Standardizing the Care of Bronchiolitis

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Objective: To study the effect of an educational intervention on the management of hospitalized infants with bronchiolitis.

Design: Sequential, prospective cohort study.

Setting: A 235-bed children's hospital with nearly all private rooms.

Patients: Consecutively admitted, previously healthy children younger than 24 months with symptoms of bronchiolitis. The first cohort was enrolled between January 1 and January 21, 1996; the second cohort between January 29 and February 18, 1996, following a 1-week intervention period; the third (follow-up) cohort between December 1996 and February 1997.

Intervention: Educational program and practice guidelines aimed at appropriate utilization of diagnostic tests, decreased antibiotic and bronchodilator use, increased compliance with isolation, decreased length of stay, and maintenance of quality care.

Main Outcome Measures: Utilization of respiratory syncytial virus (RSV) enzyme immunoassay, initiation and duration of parenteral antibiotic therapy, number of nebulized bronchodilator treatments, isolation orders, length of stay, and readmission rate.

Results: A total of 90 patients were studied preintervention, 63 postintervention, and 90 during the follow-up period. The groups were comparable in demographic and clinical features. No patient had a documented serious bacterial infection; however, almost half in each group received parenteral antibiotics, despite recommendations against this. Immediately postintervention, children with positive RSV test results received antibiotics on fewer days than other children (median 0.6 vs 2.4 days; \( P = .004 \)), suggesting that physicians stopped treatment with antibiotics once a viral diagnosis was confirmed. This effect did not persist into the follow-up period. Viral testing was reduced and isolation orders increased. Use of bronchodilators was reduced from 91% preintervention to 80% during the follow-up period (\( P = .046 \)), and the median number of treatments was reduced from 15.0 to 10.0 (\( P = .005 \)). There was no change in length of stay, which was 2 to 3 days, or in readmission rate, which was 1% to 4%.

Conclusion: Educational efforts centered around practice guidelines can improve some aspects of the treatment of patients hospitalized with bronchiolitis.

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Editor’s Note: You can teach old dogs (or young pups) new tricks, but it doesn’t last long, unless . . . What?

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PATIENTS AND METHODS

STUDY DESIGN

The initial phase took place during the first 7 weeks of 1996: a preintervention period that was from January 1 to January 21; an education and washout period from January 22 to January 28; and a postintervention period that was from January 29 to February 18. Consecutively admitted children younger than 24 months were included in the study if they were previously healthy and had a physician-assigned admission diagnosis of bronchiolitis and/or signs and symptoms of bronchiolitis (ie, upper respiratory tract symptoms progressing to lower respiratory tract disease manifested by tachypnea, retractions, wheezing, crackles, cyanosis, or apnea). Children hospitalized during the washout period were excluded, as were children with prior hospitalizations for respiratory illness or major underlying conditions such as prematurity (<36 weeks’ gestation), congenital heart disease, asthma, and cystic fibrosis. Nearly all of the children were admitted from the emergency department.

The follow-up study group was assembled by identifying every fifth bronchiolitis admission during the next respiratory syncytial virus (RSV) season, from December 1996 through February 1997. These patients were screened for inclusion using the above criteria and consecutively added to the study population until there were 90 in the group.

PRACTICE GUIDELINES

The study was conducted at Kosair Children’s Hospital, a 235-bed, free-standing pediatric facility with nearly all private rooms in Louisville, Ky. The guidelines were based on our extensive review of the English-language literature concerning diagnosis and treatment of RSV infection and bronchiolitis. These guidelines were reviewed and approved by representative hospital-affiliated specialists in infectious diseases, pulmonology, intensive care, emergency medicine, clinical microbiology, and infection control. In addition, the guidelines were approved by the medical staff patient care and laboratory committees. The goals were maintenance of quality care; appropriate utilization of diagnostic RSV enzyme immunoassay; decreased use of antibiotics and nebulized bronchodilators; increased compliance with isolation precautions; and decreased length of stay. They were written in a black-on-white, easy-to-read format on the front and back of 1 page. Six different management areas were addressed in separate boxes; recommendations were written on the left side and comments on the right. References were not included for simplicity but were available on request.

Based on the first year’s experience and an updated literature review, the guidelines were modified prior to the next RSV season (see Figure for revised version). Principal changes included the addition of stronger statements that blood culture and empiric antibiotics are not routinely indicated; highlighting in a box at the top of the document the recommendation that all patients with symptoms of respiratory viral infection be isolated; consolidation into a single box all the respiratory care recommendations; inclusion of a stronger statement to limit duration of bronchodilator therapy; and use of a bright color format.

EDUCATIONAL PROGRAM

The guidelines were initially disseminated in a week-long educational period during a community-wide outbreak of RSV infection. They were mailed to all community pediatricians, university pediatric faculty, and house staff physicians. One of the investigators reviewed the guidelines with emergency department physicians at a single visit and with house staff at morning report (3 sessions, 30 minutes each). The guidelines were also reviewed briefly at grand rounds and posted in physician charting areas. Compliance with these guidelines was entirely voluntary and was not audited. For the follow-up study, revised guidelines were mailed out and posted, and these were briefly reviewed at a departmental conference.

MEASURES

Clinical and demographic data were abstracted from patients’ charts and computerized laboratory records onto standardized forms. The management of children hospitalized with bronchiolitis was compared before (1996 preintervention) and after (1996 postintervention) the educational period. In the follow-up study, the management of children hospitalized from December 1996 through February 1997 (1997 follow-up) was compared with patients in the 1996 preintervention group. The following outcomes were assessed: (1) utilization of RSV enzyme immunoassay tests; (2) duration of parenteral antibiotic therapy; (3) number of nebulized bronchodilator treatments; (4) isolation precaution orders; (5) length of hospital stay; and (6) readmission rate.

STATISTICAL ANALYSIS

The chi-square or Fisher exact test was used for comparison of categorical variables. Continuous data were compared using the Mann-Whitney U test. A P value less than .05 defined significance.

GROUP CHARACTERISTICS

Ninety, 63, and 90 children were enrolled in the 1996 preintervention, 1996 postintervention, and 1997 follow-up groups, respectively. As shown in Table 1, children in the latter 2 groups were demographically similar to the 1996 preintervention group. Severity of illness in these groups, indicated by respiratory rate, oxygen saturation, and need for oxygen therapy, was comparable as well. The only statistically significant difference was a higher proportion of private patients in the 1997 follow-up group. Clinical reasons to suspect serious bacterial infection, namely, fever and an elevated white blood cell count, were also equivalent. No child in this study received ribavirin.

INITIAL STUDY

The RSV enzyme immunoassay test was recommended if the results would influence patient care (eg, facilitate discontinuation of antibiotic therapy). In the 1996 preintervention period, 78% (70/90) of patients were tested (Table 2). About half of the patients had blood cultures.
Bronchiolitis practice guidelines (front and back of form). Explanations of abbreviations are as follows: CXR, chest radiograph; RSV EIA, respiratory syncytial virus enzyme immunoassay; VRP, viral respiratory panel (centrifugation enhanced cellular immunofluorescence for RSV, influenza types A and B, parainfluenza types 1, 2, and 3, and adenovirus); Chem-7, electrolyte panel; CBC, complete blood count; PDR, polymerase chain reaction; WBC; white blood cell count; PICU, pediatric intensive care unit; TCU, transitional care unit; IV, intravenous; RR, respiratory rate; and IVF, IV fluids.

taken, despite discouragement of this practice; no blood cultures were positive for organisms. Half of all the patients were treated with parenteral antibiotics, and there was no difference in median duration of antibiotic therapy in RSV-positive children as compared with all others (ie, RSV-negative children and those who were not tested; Table 3). In the 1996 postintervention period, 59% (37/63) of patients were tested for RSV (P = .01; Table 2). The decision to test appeared to be unrelated to the decision to start parenteral antibiotic therapy, as an equal proportion of children were treated with antibiotics in both study periods (likewise, an equal proportion had blood cultures taken). However, the duration of parenteral antibiotic therapy in the 1996 postintervention group was much shorter in patients diagnosed with RSV than in other patients (median 0.6 vs 2.4 days, P = .004; Table 3).

Nebulized bronchodilators were recommended for 1 to 2 days after an initial trial. Although a similarly high
proportion of patients in both 1996 study periods were started on treatment using nebulized bronchodilators (91% and 86%; Table 2), the median number of treatments was significantly fewer postintervention (15.0 vs 11.0; \( P = .03 \)). In addition, orders for isolation precautions were written more frequently (23% vs 41%, \( P = .02 \); Table 2). Median length of stay was 3.0 days preintervention and 2.0 days postintervention (\( P = .23 \)), and the number of children requiring readmission within 1 month did not change appreciably (4 vs 1, \( P = .65 \)).

**FOLLOW-UP STUDY**

Persistent effects were seen during the 1997 follow-up study when compared with the 1996 preintervention period; in some cases the effect was more pronounced (Table 2). For example, orders for isolation were written in 53% (48/90) of the cases (\( P < .0001 \)) and RSV testing was done in only 40% (36/90) of the cases (\( P < .0001 \)). Fewer children received bronchodilators (80% [72/90], \( P = .046 \)) and the total number of treatments per patient remained as low as in the 1996 postintervention period (total number of treatments: 10.0, \( P = .005 \)). There was no appreciable change in length of stay or readmission rate. Also, no change was seen in the proportion of children from whom a blood culture was taken (44% [40/90]) or who received parenteral antibiotics (43% [39/90]), or in the duration of parenteral antibiotic therapy (2.0 days). Duration of antibiotic therapy was the same for RSV-positive patients as for all others (1.9 vs 2.0 days, \( P = .83 \); Table 3). None of the blood cultures were positive for pathogens.

**COMMENT**

Standardizing clinical practice through guidelines-based education has the potential to increase quality, reduce inappropriate care, and improve organization and completeness. Conditions targeted for this type of intervention should have high prevalence, high care burden, high cost, and notable variation in treatment and outcome. While bronchiolitis meets many of these criteria, guidelines from authoritative agencies like the American Academy of Pediatrics, the Agency for Health Care Policy and Research, or the National Institutes of Health Consensus Development Program have not been published. Local guidelines, such as those used in this study, may be developed with less rigor than those is-
sued from large national bodies. Nevertheless, in the current study, a standard approach was followed. First, recommendations for diagnostic tests and treatments were based on well-designed clinical studies or published expert opinion. Second, the guidelines were implemented as clinically relevant and flexible suggestions applicable to most children with bronchiolitis, preserving physician autonomy. Third, recommendations and comments were summarized in a simple and direct document. Fourth, the guidelines were disseminated during a community-wide outbreak of bronchiolitis, when physicians were most likely to be receptive. Finally, the guidelines were supported by an educational campaign.

One hundred nine (45%) of the 243 children in this study were empirically treated with parenteral antibiotics (this reflects an international trend: in a recent Canadian study, 60% of previously healthy children with bronchiolitis were given antibiotics). No child in the current study had proven bacteremia. Despite this confirmation that serious bacterial infection is rare in bronchiolitis, the educational intervention failed to alter practice with respect to empiric initiation of parenteral antibiotics. Not surprisingly, initiation of antibiotic therapy was strongly associated with chest x-ray film findings of infiltrate or atelectasis during each period (data not shown). A recent article documented a high prevalence of otitis media in patients with bronchiolitis. While this may be an indication for antibiotic therapy, presumably oral rather than parenteral agents could be used.

Testing for RSV was recommended if the results would affect patient management. Among children started on parenteral antibiotic therapy postintervention, those who tested positive for RSV received fewer days of therapy than other children, suggesting that physicians stopped treatment with antibiotics once a viral diagnosis was confirmed. In a sense, the guidelines may have unmasked the potential for viral diagnostic tests to influence antibiotic use. This is an important observation given the current climate of antibiotic overuse and emerging resistance. Unfortunately, the effect was not sustained during the follow-up period, despite stronger language in the revised guidelines. The most desirable solution would be to initiate fewer antibiotic courses in patients with viral illnesses. Offering rapid viral diagnostic tests around the clock could facilitate this, and the cost might be offset by dollars saved in other ways.

Physicians may feel pressure from parents and nursing staff to render some form of treatment for bronchiolitis. Bronchodilators are among the more common treatments used, but they are expensive, of only modest clinical benefit in a subset of patients, and have not been shown to reduce morbidity or length of hospital stay. In the current study, reduced bronchodilator therapy was seen postintervention and during the follow-up period, without consequent increases in length of stay or readmission rates. Some children may have been readmitted to other institutions, but this is unlikely since few other hospitals in the region admit children. Alternatively, some children may have required further treatment at their physicians' offices. It should be mentioned that 86% of children in the Canadian study were treated with bronchodilators, and nearly all members of the European Society for Paediatric Infectious Diseases use bronchodilators in children with bronchiolitis. Limiting bronchodilator use might therefore result in large-scale cost savings. The intervention program also resulted in reduced viral testing and better compliance with isolation orders.

The median length of stay of 3.0 days preintervention was not reduced by the intervention. However, this length of stay compares favorably with mean values reported from the United States (3.4 days) and Canada (4.6–6.7 days). It is possible that 2 or 3 days represent the lower limit achievable for bronchiolitis. It is important to emphasize that the length of stay did not increase despite less viral testing and less bronchodilator use. Hospital costs did not change as a result of the intervention. However, there may have been competing factors involved. For example, savings resulting from fewer bronchodilator treatments may have been offset by the increased costs of respiratory isolation. A detailed cost-benefit analysis was not possible because the costs of the intervention were not recorded.

There are other limitations of this study. First, it is difficult to ascertain whether the written guidelines or the educational program were responsible for changes in patient management. Regardless, it is unlikely practice guidelines would be instituted without concomitant educational interventions. Second, educational efforts were directed mostly at physicians and some ancillary personnel. Nurses and respiratory therapists could have influenced patient care by requesting that physicians order treatments or by making recommendations about disposition. Future studies should include these health care workers in guideline development and implementation. Third, indices of quality other than readmission rate, such as subsequent outpatient visits, absence from day care, or parental absence from work, were not assessed. Finally, this study examined only previously healthy infants. Treatment for these children was easier to standardize because they were at low risk of serious complications.

An educational program centered around practice guidelines for the treatment of patients with bronchiolitis reduced viral testing, increased compliance with isolation orders, and reduced the use of bronchodilators. These effects persisted into the subsequent respiratory viral season. There was no reduction in the initiation of parenteral antibiotic therapy, but in the immediate postintervention period, physicians appeared to curtail the duration of antibiotic therapy if RSV was identified. This

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### Table 3. Duration of Parenteral Antibiotic Use*

<table>
<thead>
<tr>
<th></th>
<th>1996 Preintervention Period (n = 90)</th>
<th>1996 Postintervention Period (n = 63)</th>
<th>1997: Follow-up Period (n = 90)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive RSV test</td>
<td>1.6 (20)†</td>
<td>0.6 (11)</td>
<td>1.9 (8)</td>
</tr>
<tr>
<td>All others</td>
<td>1.9 (23)</td>
<td>2.4 (16)</td>
<td>2.0 (31)</td>
</tr>
<tr>
<td><em>P</em></td>
<td>.72</td>
<td>.004</td>
<td>.83</td>
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</tbody>
</table>

*Includes all of the children initially given parenteral antibiotics. RSV indicates respiratory syncytial virus.
†Indicates the median number of days with the number of patients given parenterally.
study demonstrated the potential for an educational intervention to address public health problems such as emerging antimicrobial resistance and to concomitantly meet the needs of health care consumers by standardizing patient treatment. Future studies could define, then capitalize on, the most effective components of educational interventions such as the one presented herein.

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REFERENCES