RESEARCH ARTICLE

Antibiotic Use for Inpatient Bronchiolitis: Did National Guidelines Impact Practice at a Pediatric Hospital?

Alison Ashwini Lopez, MD, FRCPC,[a] Rana Aslanova, MD, PhD,[b] Natalie Bridger, MD, FRCPC,[b] Roger Chafe, PhD[b]

ABSTRACT

BACKGROUND AND OBJECTIVES: Bronchiolitis is a common lower respiratory tract infection that affects infants and young children. Because of variability in physician practice, inpatient management varies among pediatricians. In 2014, the Canadian Pediatric Society published national guidelines aimed at standardizing the inpatient management of this illness, which included recommending against the need for antibiotics for most patients. The study objective was to evaluate antibiotic prescription and supportive investigations for inpatient management of bronchiolitis before and after the publication of national guidelines.

METHODS: This study was a single-center retrospective chart review of inpatients with bronchiolitis. We included healthy children 1 to 24 months of age who were admitted from November 2011 to October 2016. Those admitted before December 2014 were analyzed in the preguidelines cohort; the remaining, in the postguidelines cohort. The main outcome was antibiotic prescription. The secondary outcome was the frequency of chest radiographs, nasopharyngeal swabs, and blood cultures.

RESULTS: A total of 131 patients were included in the first cohort; 71, in the second cohort. The rates of antibiotic initiation were almost equal in both cohorts (~44%; $P = .98$). More antibiotics were discontinued during hospitalization in the second cohort compared with the first cohort (10% vs 20%; $P = .001$). Significantly fewer patients were discharged with antibiotics in the second cohort (31% vs 16%; $P = .02$).

CONCLUSIONS: Our study revealed a reduction in antibiotic use after the release of national guidelines, illustrating that antibiotic prescribing practices can change. However, there is still a pressing need for local initiatives to continue to reduce the unnecessary use of antibiotics within the pediatric setting.

www.hospitalpediatrics.org
DOI:https://doi.org/10.1542/hpeds.2019-0230

Address correspondence to Alison Ashwini Lopez, MD, FRCPC, 303-108 23 Ave SW, Calgary, AB T2S 0J1, Canada. E-mail: alison.lopez17@gmail.com

HOSPITAL PEDIATRICS (ISSN Numbers: Print, 2154-1663; Online, 2154-1671).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: Funded by the Janeway Children's Hospital Foundation (project file 20171304).

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

[a]Independent scholar, Calgary, Alberta, Canada; and [b]Memorial University of Newfoundland, St. John's, Newfoundland and Labrador, Canada

Dr Lopez assisted in the study design, drafted the initial manuscript, collected the data, and revised the final manuscript; Dr Aslanova conducted the data analysis, provided support to the research assistants during data collection, and revised the final manuscript; Dr Bridger conceptualized the study, assisted in the study design, and revised the final manuscript; Dr Chafe assisted with the study design and revised the final manuscript; and all authors approved the final manuscript as submitted.

Bronchiolitis is a common lower respiratory tract infection that can result in inflammation, edema, necrosis of the epithelial cells lining the bronchioles, and increased mucus production.[1] It is commonly seen in children <2 years of age, with a peak in infections occurring between 3 and 6 months of age. Although the disease is generally self-limiting, the clinical presentation can be variable, with cases ranging from mild to severe respiratory distress. Bronchiolitis is typically caused by respiratory viruses, most commonly respiratory syncytial virus (RSV). Other causes include human metapneumovirus, adenovirus, enterovirus, influenza virus, and parainfluenza virus.[1,2] Coinfection with multiple viruses occurs in 10% to 30% of young children who are hospitalized.[3]

In 2014, both the American Academy of Pediatrics and the Canadian Pediatric Society (CPS) released clinical practice guidelines for the management of inpatients with bronchiolitis.[1,4] The guidelines were aimed at reducing the significant practice variations in the management of this condition across pediatric centers.[5] Both guidelines recommend against the routine use of antibiotics, except in cases in which there is a strong suspicion of a secondary bacterial infection; however, this is uncommon in otherwise healthy children with bronchiolitis.[1,4,6] Current recommended therapies are focused on supportive management, such as hydration, gentle nasal suctioning, and supplemental oxygen therapy.[1]

Antibiotic use for inpatients has been found to be influenced by patient age, whether they had chest radiography performed, or whether they had blood culture samples taken.[5] Previous initiatives to standardize care for bronchiolitis have revealed some positive changes in practices.[7–9] There is also evidence that identifying RSV in infants who were affected was independently associated with discontinuation of antibiotics during hospitalization; however, it is unclear whether the issuance of guidelines can affect the use of antibiotics.[10–12]

Our primary study aim was to examine antibiotic prescribing practices as part of the inpatient management of bronchiolitis at a single tertiary care pediatric hospital before and after the publication of the CPS guidelines in November 2014. Given concerns about the overuse of antibiotics as a major contributor to antibiotic resistance, we wanted to determine if the release of national guidelines was associated with a reduction in antibiotic use for this illness. For our secondary outcome, we evaluated the prevalence of supportive investigations commonly ordered to determine if the guidelines corresponded with a reduction in the investigations being ordered. Specifically, we assessed orders for chest radiographs (CXRs), nasopharyngeal swabs for multiplex respiratory virus polymerase chain reaction (PCR), and blood cultures done on admission to determine if the publication of guidelines corresponded with a reduction in other supportive investigations.

METHODS

We conducted a retrospective chart review on infants who were hospitalized at a pediatric hospital in eastern Canada. It is a medium-size pediatric hospital with ~34 000 emergency department patient visits and 1000 patients hospitalized annually, representing a wide range of pediatric conditions and injuries. The medical staff consists of a mix of specialist and general pediatricians. Potential cases were identified by using the records maintained by the hospital medical health records department. We included patients aged 1 to 24 months at the time of admission who were admitted between November 1, 2011, and October 31, 2016. To capture as many patients with probable bronchiolitis as possible, we screened all patients discharged with a most responsible diagnosis of bronchiolitis, viral lower respiratory tract infection, RSV, respiratory distress, or pneumonia (viral or bacterial). We confirmed patient eligibility for study inclusion by detailed review of medical records.

No specific interventions were implemented to reinforce the recommendations of the CPS guidelines at our hospital before this study.

Data Collection

A data abstraction sheet was developed by the research team on the basis of the study aims. Admission and discharge documentation were reviewed to determine eligibility and to extract basic demographic information (eg, age, sex, length of stay [LOS], and location of initial assessment). We documented features of clinical presentation, radiographic and microbiological investigations on admission, and transfer to intensive care after admission if applicable. For antibiotic prescription practices, we documented the antibiotics prescribed from the time of admission to discharge, including discharge prescriptions. For patients receiving antibiotics, we recorded the rationale for the initiation of or changes in antibiotic prescription if the information was available.

Statistical Analysis

We divided patients who met inclusion criteria into 2 cohorts on the basis of the publication date of the CPS position statement. The first cohort (preguidelines) included patients from November 1, 2011, to November 30, 2014, and the second cohort (postguidelines) included patients from December 1, 2014, to October 31, 2016. We also divided cohort patients into 2 age subgroups (0.08–1.00 years: 174 [86.1%]; 1.01–2.00 years: 28 [13.9%]). Our primary outcome was the frequency of antibiotic prescription: at admission, during patients' hospital stay (including change or discontinuation of antibiotic), and at discharge. Our secondary outcome was the frequency of CXRs, nasopharyngeal swabs for viral PCR, and blood cultures.

Baseline characteristics (age and sex) were summarized by using descriptive statistics, including mean and SD for continuous variables and proportions for categorical variables. Cohorts were compared by using the χ^2 test or Fisher's exact test for categorical variables and the t test for continuous variables. Fisher's exact test was applied when the expected cell counts were <5. Finally, a multivariate logistic regression was conducted to determine which factors were associated with the initiation and discontinuation of antibiotics

in all the included patients. All statistical analyses were conducted by using SPSS version 21.0 (IBM SPSS Statistics, IBM Corporation, Armonk, NY).

Ethical and institutional approvals for the study was granted by the provincial Health Research Ethics Authority (2015.272) and the regional Research Proposal Approval Committee.

RESULTS

We identified 233 patients in our initial chart review, with 202 patients meeting our inclusion criteria. Patients were excluded if they had chronic complex medical issues (eg, chronic lung disease, congenital heart defects, immunosuppression, etc) (10 patients), were born at <35 weeks' gestational age, and/or required home oxygen at baseline (12 patients). We excluded readmissions within a week from the time of the previous discharge on the presumption that these cases would be managed differently from the first admission (7 patients). We also excluded those who had radiographs revealing a lobar consolidation because this likely reflected primary bacterial pneumonia (2 patients). We did, however, include abnormal radiograph results in which a viral appearance was reported or early pneumonia could not be excluded.

Of the 202 patients include in the study, 131 (65%) were included in cohort 1 (preguidelines) and 71 (35%) were included in cohort 2 (postguidelines). Baseline demographics were similar between the 2 cohorts (Table 1). A total of 177 patients were admitted directly from our hospital's emergency department, with the remaining transferred from a peripheral hospital. Of the 202 patients, only 6 had intensive care admissions during their hospitalization.

Antibiotic Prescribing Practices

Antibiotics were prescribed in 89 (44%) study patients (Fig 1), which included 58 (44%) patients in cohort 1 and 31 (44%) patients in cohort 2 ($P = .98$). During their hospital stay, antibiotics were discontinued for 29 (33%) patients: 15 (26%) in cohort 1 and 14 (45%) in cohort 2 ($P = .08$). Discontinuation due to a viral cause occurred for 6 (10%) patients in the first cohort and 14 (45%) patients in the second cohort ($P = .001$). The main reason identified for initiation of antibiotics was presentation of patient with severe clinical symptoms. Regardless of the intervention, the percentage of patients discharged on antibiotics in cohort 1 was significantly higher than that in cohort 2 (41 [31%] vs 11 [16%]; $P = .02$). Comparison of age subgroups by the frequency of CXRs, nasopharyngeal swabs for viral PCR, and blood cultures did not reveal a significant difference between them. However, antibiotic therapy was significantly more often initiated among younger children compared with those at 1 year and older (70 [79%] vs 19 [21%], respectively; Fisher's exact test: $P = .008$). There were also no significant differences between patients who were hospitalized and those transferred to a PICU.

The most frequently prescribed antibiotic in cohort 1 was amoxicillin (18%), followed by ampicillin (12%). In cohort 2, ceftriaxone (16%) was most frequently prescribed antibiotic, followed by amoxicillin and ampicillin (9% each). During the hospital stay, the original antibiotic choice changed in cohort 1 for 25 (43%) patients and in cohort 2 for 4 (13%) patients ($P = .01$).

TABLE 1 Patient Demographics by Cohort

	Total Patients, *n* (%)	Male Sex, *n* (%)	Mean Age (SD), y	Mean LOS (SD), d
Cohort 1	131 (65)	79 (60)	0.48 (0.45)	3.3 (2.4)
Cohort 2	71 (35)	43 (61)	0.52 (0.47)	3.1 (2.3)

In total, 186 (92%) study patients had a CXR performed, with similar proportions in both cohorts (124 [95%] vs 62 [87%]; $P = .10$). Of the 37 (20%) patients whose CXR result was reported as possible or cannot exclude pneumonia, 32 (87%) had antibiotics prescribed. An additional 54 (36%) study patients received antibiotics despite a CXR result that was reported to be normal or consistent with viral pneumonia.

Of the study patients, 189 (94%) had nasopharyngeal swabs or aspirates performed to isolate a respiratory virus. There was no significant difference in the number of tests ordered in the cohorts (121 [92%] vs 68 [96%]). A total of 146 isolates had positive results, of which 117 (80%) were positive for RSV. Other viruses isolated were enterovirus, human metapneumovirus, adenovirus, and parainfluenza virus.

Blood cultures were ordered in 60 study patients, with similar proportions in both cohorts (37 [28%] vs 23 [32%]; $P = .63$). No blood cultures were reported to have positive results.

Multivariate Logistic Regression

We conducted a multivariate logistic regression to determine which factors were

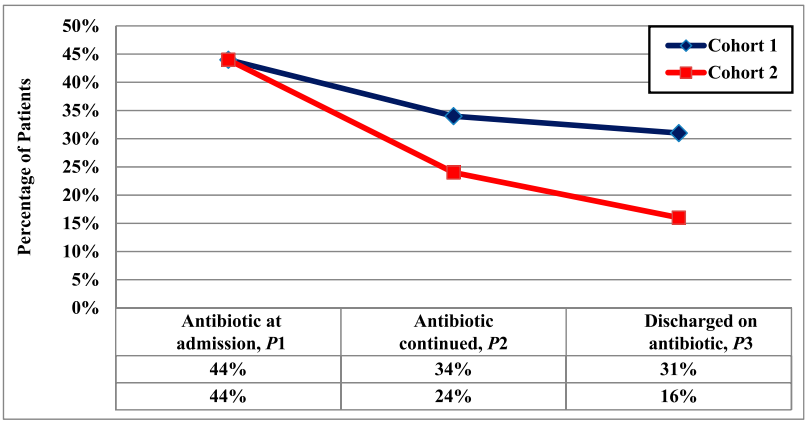

FIGURE 1 Comparison of antibiotic use between cohorts (*t* test). Two-sided *P* values were as follows: $P1 = .98$, $P2 = .001$ (95% confidence interval <0.001–0.003), and $P3 = .02$ (95% CI 0.25–0.28).

associated with initiation (Table 2) and discontinuation (Table 3) of antibiotics in all the study patients.

Children <1 year old, who had a LOS >3 days or who had a confirmed diagnosis of pneumonia were significantly more likely to receive an antibiotic prescription. Having a blood culture drawn was significantly associated with both initiation and discontinuation of antibiotics.

DISCUSSION

To our knowledge, this is the first Canadian study in which antibiotic prescribing practices at a pediatric center are compared before and after the publication of national guidelines recommending against the use of antibiotics for most cases of bronchiolitis. Baseline demographics and the number of supportive investigations ordered were similar for both cohorts (~44%). Our observation revealed that although antibiotics were initiated at approximately similar rates in both cohorts, there was a significant difference between them in other parameters, revealing better results in postguidelines cohort 2: treatment by antibiotic was discontinued due to a viral cause for more patients (45% vs 10%; $P = .001$), and the original antibiotic was changed for less patients (13% vs 43%; $P = .01$). There was also a reduction in the number of patients who remained on antibiotics during hospitalization (24% vs 34%; $P = .001$) and who were discharged on antibiotics (16% vs 31%; $P = .02$) after the publication of guidelines.

Our analysis of the interventions taken raises a number of interesting points for further discussion. It is unclear why the most common antibiotic prescribed in the second cohort was ceftriaxone. It is possible that those patients had a more severe illness at presentation or that there were other issues impacting the choice of antibiotic across the study time line. CXR findings are inconsistent in bronchiolitis and are known to lead to increased antibiotic use.[1] Under the current guidelines, radiographs are only recommended if there is concern for an alternative diagnosis or when the disease does not improve as expected.[1] We found that having a CXR result that could not exclude pneumonia was associated with a higher rate of antibiotic prescription (Table 2), which raises the following issue: To what extent should initiatives to improve antimicrobial stewardship focus on the investigations that may lead to unnecessary antibiotic usage? Although we found that having a blood culture drawn was significantly associated with both initiation and ultimate discontinuation of antibiotics, because none of the blood cultures taken for either cohort had positive results, it is likely that they did not have any clinical significances in the initiation and/or discontinuation of antibiotic prescriptions, which raises the issue of their usefulness in these cases.

The overuse of antibiotics for bronchiolitis is widespread. Despite published guidelines, reducing the use of antibiotics for this illness continues to be a challenge.[7,8,13–15] In their 2014 study, Parikh et al[16] offered clinically achievable benchmarks of care for asthma, bronchiolitis, and pneumonia in children. Encounters from 42 US hospitals included 14 882 patients from 2 months to 2 years of age with bronchiolitis. They did not observe a significant decrease in hospital investigations. They also stated that there are no currently accepted benchmarks for what constitutes best-in-class performance for quality measures and that hospitals that wish to improve their performance are faced with inventing goals for their improvement projects, with the potential achievable benchmarks of care for CXR being 32.4%; for viral testing, 0.06%; and for antibiotic administration,18.5%. Comparison of their achievable benchmarks with our recent numbers clearly reveals the work that needs to be done for local quality improvements.

National guidelines are an effective way of educating physicians and advocating for evidence-based practices; however, uptake among physicians is not uniform. Center-specific interventions, such as local clinical pathways and antimicrobial stewardship interventions, appear to have the biggest impact on decreasing the use of unnecessary resources for bronchiolitis.[14–20] Educational interventions are also an

TABLE 2 Variables Associated With Initiation of Antibiotics

Variables	β-Coefficient	OR (95% CI)	P
Age categories	−1.42	0.22 (0.07–0.67)	.01
LOS categories	1.32	1.37 (1.15–1.66)	<.001
Increased work of breathing	−.22	0.71 (0.30–1.66)	.42
Wheezing or crackles	.68	2.02 (0.95–4.32)	.07
Normal CXR result or viral appearance	−.20	0.93 (0.22–3.96)	.92
Confirmed diagnosis of pneumonia or probable pneumonia	2.89	0.059 (0.01–0.34)	.001
Blood culture	−1.99	0.154 (0.07–0.34)	<.001

Variables included in the multivariate model were age categories (0–1.00 and 1.01–2.00 y), LOS categories (1–3d and ≥4 d), increased work of breathing (tachypnea, indrawing or accessory muscle use, and nasal flaring), wheezing or crackles on physical examination, normal CXR result, confirmed diagnosis of pneumonia, and blood culture drawn on admission. CI, confidence interval; OR, odds ratio.

TABLE 3 Variables Associated With Discontinuation of Antibiotics

Variables	β-Coefficient	OR (95% CI)	P
Age categories	.41	1.37 (0.36–5.22)	.64
LOS categories	.47	1.16 (0.99–1.36)	.06
Normal CXR result or viral appearance	.36	1.57 (0.63–3.92)	.34
Blood culture	1.37	0.27 (0.12–0.63)	.003

Variables included in the multivariate model were age categories (0–1.00 and 1.01–2.00 y), LOS categories (1–3 d and ≥4 d), normal CXR result or viral appearance, and blood culture drawn on admission. CI, confidence interval; OR, odds ratio.

effective way to increase guideline compliance.[19,20] A study by Benhamida et al[19] revealed that interventions such as interprofessional team meetings and posting of a summary of guidelines in emergency and inpatient wards effectively reduced the use of unnecessary tests and therapies in bronchiolitis. At our center, no specific interventions were implemented to reinforce the recommendations of the CPS guidelines, which could have further increased their impact. Although we did find lower uses of antibiotics in the postguidelines cohort, it is difficult to determine the extent to which the guidelines themselves influenced practice. Overall, there is strong evidence that relying on passive dissemination of national guidelines alone is insufficient to change individual physician practice. The long-term sustainability of local implementation on physician practice, however, is not well studied.

In this study, we focused on antibiotic prescribing practices for patients hospitalized with bronchiolitis as a way of promoting inpatient antimicrobial stewardship at our hospital. Addressing ambulatory antibiotic prescription in this illness is equally relevant. Studies to assess clinical practices in emergency departments for the management of bronchiolitis revealed practices inconsistent with national guidelines.[14,21–23] Similar to inpatient studies, local implementation of guidelines in an emergency department can be successful and reduce health costs.[14] Other challenges encountered in emergency departments are parental pressure and high patient volumes that lead to inappropriate antibiotic prescription. Providing families with an information leaflet that highlights drugs that are ineffective against bronchiolitis could be a simple way to overcome this barrier.[8] Regardless of the intervention, it is crucial to have voluntary leadership of individuals who are willing to champion the changes targeted. Equally crucial is the interaction with all relevant medical staff. Physicians have their own perceptions and experience in managing common diseases, so interventions to change practice need to take such factors into account.

This retrospective study had a few limitations. We relied on admission and discharge documentation to determine the clinical status of our eligible patients. As in most teaching hospitals, the documentation is done by different medical personnel at varying levels of training and is therefore difficult to standardize. Reviewing the reports of CXRs was an important part of our eligibility process; however, in real life, the reports are not immediately available, and thus physicians may empirically treat perceived bacterial pneumonia. We did not analyze admissions to the ICU separately because the volume of patient admissions to the unit was too low. However, a recent survey of Canadian pediatric intensivists revealed that respondents would frequently use antibiotic initiation, especially if mechanical ventilation was required.[24] These findings highlight the challenge in changing practices for more severe cases of bronchiolitis. Because of how the data were recorded, we could not determine the number of patients who were prescribed an antibiotic before their hospitalization. Lastly, our study was focused on a single medium-sized children's hospital. Our findings therefore may not be reflective of larger centers or those with established antimicrobial stewardship programs.

CONCLUSIONS

Our study of a single tertiary care center did reveal a difference in the rate at which antibiotics were discontinued after the publication of national guidelines. In this study, we found that antibiotic prescribing practices can change for patients who are hospitalized with bronchiolitis. In this study, we also emphasize the need for local antimicrobial stewardship initiatives to further reduce unnecessary investigations and use of antibiotics within the pediatric setting. Further research should be targeted at inappropriate ambulatory antibiotic prescription for bronchiolitis and at ways to increase the impact of clinical practice guidelines across the country.

Acknowledgments

We thank Ms Sharon Penny and Mrs Alyona Lewis for their help with the data collection for this project.

REFERENCES

1. Friedman JN, Rieder MJ, Walton JM; Canadian Paediatric Society, Acute Care Committee, Drug Therapy and Hazardous Substances Committee. Bronchiolitis: recommendations for diagnosis, monitoring and management of children one to 24 months of age. *Paediatr Child Health*. 2014;19(9):485–498
2. Florin TA, Plint AC, Zorc JJ. Viral bronchiolitis. *Lancet*. 2017;389(10065):211–224
3. Paranhos-Baccalà G, Komurian-Pradel F, Richard N, Vernet G, Lina B, Floret D. Mixed respiratory virus infections. *J Clin Virol*. 2008;43(4):407–410
4. Ralston SL, Lieberthal AS, Meissner HC, et al. Clinical practice guideline: the diagnosis, management, and prevention of bronchiolitis [published correction appears in *Pediatrics*. 2015;136(4):782]. *Pediatrics*. 2014;134(5). Available at: www.pediatrics.org/cgi/content/full/134/5/e1474
5. 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
6. Farley R, Spurling GK, Eriksson L, Del Mar CB. Antibiotics for bronchiolitis in children under two years of age. *Cochrane Database Syst Rev*. 2014;(10):CD005189
7. Parikh K, Hall M, Teach SJ. Bronchiolitis management before and after the AAP guidelines. *Pediatrics*. 2014;133(1). Available at: www.pediatrics.org/cgi/content/full/133/1/e1
8. 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
9. Mittal V, Darnell C, Walsh B, et al. Inpatient bronchiolitis guideline implementation and resource utilization. *Pediatrics*. 2014;133(3). Available at: www.pediatrics.org/cgi/content/full/133/3/e730

10. Ferronato ÂE, Gilio AE, Ferraro AA, Paulis Md, Vieira SE. Etiological diagnosis reduces the use of antibiotics in infants with bronchiolitis. *Clinics (São Paulo)*. 2012;67(9):1001–1006

11. Chen IL, Huang HC, Chang YH, et al. Effect of antibiotic use for acute bronchiolitis on new-onset asthma in children. *Sci Rep*. 2018;8(1):6090

12. Papenburg J, Fontela PS, Freitas RR, Burstein B. Inappropriate antibiotic prescribing for acute bronchiolitis in US emergency departments, 2007-2015 [published online ahead of print January 17, 2019]. *J Pediatric Infect Dis Soc*.

13. Quintos-Alagheband ML, Noyola E, Makvana S, et al. Reducing antibiotic use in respiratory syncytial virus-A quality improvement approach to antimicrobial stewardship. *Pediatr Qual Saf*. 2017;2(6):e046

14. Johnson LW, Robles J, Hudgins A, Osburn S, Martin D, Thompson A. Management of bronchiolitis in the emergency department: impact of evidence-based guidelines? *Pediatrics*. 2013;131(suppl 1):S103–S109

15. Florin TA, Byczkowski T, Ruddy RM, Zorc JJ, Test M, Shah SS. Variation in the management of infants hospitalized for bronchiolitis persists after the 2006 American Academy of Pediatrics bronchiolitis guidelines. *J Pediatr*. 2014;165(4):786–792.e1

16. Parikh K, Hall M, Mittal V, et al. Establishing benchmarks for the hospitalized care of children with asthma, bronchiolitis, and pneumonia. *Pediatrics*. 2014;134(3):555–562

17. Montejo Fernández M, Benito Manrique I, Montiel Eguía A, Benito Fernández J. An initiative to reduce the use of unnecessary medication in infants with bronchiolitis in primary care [in Spanish]. *An Pediatr (Barc)*. 2019;90(1):19–25

18. 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

19. Benhamida M, Bihouee T, Verstraete M, Gras Le Guen C, Launay E. Retrospective audit of guidelines for investigation and treatment of bronchiolitis: a French perspective. *BMJ Paediatr Open*. 2017;1(1):e000089

20. Breakell R, Thorndyke B, Clennett J, Harkensee C. Reducing unnecessary chest X-rays, antibiotics and bronchodilators through implementation of the NICE bronchiolitis guideline. *Eur J Pediatr*. 2018;177(1):47–51

21. Perlstein PH, Kotagal UR, Schoettker PJ, et al. Sustaining the implementation of an evidence-based guideline for bronchiolitis. *Arch Pediatr Adolesc Med*. 2000;154(10):1001–1007

22. Ochoa Sangrador C, González de Dios J; Research Group of the aBREVIADo Project (Bronchiolitis–Study of Variability, Adequacy, and Adherence). Management of acute bronchiolitis in emergency wards in Spain: variability and appropriateness analysis (aBREVIADo Project). *Eur J Pediatr*. 2012;171(7):1109–1119

23. Gong C, Byczkowski T, Mcaneney C, Goyal MK, Florin TA. Emergency department management of bronchiolitis in the United States. *Pediatr Emerg Care*. 2019;35(5):323–329

24. Bradshaw ML, Déragon A, Puligandla P, Emeriaud G, Canakis AM, Fontela PS. Treatment of severe bronchiolitis: a survey of Canadian pediatric intensivists. *Pediatr Pulmonol*. 2018;53(5):613–618

Antibiotic Use for Inpatient Bronchiolitis: Did National Guidelines Impact Practice at a Pediatric Hospital?

Alison Ashwini Lopez, Rana Aslanova, Natalie Bridger and Roger Chafe

Hospital Pediatrics 2020;10;147
DOI: 10.1542/hpeds.2019-0230 originally published online January 17, 2020;

Hospital Pediatrics®

AN OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Antibiotic Use for Inpatient Bronchiolitis: Did National Guidelines Impact Practice at a Pediatric Hospital?

Alison Ashwini Lopez, Rana Aslanova, Natalie Bridger and Roger Chafe

Hospital Pediatrics 2020;10;147
DOI: 10.1542/hpeds.2019-0230 originally published online January 17, 2020;