Impact of Inpatient Bronchiolitis Clinical Practice Guideline Implementation on Testing and Treatment

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Objective To determine the association between institutional inpatient clinical practice guidelines (CPGs) for bronchiolitis and the use of diagnostic tests and treatments.

Study design A multicenter retrospective cohort study of infants aged 29 days to 24 months with a discharge diagnosis of bronchiolitis was conducted between July 2011 and June 2012. An electronic survey was sent to quality improvement leaders to determine the presence, duration, and method of CPG implementation at participating hospitals. The Wilcoxon rank-sum test was used to perform bivariate comparisons between hospitals with CPGs and those without CPGs. Multivariable analysis was used to determine associations between CPG characteristics and the use of tests and treatments; analyses were clustered by hospital.

Results The response rate to our electronic survey was 77% (33 of 43 hospitals). The majority (85%) had an institutional bronchiolitis CPG in place. Hospitals with a CPG had universal agreement regarding recommendations against routine tests and treatments. The presence of a CPG was not associated with significant reductions in the use of tests and treatments (eg, complete blood count, chest radiography, bronchodilator use, steroid and antibiotic use). A longer interval duration since CPG implementation and presence of an easily accessible online CPG document were associated with significant reductions in the performance of complete blood count and chest radiography and the use of corticosteroids. Other implementation factors demonstrated mixed results.

Conclusion Most children's hospitals have an institutional bronchiolitis CPG in place. The content of these CPGs is largely uniform in practice recommendations against tests and treatments. The presence of institutional CPGs did not significantly reduce the ordering of tests and treatments. Online accessibility of a written CPG and prolonged duration of implementation reduce tests and treatments. *(J Pediatr 2014;165:570-6)*.

Bronchiolitis is the most common reason for hospital admission in infants and children aged ≤2 years and accounts for more than $500 million in annual direct expenditures.[1-3] The mainstay of treatment for bronchiolitis is supportive care.[4] Despite the lack of evidence to support a role for routine diagnostic testing or interventions, performance of a complete blood count (CBC), bacterial cultures, and chest radiography (CXR),[5,6] as well as the use of bronchodilators,[7,8] corticosteroids,[9] and antibiotics,[10,11] are common in patients with bronchiolitis. Management of bronchiolitis varies widely among providers,[12-14] contributing significantly to hospital costs and length of stay (LOS).[15]

The implementation of clinical practice guidelines (CPGs) for bronchiolitis has been reported to result in reductions in diagnostic testing and treatment resources,[16-19] although not uniformly. A recent study reported significant reductions in LOS (by 17%), use of CXR (by 20%), and use of bronchodilators (30% reduction in use of at least 1 beta agonist) after bronchiolitis CPG implementation; however, antibiotic utilization was not affected.[17] These outcomes were achieved within 1 season and were sustainable for 3 years.[17,18] Another study reported successful CPG implementation with reductions in LOS (9%) and antibiotic use (27%).[19] A multisite study reported successful bronchiolitis CPG implementation from 1 hospital to 7 hospitals in a hospital system, with reductions in LOS, CXR, and mean number of bronchodilator doses.[17]

CPGs can help streamline care and reduce unnecessary variation in care; however, CPG implementation is complex. Although multiple implementation interventions have been described, implementation of CPGs requires a multifaceted approach.[20,21]

AAP	American Academy of Pediatrics
APR-DRG	All-patient refined diagnosis-related group
CBC	Complete blood count
CPG	Clinical practice guideline
CXR	Chest radiography
ED	Emergency department
ICD-9	*International Classification of Diseases, Ninth Revision*
LOS	Length of stay
PHIS	Pediatric Health Information System
RSV	Respiratory syncytial virus

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The objectives of the present study were to describe the prevalence and characteristics of inpatient hospital bronchiolitis CPGs, identify commonly used strategies for CPG implementation, and determine factors associated with decreased resource utilization.

Methods

This was a retrospective cohort study of children aged 29 days to 24 months with bronchiolitis hospitalized in US children's hospitals between July 1, 2011, and June 30, 2012. The age range of subjects was based on the American Academy of Pediatrics (AAP) CPG for management of bronchiolitis.

We obtained data regarding the availability, characteristics of CPG implementation, and implementation date of the institutional CPG for management of bronchiolitis by surveying the Chief Quality Officers at Children's Hospital Association hospitals that contribute data to the Pediatric Health Information System (PHIS) database (**Appendix**; available at www.jpeds.com). Hospitals with a bronchiolitis CPG were requested to submit a copy of that CPG to the study team.

We identified bronchiolitis-related hospitalizations and evaluated resource utilization using the PHIS database, which contains deidentified administrative data, including patient demographic information, diagnosis and procedure codes, and line item charges from 43 freestanding tertiary care children's hospitals across the US. The charges at each hospital are mapped to a common set of codes that include imaging studies, clinical services, laboratory tests, pharmacy, supplies, and room charges. Encrypted medical record numbers allow the tracking of individual patients across admissions. The Children's Hospital Association and participating hospitals jointly ensure data quality, as described previously.[22]

In accordance with Common Rule (45 CFR 46.102[f]) and the policies of University of Texas Southwestern Medical Center and Cincinnati Children's Hospital Medical Center Institutional Review Boards, this research, using a deidentified dataset, was not considered human subject research.

Study patients were identified within the PHIS database as those with an all-patient refined diagnosis-related group (APR-DRG) of bronchiolitis and respiratory syncytial virus (RSV) pneumonia (APR-DRG 138) and either a primary diagnosis of acute bronchiolitis due to RSV (*International Classification of Diseases, Ninth Revision* [ICD-9] code 466.11 or 466.19) or a secondary diagnoses of acute bronchiolitis due to RSV (ICD-9 code 466.11 or 466.19), where the primary ICD-9 discharge diagnosis was 1 of the following: pneumonia unspecified or due to RSV, dehydration, respiratory failure, viral pneumonia, influenza with other respiratory manifestation, urinary tract infection, or acute upper respiratory infection.

Patients with a complex medical condition[23] (eg, prematurity, chronic lung disease), technology dependence,[24] or intensive care unit admission were excluded because they were not CPG-eligible. Patients with interhospital transfer were excluded owing to a lack of available pretransfer data. Previous authors have used ICD-9 codes and/or APR-DRGs for bronchiolitis to identify the cohort.[14,16,18] ICD-9 code assignments for bronchiolitis have been validated previously.[25]

Exposures

The measured exposures of interest were presence or absence of a CPG for the management of children with bronchiolitis, time that the CPG was in place, and methods of CPG implementation. Survey questions identified the measured exposures. The implementation factors surveyed included easy online accessibility of a written CPG, use of evidence summaries, order sets, a pathway algorithm, provider education, identification and sharing of outcome metrics, and performance of plan-do-study-act cycles. Two of the coauthors (V.M. and S.S.) independently reviewed each CPG to identify the content using a structured abstraction form. Any discrepancies were resolved by group consensus. The CPG content was reviewed for inclusion/exclusion criteria and recommendations for and against tests and treatments.

Outcomes

The measured outcomes were the proportion of patients at hospitals undergoing diagnostic tests and treatments performed. The PHIS database was used to determine hospital-level resource utilization for diagnostic tests and treatments. Resource utilization included both emergency department (ED) and inpatient utilization. Diagnostic tests included CBC, blood culture, urine culture, and CXR.

We did not include viral testing as an outcome measure, because testing decisions may be determined by hospital factors (eg, infection control policies) rather than patient or physician factors. Treatments studied were the use of any bronchodilator, corticosteroid, or antibiotic. Bronchodilators included albuterol, levalbuterol, and racemic epinephrine when administered by inhalation. Corticosteroids and antibiotics were included when administered by oral, intravenous, or intramuscular routes.

Statistical Analyses

Because of their nonnormal distributions, continuous factors were summarized as median (IQR). Bivariate comparisons between hospitals with a CPG and those without a CPG were made using the Wilcoxon rank-sum test. Categorical factors were summarized as frequencies with percentages and then compared using the χ^2 test. The association between CPG characteristics (ie, presence, duration, and implementation method) and the use of diagnostic tests and treatments was estimated at the hospital and patient levels using generalized estimating equations, adjusting for age, sex, race, payor, disposition, and admission through the ED while controlling for hospital clustering. aORs with associated 95% CIs were calculated.

All statistical analyses were performed with SAS version 9.3 (SAS Institute, Cary, North Carolina). A P value $<.05$ was considered statistically significant.