0.33–0.99)
Other	1.59	(0.60–4.22)
Gender		
Female	1.00	—
Male	0.98	(0.65–1.47)
Admission status		
Discharged from hospital	1.00	—
Admitted	2.97	(1.52–5.78)
Region		
Northeast	1.00	—
Midwest	2.07	(1.05–4.08)
South	2.31	(1.27–4.21)
West	2.66	(1.34–5.31)
Hospital ownership		
Not-for-profit	1.00	—
Government	0.74	(0.38–1.45)
Proprietary	2.31	(1.20–4.45)
ED type		
General ED	1.00	—
Children's facility	0.37	(0.22–0.60)

TABLE 4 Factors Associated With Use of Medications in Patients With Bronchiolitis

	Bronchodilators		Systemic Steroids		Antibiotics	
	AOR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)
Timing of the visit						
Before guidelines	1.00	—	1.00	—	1.00	—
After guidelines	1.38	(0.85–2.22)	0.81	(0.46–1.46)	0.89	(0.53–1.50)
Age						
0–90 d	1.00	—	1.00	—	1.00	—
91–365 d	1.66	(1.02–2.70)	2.42	(1.15–5.07)	1.76	(1.08–2.86)
1–2 y	2.16	(1.12–4.14)	1.65	(0.59–4.58)	1.41	(0.74–2.67)
Race/ethnicity						
White, non-Hispanic	1.00	—	1.00	—	1.00	—
Black, non-Hispanic	1.48	(0.87–2.52)	1.50	(0.79–2.86)	0.87	(0.46–1.65)
Hispanic	1.03	(0.61–1.75)	1.55	(0.81–2.97)	0.96	(0.54–1.71)
Other	1.91	(0.75–4.87)	1.06	(0.34–3.33)	0.59	(0.22–1.57)
Gender						
Female	1.00	—	1.00	—	1.00	—
Male	1.31	(0.89–1.91)	1.16	(0.64–2.10)	1.36	(0.81–2.25)
Admission status						
Discharged from hospital	1.00	—	1.00	—	1.00	—
Admitted	1.53	(0.91-2.57)	0.77	(0.40–1.49)	0.90	(0.45–1.82)
Region						
Northeast	1.00	—	1.00		1.00	—
Midwest	1.10	(0.60–2.07)	1.30	(0.56–3.04)	3.07	(1.38–6.82)
South	0.61	(0.33–1.14)	1.82	(0.80–4.14)	3.73	(1.73–8.06)
West	0.95	(0.47–1.93)	1.35	(0.53–3.45)	4.38	(1.89–10.2)
Hospital ownership						
Not for profit	1.00	—	1.00	—	1.00	—
Government	1.49	(0.81–2.74)	0.74	(0.38–1.45)	0.80	(0.41–1.59)
Proprietary	1.24	(0.68–2.28)	2.31	(1.20–4.45)	2.24	(1.16–4.36)
ED type						
General ED	1.00	—	1.00	—	1.00	—
Children's facility	2.77	(1.62–4.72)	0.37	(0.22–0.60)	0.26	(0.13–0.51)

population of patients and practitioners seen in Switzerland may have been critical to the success of the national approach and may not be reproducible across a larger and less-integrated health care system like that in the United States.

This study has several limitations. Because this is an analysis of an existing data set, many aspects of care, including more detailed clinical data, are not available. Determining the severity of illness, past medical history, and other components for each ED visit was not possible with these data but would be helpful to understand more fully the impact of the evidence-based guidelines and account for additional confounders. In addition, the definition of bronchiolitis is based solely on patient age and an *International Classification of Diseases, Ninth Revision* diagnosis code for bronchiolitis. This definition may not accurately capture patients with a clinical diagnosis of bronchiolitis. There is significant variation in diagnostic labeling of patients with lower respiratory tract infection,[30] and the data set is entirely dependent on the diagnoses chosen by the treating physicians in the EDs that comprised the NHAMCS sample. Other technical limitations are based on availability of specific variables within the data set. The lack of a specific variable for chest x-rays versus other radiographs for years 2005 through 2009 may have overestimated the use of chest radiographs. Given the direction of the trend in chest radiograph use, this possible overestimation would tend to bias toward the null. In addition, our definition of child-focused ED is based on characteristics of patients seen in each sample ED. This does not necessarily reflect EDs that are children's EDs or that are part of children's hospitals but rather those that had a large proportion of pediatric visits during the sampling frame. Some general EDs may have been misclassified as child-focused EDs, but this possible misallocation would also tend to bias toward the null, and the results regarding child-focused EDs should therefore be interpreted with caution

Despite these limitations, this study provides a nationally representative picture of care for patients with bronchiolitis focusing not only on a few institutions or on children's EDs but on a representative sample of all ED visits for bronchiolitis. Because most children receive their emergency care in general rather than children's EDs,[31] assessing and addressing care provided

by nonpediatrician providers will be necessary for significant change. Multiple authors have reported significant variation in practice patterns for bronchiolitis.[20,21,23,32–35] It is likely that there was significant site-by-site variation in this sample as well, but the numbers of patients are too limited to allow a site-by-site analysis. Nevertheless, the extent to which practice patterns were not consistent with evidence-based recommendations suggests that there is significant room for improvement and standardization.

CONCLUSIONS

Publication of evidence-based guidelines was not associated with changes in medication use for bronchiolitis in this nationally representative sample but was associated with decreases in chest radiography. These data underscore the difficulties in changing practice patterns and suggest that limiting overuse of unproven therapies in bronchiolitis will require focused efforts both nationally and locally.

REFERENCES

1. American Academy of Pediatrics Subcommittee on Diagnosis and Management of Bronchiolitis. Diagnosis and management of bronchiolitis. *Pediatrics*. 2006;118(4):1774–1793
2. Mansbach JM, Emond JA, Camargo CA Jr. Bronchiolitis in US emergency departments 1992 to 2000: epidemiology and practice variation. *Pediatr Emerg Care*. 2005;21(4):242–247
3. Pelletier AJ, Mansbach JM, Camargo CA. Direct medical costs of bronchiolitis hospitalizations in the United States. *Pediatrics*. 2006;118(6):2418–2423
4. Shay DK, Holman RC, Roosevelt GE, Clarke MJ, Anderson LJ. Bronchiolitis-associated mortality and estimates of respiratory syncytial virus—associated deaths among US children, 1979–1997. *J Infect Dis*. 2001;183(1):16–22
5. Corneli HM, Zorc JJ, Mahajan P, et al; Bronchiolitis Study Group of the Pediatric Emergency Care Applied Research Network (PECARN). A multicenter, randomized, controlled trial of dexamethasone for bronchiolitis [published correction appears in *N Engl J Med*. 2008;359(18):1972]. *N Engl J Med*. 2007;357(4):331–339
6. Csonka P, Kaila M, Laippala P, Iso-Mustajärvi M, Vesikari T, Ashorn P. Oral prednisolone in the acute management of children age 6 to 35 months with viral respiratory infection-induced lower airway disease: a randomized, placebo-controlled trial. *J Pediatr*. 2003;143(6):725–730
7. Fernandes RM, Bialy LM, Vandermeer B, et al. Glucocorticoids for acute viral bronchiolitis in infants and young children. *Cochrane Database Syst Rev*. 2010;10(10):CD004878
8. Mesquita M, Castro-Rodríguez JA, Heinichen L, Fariña E, Iramain R. Single oral dose of dexamethasone in outpatients with bronchiolitis: a placebo controlled trial. *Allergol Immunopathol (Madr)*. 2009;37(2):63–67.
9. Panickar J, Lakhanpaul M, Lambert PC, et al. Oral prednisolone for preschool children with acute virus-induced wheezing. *N Engl J Med*. 2009;360(4):329–338
10. Petruzella FD, Gorelick MH. Current therapies in bronchiolitis. *Pediatr Emerg Care*. 2010;26(4):302–307, quiz 308–311
11. Plint AC, Johnson DW, Patel H, et al; Pediatric Emergency Research Canada (PERC). Epinephrine and dexamethasone in children with bronchiolitis. *N Engl J Med*. 2009;360(20):2079–2089
12. King VJ, Viswanathan M, Bordley C, et al. Pharmacologic treatment of bronchiolitis in infants and children - a systematic review. *Arch Pediatr Adolesc Med*. 2004;158(2):127–137
13. Schuh S, Coates AL, Dick P, et al. A single versus multiple doses of dexamethasone in infants wheezing for the first time. *Pediatr Pulmonol*. 2008;43(9):844–850
14. Somers CC, Ahmad N, Mejias A, et al. Effect of dexamethasone on respiratory syncytial virus-induced lung inflammation in children: results of a randomized, placebo controlled clinical trial. *Pediatr Allergy Immunol*. 2009;20(5):477–485
15. Teeratakulpisarn J, Limwattananon C, Tanupattarachai S, Limwattananon S, Teeratakulpisarn S, Kosalaraksa P. Efficacy of dexamethasone injection for acute bronchiolitis in hospitalized children: a randomized, double-blind, placebo-controlled trial. *Pediatr Pulmonol*. 2007;42(5):433–439
16. Walsh P, Caldwell J, McQuillan KK, Friese S, Robbins D, Rothenberg SJ. Comparison of nebulized epinephrine to albuterol in bronchiolitis. *Acad Emerg Med*. 2008;15(4):305–313
17. Zhang L, Ferruzzi E, Bonfanti T, et al. Long and short-term effect of prednisolone in hospitalized infants with acute bronchiolitis. *J Paediatr Child Health*. 2003;39(7):548–551
18. Landman AB, Bernstein SL, Hsiao AL, Desai RA. Emergency department information system adoption in the United States. *Acad Emerg Med*. 2010;17(5):536–544
19. Todd J, Bertoch D, Dolan S. Use of a large national database for comparative evaluation of the effect of a bronchiolitis/viral pneumonia clinical care guideline on patient outcome and resource utilization. *Arch Pediatr Adolesc Med*. 2002;156(11):1086–1090
20. Knapp JF, Simon SD, Sharma V. Quality of care for common pediatric respiratory illnesses in United States emergency departments: analysis of 2005 National Hospital Ambulatory Medical Care Survey Data. *Pediatrics*. 2008;122(6):1165–1170
21. Chang YC, Ng CJ, Chen YC, Chen JC, Yen DHT. Practice variation in the management for nontraumatic pediatric patients in the ED. *Am J Emerg Med*. 2010;28(3):275–283
22. Damore D, Mansbach JM, Clark S, Ramundo M, Camargo CA Jr. Insurance status and the variable management of children presenting to the emergency department with bronchiolitis. *Pediatr Emerg Care*. 2010;26(10):716–721
23. Christakis DA, Cowan CA, Garrison MM, Molteni R, Marcuse E, Zerr DM. Variation in inpatient diagnostic testing and management of bronchiolitis. *Pediatrics*. 2005;115(4):878–884
24. Kotagal UR, Robbins JM, Kini NM, Schoettker PJ, Atherton HD, Kirschbaum MS. Impact of a Bronchiolitis Guideline. *Chest*. 2002;121:1789–1797
25. Moody-Williams JD, Krug S, O'Connor R, Shook JE, Athey JL, Holleran RS. Practice guidelines and performance measures in emergency medical services for children. *Ann Emerg Med*. 2002;39(4):404–412
26. Perlstein PH, Kotagal UR, Bolling C, et al. Evaluation of an evidence-based guideline for bronchiolitis. *Pediatrics*. 1999;104(6):1334–1341

27. Wilson SD, Dahl BB, Wells RD. An evidence-based clinical pathway for bronchiolitis safely reduces antibiotic overuse. *Am J Med Qual*. 2002;17(5):195–199
28. Hartling L, Scott-Findlay S, Johnson D, et al; Canadian Institutes for Health Research Team in Pediatric Emergency Medicine. Bridging the gap between clinical research and knowledge translation in pediatric emergency medicine. *Acad Emerg Med*. 2007;14(11):968–977
29. Barben J, Kuehni CE, Trachsel D, Hammer J; Swiss Paediatric Respiratory Research Group. Management of acute bronchiolitis: can evidence based guidelines alter clinical practice? *Thorax*. 2008;63(12):1103–1109
30. Mansbach JM, Espinola JA, Macias CG, Ruhlen ME, Sullivan AF, Camargo CA Jr. Variability in the diagnostic labeling of nonbacterial lower respiratory tract infections: a multicenter study of children who presented to the emergency department. *Pediatrics*. 2009;123(4). Available at: www.pediatrics.org/cgi/content/full/123/4/e573
31. Institute of Medicine of the National Academies. *Emergency Care for Children: Growing Pains*. 2007. Available at: www.iom.edu/Reports/2006/Emergency-Care-for-Children-Growing-Pains.aspx. Accessed March 5, 2012
32. Alak A, Seabrook JA, Rieder MJ. Variations in the management of pneumonia in pediatric emergency departments: compliance with the guidelines. *CJEM*. 2010;12(6):514–519
33. Knapp JF, Hall M, Sharma V. Benchmarks for the emergency department care of children with asthma, bronchiolitis, and croup. *Pediatr Emerg Care*. 2010;26(5):364–369
34. Mansbach JM, Clark S, Christopher NC, et al. Prospective multicenter study of bronchiolitis: predicting safe discharges from the emergency department. *Pediatrics*. 2008;121(4):680–688
35. Plint AC, Johnson DW, Wiebe N, et al. Practice variation among pediatric emergency departments in the treatment of bronchiolitis. *Acad Emerg Med*. 2004;11(4):353–360

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