Effect of an educational program on the treatment of RSV lower-respiratory-tract infection

KEVIN PURCELL AND JAIME FERGIE

Respiratory syncytial virus (RSV) is the most common cause of hospitalization for lower-respiratory-tract infection in infants and young children. RSV infection has been associated with 50-90% of hospitalizations for bronchiolitis and 5-40% of pneumonia-related hospitalizations. In 1985, the Institute of Medicine estimated that approximately 90,000 infants and children younger than five years of age were hospitalized annually in the United States for RSV bronchiolitis or pneumonia at a cost of about $300 million per year. More recent estimates using hospitalization rates from 1994 to 1996 and hospitalization costs in 1998 dollars place these figures at 113,000-182,000 annual admissions at a cost of $800 million-$1.2 billion per year.

Previously healthy infants and young children hospitalized for RSV infection usually improve within a few days with only supportive care, and the mortality rate is less than 1%. However, many of these infants and young children receive antimicrobials and ribavirin, adding to the cost of hospitalization. Although antimicrobials have been shown to be of no benefit in the treatment of bronchiolitis, a prospective study in Canada revealed that 57-81% of infants with bronchiolitis receive antimicrobials. In addition, there is evidence that treatment of RSV lower-respiratory-tract infection with broad-spectrum intravenous antimicrobials actually increases the risk of infection. The results before and after the educational program were compared.

Ribavirin was prescribed for 37.9% of patients before the program, and only 9.0% received it afterward (p < 0.001). Before the program, 24.8% of patients with no risk factors received ribavirin compared with 1.6% of patients after the program (p < 0.001). However, more patients with three or more risk factors for morbidity and mortality received ribavirin before the program than afterward (97.8% versus 39.2%, respectively). A broad-spectrum i.v. antimicrobial was prescribed for 85.6% of patients before the program while 60.6% received one afterward (p < 0.001). The cost savings for ribavirin and antimicrobials during the three-year period after the program were $1,235,484 and $34,839, respectively. Hospital length of stay decreased from 5.6 to 5.1 days (p < 0.001). No readmissions occurred during the study period.

A multifaceted educational intervention program may have been somewhat effective in modifying physician’s prescribing habits for the treatment of RSV lower-respiratory-tract infection.
bacterial superinfection.9 Also, because of the controversy surrounding the clinical effectiveness and cost benefit of ribavirin, the American Academy of Pediatrics (AAP) Committee on Infectious Diseases developed guidelines for the appropriate use of ribavirin.10-12 A recent review of the effectiveness of ribavirin therapy concluded that the existing clinical trials lacked the power to provide useful information.13 However, a meta-analysis showed that ribavirin reduced length of mechanical ventilator support and may reduce days of hospitalization.

Publication of consensus statements or practice guidelines alone has not been effective in changing physicians' practice patterns.14,15 However, implementation of guidelines for ribavirin therapy16 and for inpatient care of infants with bronchiolitis17 has been shown to decrease inappropriate use of antimicrobials and ribavirin and reduce costs. In addition, educational programs targeting physicians have been effective in changing physician prescribing habits and improving rational drug therapy, especially those using face-to-face personal educational visits with pharmacist or physician experts (academic detailing).18-25 Many programs have specifically attempted to change physicians' antimicrobial prescribing patterns.26-32 Interventions using three or more educational strategies may be more effective than single- or double-method approaches,21 and the components of an ideal academic detailing program have been described.33

During the early 1990s, ribavirin was the number-one drug expenditure in the annual pharmacy drug budget at Driscoll Children's Hospital (DCH). Also, most infants and young children hospitalized with RSV lower-respiratory-tract infections received i.v. broad-spectrum antimicrobials. A multifaceted educational intervention program was jointly designed and implemented during the 1994-95 RSV season by the department of pharmacy and the pediatric infectious diseases service. The primary objective of this program was to improve the appropriateness of ribavirin and antimicrobial prescribing in infants and young children hospitalized with RSV bronchiolitis or pneumonia.

Methods

Setting. DCH is a nonprofit, 200-bed, tertiary care pediatric teaching hospital in Corpus Christi, Texas. There is no traditional teaching service run by attending physicians on university faculties and pediatric medical residents as seen at academic health centers. All patients are managed by private practice community pediatricians. Patient care decisions are made primarily by these community pediatricians, although pediatric medical residents have input into the decision-making process. The population of attending physicians was relatively stable during the study period. Most of the community pediatricians were graduates of DCH's pediatric residency training program. In addition, the same pediatricians covered many of the emergency room shifts.

Patients. The medical records of all infants and children admitted over seven RSV seasons (from July 1, 1991, through June 30, 1998) with RSV lower-respiratory-tract infection were reviewed. Only those patients with laboratory test-confirmed RSV infection were included in this study. During the seven RSV seasons, the hospital's policy required all patients with lower-respiratory-tract illnesses to be tested for RSV. Subjects were identified via a medical records search for International Classification of Diseases, Ninth Edition (ICD-9) discharge diagnoses of RSV bronchiolitis or RSV pneumonia as either the primary or secondary diagnosis. Patients with a positive RSV rapid antigen test or a nasopharyngeal viral culture recorded in the history and physical examination or in the laboratory results section were entered into the study. There were no age limit criteria for study entry. However, RSV lower-respiratory-tract infection typically affects infants and young children less than two years of age and is rarely reported in patients older than three years. No clinical scoring system was used to estimate disease severity in patients at admission as this is difficult to do in a retrospective study.

Study design. The institutional review board at DCH approved this research project. The effect of the educational program was measured retrospectively by comparing data collected from the three RSV seasons before 1994-95 with data from the three seasons afterward. Data were collected on age, sex, date of admission, length of stay, pediatric intensive care unit (PICU) admissions, readmissions, ribavirin use, antimicrobial use, sepsis or meningitis workup results upon admission, and risk factors for increased morbidity and mortality as defined in the 1993 AAP guidelines.11 Antimicrobial use was defined as the prescribing of a broad-spectrum i.v. antimicrobial (e.g., second- or third-generation cephalosporin) in the initial admission orders or during the first day of hospitalization. Oral antimicrobials were not considered. Subsequent physician orders were reviewed to determine if the i.v. antimicrobial was discontinued. A sepsis workup included both blood and urine cultures, while a meningitis workup included blood, urine, and spinal fluid cultures. Only cultures obtained on admission (first day of hospitalization) were included. This was done to limit the study to concurrent serious bacterial infections present at admission and exclude nosocomial infections.

For comparative purposes, only drug therapy costs were calculated in this study. Drug therapy costs did not include administration costs. The cost of ribavirin therapy was based solely...
on 1994 figures. The 1994 acquisition cost for the drug alone was approximately $1100 per 6-g dose. An average acquisition cost of $25 per patient per day was used for the various broad-spectrum i.v. antimicrobials (primarily third-generation cephalosporins). The estimated cost savings for ribavirin for the included patients during the three-year period after implementation of the program were calculated by using the following equation:

\[
\text{Ribavirin cost savings} = [(D_1 \times P_1) - (D_2 \times P_2)] \times N \times T
\]

where \(D_1\) is the average number of doses per treated patient in 1991–94, \$1100 is the cost per dose, \(P_1\) is the percentage of patients who received ribavirin in 1991–94, \(D_2\) is the average number of doses per treated patient in 1995–98, \(P_2\) is the percentage of patients who received ribavirin in 1995–98, and \(N\) is the number of patients hospitalized with RSV infection in 1995–98. This equation subtracts the actual cost of ribavirin use in 1995–98 from the projected cost of treating patients if the ribavirin prescribing rate and the average number of doses per patient per admission had remained the same as those in 1991–94. The estimated cost savings for antimicrobials for the three-year period after the intervention were similarly calculated using the following equation:

\[
\text{Antimicrobial cost savings} = [(S25 \times P_1) - (S25 \times P_2)] \times N \times T
\]

where \$25 is the average cost per patient per day, \(P_1\) is the percentage of patients treated with antimicrobials for RSV in 1991–94, \(P_2\) is the percentage of patients treated in 1995–98, \(N\) is the number of patients hospitalized with RSV infection in 1995–98, and \(T\) is the average number of days of hospitalization for RSV patients in 1995–98. This equation subtracts the actual cost of treating these patients in 1995–98 from the projected cost of treating them if the antimicrobial-prescribing rate had remained the same as that in 1991–94.

**Interventions.** The educational intervention program was multidimensional, used several educational strategies, and targeted both attending physicians and medical residents. All education was conducted by the authors who, at the time of this study, were the director of clinical pharmacy services and the director of pediatric infectious diseases. In addition, both authors were faculty members in the department of medical education and had teaching responsibilities for the more than 40 medical residents enrolled in the pediatric residency training program.

Attending physicians were educated about RSV management through grand rounds, continuing-education programs at Corpus Christi Pediatric Society meetings, presentations at hospital committee meetings (pharmacy and therapeutics, pediatric medical care evaluation, and department of pediatrics), and a mailing that included a cover letter and a copy of the AAP guidelines for ribavirin use.11 The cover letter provided hospital cost and patient charge data for ribavirin and encouraged the appropriate use of ribavirin. The letter also stated that the AAP guidelines would be posted in the prescribing areas of all inpatient wards as a convenient reminder. Pediatric medical residents were educated through morning report discussions, journal club presentations, noon conference lectures, teaching rounds, and grand rounds. Residents were included in the educational program because of their potential ability to influence attending physicians’ prescribing patterns when making daily rounds with them by reminding them about the guidelines. Furthermore, at least one or two senior residents per year join local pediatric practices after graduation.

A group of pediatric medical residents conducted a research project examining the current state of RSV management at DCH. The authors acted as the faculty advisors for this resident research project and educated this group of residents about appropriate RSV management. Data were collected retrospectively on all infants and young children hospitalized for treatment of RSV lower-respiratory-tract infection during the 1994–95 RSV season. The local pattern of ribavirin use was compared with the recommendations made in the AAP guidelines. Rates of antimicrobial prescribing and concurrent serious bacterial infections were also studied. The residents presented their findings to attending physicians at DCH’s Annual Resident Research Conference in May 1995.

**Statistical analysis.** Descriptive statistics (e.g., mean, standard deviation [S.D.], and range) and inferential statistics (e.g., Student’s t test and chi-square test) were calculated with Sigmaplot statistical software, version 2.0 (SPSS Inc., Chicago, IL). Student’s t test was used to compare means between the two study groups. Chi-square analysis was used to compare frequencies between the two study groups.

**Results**

Data were collected for 2396 patients hospitalized for treatment of RSV infection. There were 847 patients admitted in the three seasons before the 1994–95 RSV season and 1093 patients admitted in the three seasons afterward, accounting for 1940 study patients. All comparisons were made between these two groups. The 456 patients admitted during the 1994–95 season were excluded from all the comparative analyses. The numbers of included patients by season are listed in Table 1. There were no significant differences in age or sex between the two groups. The mean age ± S.D. of both groups was 219 ± 244 days and 246 ± 246 days, respectively. The majority of the infants and young children
were boys. Boys accounted for 59.4% and 57.3% of the patients in both groups, respectively. Almost all of the 1940 patients (95.5%) were younger than two years, with 79.5% less than one year, 33.2% less than 90 days, 11.7% less than six weeks, and 5.8% less than 30 days of age. Although most of the infants and young children were otherwise normal and healthy, 10.9% were born prematurely, and 14.3% had at least one underlying disease. The most common comorbidities were congenital heart disease (6.0%), bronchopulmonary dysplasia (4.6%), neurologic problems (3.1%), multiple congenital anomalies (1.3%), and metabolic disorders (0.9%).

Before the program, ribavirin was prescribed for 321 (37.9%) of the 847 patients; after program implementation, only 98 (9.0%) of 1093 patients received it ($p < 0.001$). The ribavirin prescribing rate ranged from a high of 46.8% in 1993–94 to 7.9% in 1996–97 (Table 1). The mean number of doses per treated child decreased from 3.4 (range, 3.2–3.6) before the program to 2.9 (range, 2.8–3.1) afterward ($p < 0.001$). A smaller percentage of patients received three doses before the program (77.6%) than afterward (80.6%, $p < 0.001$). Before the program, more patients received four or more doses of ribavirin (18.6% versus 6.1%, respectively) ($p = 0.004$) and less received one or two doses of ribavirin (3.8% versus 13.3%, respectively) ($p < 0.001$). The mean ± S.D. start day for ribavirin therapy was the same before and after the program (1.6 ± 1.8 days versus 1.7 ± 1.2 days after admission) ($p = 0.15$).

Ribavirin was started on the first or second day of hospitalization for 87.8% of patients before the program and for 86.7% of patients after program implementation. The total number of doses of ribavirin prescribed by season are listed in Table 1.

A broad-spectrum i.v. antimicrobial agent was prescribed for 85.6% of patients at admission before the program, while only 60.6% ($p < 0.001$) received one afterward. This ranged from a high of 90.2% in 1991–92 to a low of 56.5% in 1995–96 (Figure 1). Once started, the antimicrobial was continued in 98.6% of patients before the program and in 95.5% afterward ($p = 0.001$). By inclusion criteria, all of these patients had a positive RSV rapid antigen test on admission. Only 34 (1.8%) of the 1940 infants and young children had a positive bacterial culture from an initial sepsis or meningitis workup on admission. There were 18 patients with positive bacterial cultures during the three seasons before 1994–95 and 16 patients with positive cultures afterward. Of these 34 patients, 12 (35.3%) had positive blood cultures, and 22 (64.7%) had positive urine cultures. There were no positive spinal fluid cultures. All of the positive blood cultures revealed Staphylococcus epidermidis, Staphylococcus warneri, or Bacillus sp., all of which are common contaminants from the skin. The positive urine cultures grew only one organism, and the bacteria isolated were typical urinary-tract pathogens.

Before the program, ribavirin was prescribed most frequently in other-
wise normal, healthy infants (27.6%). The next most common indications for ribavirin use before the program were less than six weeks of age (18.4%), oxygen saturation of <90% (12.7%), and prematurity (11.9%); the distribution was oxygen saturation of <90% (24.9%), less than six weeks of age (21.8%), on the ventilator (16.6%), and prematurity (15.3%) after the program. Before the program, 24.8% of all infants and young children with no morbidity and mortality risk factors received ribavirin compared with only 1.6% (p < 0.001) afterward. Before the program, 86.8% of patients with congenital heart disease, 97.8% of patients on the ventilator, and 71.6% of the premature infants received ribavirin compared with 23.8%, 37.6%, and 26.9%, respectively, after the program (Table 2). In addition, 95.8% of patients with three or more risk factors received ribavirin before the program versus 39.2% after the program (Table 3). Interestingly, during the three seasons before the program 29.6% of the patients had at least one risk factor compared with 38.7% (p < 0.001) during the three RSV seasons afterward.

The mortality rate before the program was 0.12% (1 of 847) compared with 0.46% after the program (5 of 1093; p = 0.36, power = 0.14). However, the study did not have sufficient power (0.80) to resolve such a small difference in mortality given the very low death rate of less than 0.5%. Thus, it could not be determined if the decrease in ribavirin use was associated with an increase in mortality. Ribavirin was administered to four of the six patients who died, including three of the five patients in 1995–98. Interestingly, ribavirin was started during the first three days of hospitalization in only three of these six patients and on the fourth or fifth day in the others.

A larger percentage of children were admitted to the PICU during the years after the program. Before the program, an average of 5.5% of patients (range, 4.9–6.1%) were admitted to the PICU compared with 11.0% (range, 7.6–15.8%; p < 0.001) afterward. Of the patients admitted to the PICU, 46 (97.9%) of 47 received ribavirin before or during their PICU stay before the program, compared with 44 (36.7%) of 120 afterward (p < 0.001). Also, 46 of the 47 patients admitted to the PICU before the program and 111 of the 120 patients afterward had two or more risk factors. Only 1 (2.2%) of 46 PICU patients with two or more risk factors before the program did not receive ribavirin, compared with 71 (64.0%) of 111 patients admitted after the program (p < 0.001). We did not collect data on whether ribavirin therapy was initiated before or after admission to the PICU and whether patients were admitted to the PICU from the floor, the emergency room, or a referral hospital.

There was a decrease in hospital length of stay from 5.6 days before the program to 5.1 days afterward (p < 0.001). However, length of stay steadily decreased throughout the entire study period from a high of 6.3 days in 1991–92 to a low of 4.5 days (p < 0.001) in 1997–98, probably reflecting the general trend in health care. None of the 1940 study patients were readmitted within seven days for complications or failed therapy for RSV lower-respiratory-tract infection.

The cost savings for ribavirin for the 1093 patients hospitalized during the three-year period after the program was $1,235,484. This calculation was based on reductions in the ribavirin prescribing rate (from

### Table 2.

**Percentage of RSV Patients with Each Individual Risk Factor for Morbidity and Mortality Who were Treated with Ribavirin**

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Before Program</th>
<th>After Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>148 (25)</td>
<td>11 (1.6)</td>
</tr>
<tr>
<td>&lt;6 wk old</td>
<td>66 (72)</td>
<td>39 (30)</td>
</tr>
<tr>
<td>O₂ saturation &lt;90%</td>
<td>62 (85)</td>
<td>57 (27)</td>
</tr>
<tr>
<td>Premature</td>
<td>58 (72)</td>
<td>35 (27)</td>
</tr>
<tr>
<td>CHD</td>
<td>46 (87)</td>
<td>15 (24)</td>
</tr>
<tr>
<td>Ventilator use</td>
<td>45 (98)</td>
<td>38 (38)</td>
</tr>
<tr>
<td>Neurologic disorder</td>
<td>19 (73)</td>
<td>9 (26)</td>
</tr>
<tr>
<td>BPD</td>
<td>15 (52)</td>
<td>7 (11)</td>
</tr>
<tr>
<td>Congenital anomaly</td>
<td>8 (89)</td>
<td>4 (24)</td>
</tr>
<tr>
<td>Metabolic disorder</td>
<td>7 (88)</td>
<td>5 (50)</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>2 (100)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Transplant recipient</td>
<td>1 (100)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Immunodeficiency disorder</td>
<td>1 (100)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

*RSV = respiratory syncytial virus, O₂ = oxygen, CHD = congenital heart disease, BPD = bronchopulmonary dysplasia.

### Table 3.

**Percentage of RSV Patients with Risk Factors for Morbidity and Mortality Who were Treated with Ribavirin**

<table>
<thead>
<tr>
<th>No. Risk Factors</th>
<th>Before Program</th>
<th>After Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>148 (25)</td>
<td>11 (1.6)</td>
</tr>
<tr>
<td>One</td>
<td>86 (56)</td>
<td>28 (12)</td>
</tr>
<tr>
<td>Two</td>
<td>42 (84)</td>
<td>19 (24)</td>
</tr>
<tr>
<td>Three</td>
<td>30 (97)</td>
<td>21 (36)</td>
</tr>
<tr>
<td>Four</td>
<td>10 (91)</td>
<td>15 (44)</td>
</tr>
<tr>
<td>Five or more</td>
<td>5 (100)</td>
<td>4 (40)</td>
</tr>
</tbody>
</table>

*RSV = respiratory syncytial virus.
37.9% to 9.0%) and in the average number of doses per treated patient (from 3.4 to 2.9). The cost savings for antimicrobials for the 1093 patients hospitalized during the three-year period after the program was $34,839. This calculation was based on a reduction in the antimicrobial prescribing rate from 85.6% to 60.6%. These cost savings do not reflect the overall health care costs from the hospital's perspective.

Discussion

Many underlying factors influence physicians' prescribing behavior, including (1) formal medical education and training, which lack courses in rational therapeutic decision-making that emphasize cost-effectiveness comparisons and the necessity for critically analyzing promotional literature, (2) time constraints of a busy practice, which limit thoughtful therapeutic decision-making, (3) fear of malpractice litigation, (4) inability to keep abreast of advances in medicine, (5) lack of knowledge about costs, (6) misinterpretation of test results or even which test to order in a given situation, (7) inexperience, (8) overreliance on clinical experience as a sole guide for practice, (9) patient demand for treatment even when it is unnecessary, (10) influence of opinion leaders or powerful authority figures who set practice patterns for their more junior colleagues sometimes without the benefit of the best or most recent data, (11) financial incentives or insulation from cost considerations because of third-party coverage, and (12) advertising campaigns and detailing programs of sales representatives that effectively communicate, but sometimes inflate, claims that encourage use of their products.

Pharmaceutical companies have been very successful at influencing physicians' prescribing patterns by applying principles of communications and behavioral science theories. Although physicians claim they are not heavily influenced by drug advertisements or sales representatives, their beliefs concerning drug effectiveness have been shown to be congruent with messages received through commercial rather than scientific channels. In addition, a temporal relationship between industry's enticements and prescribing patterns has been demonstrated.

Educational intervention programs are tools for improving the quality, safety, effectiveness, and cost-benefit of patient care. The overriding principles are to provide physicians with accurate, unbiased, up-to-date, evidence-based information and encourage appropriate utilization of resources (e.g., drugs, laboratory tests, radiological procedures). Some of the best proven methods of influencing physicians' clinical decision-making include (1) conducting interviews to determine baseline knowledge and motivations for current practice patterns, (2) defining clear educational and behavioral change goals, (3) establishing credibility through a respected organizational identity, referencing authoritative and unbiased sources of information, and presenting both sides of a controversial issue, (4) focusing programs on specific physicians based on prescribing profiles that show heavy use of targeted drugs, tests, or procedures, (5) having face-to-face interactions with prescribing physicians and their opinion leaders, (6) providing educational sessions that stimulate active participation in an informal atmosphere, (7) offering an alternative to the practice being discouraged (e.g., a more rational medication choice or a nonpharmacologic therapy), (8) using visually appealing print materials that emphasize a few key points with graphics and headlines, (9) highlighting and repeating the essential messages, and (10) providing positive reinforcement of improved practices in follow-up visits.

In our case, a preliminary study was not conducted to gain an understanding of why physicians routinely prescribed ribavirin and antimicrobials for infants and young children hospitalized with RSV-related lower-respiratory-tract infection. However, the investigators' conversations with attending physicians and residents revealed that the reasons were multiple and included a lack of knowledge of the 1993 AAP guidelines or interpretation of them as requiring the use of ribavirin, the misconception that concurrent serious bacterial infections were common with RSV-related lower-respiratory-tract infections, the belief that RSV infections could not cause infiltrates to appear on chest x-rays or a mildly elevated white blood cell count with a left shift, a fear of malpractice litigation due to a missed case of sepsis or meningitis, and the belief that administering antimicrobials for a few days could do no harm. In addition, based on the high prescribing rate, it appeared that the pharmaceutical company sales representatives' detailing program had probably influenced physicians' prescribing patterns for ribavirin.

As a result of these informal findings, the major themes of the educational messages were as follows: (1) The physician should prescribe ribavirin only for those infants and children who meet at least one of the criteria for use as recommended in the AAP guidelines, (2) he or she should initiate ribavirin therapy when indicated as early as possible to maximize effectiveness, (3) concurrent serious bacterial infections are very rare in infants and young children hospitalized with RSV lower-respiratory-tract infection, (4) RSV infection can cause fever, infiltrates on chest x-rays, and a mildly elevated white blood cell count with a left shift, and (5) treating RSV lower-respiratory-tract infection with broad-spectrum i.v. antimicrobials actually increases the chance of bacterial superinfection. Educational presentations and discussions focused on clinical, laboratory, and radiological findings of
RSV lower-respiratory-tract infection, disease pathophysiology, clinical course, and the clinical pharmacology and therapeutic effectiveness of various treatment options. Information presented was based on critical review of the literature, included pros and cons, and focused on appropriate disease management rather than cost containment. Additionally, the investigators argued that routine full sepsis or meningitis workups at admission for infants and young children with typical signs and symptoms of RSV bronchiolitis are unnecessary and add to the cost, discomfort, and stress of the hospitalization. However, physicians were encouraged to consider laboratory testing for bacterial infections in infants appearing severely ill with an atypical presentation or clinical course because of the small risk of a concurrent serious bacterial infection.

Our multifaceted educational intervention program was somewhat successful at improving physicians’ prescribing of ribavirin and broad-spectrum i.v. antimicrobials in infants and young children hospitalized for treatment of RSV lower-respiratory-tract infections. Excessive use of ribavirin and antimicrobials significantly decreased after the educational interventions, resulting in significant cost savings for drug therapy. Although this study did not examine the effects on overall health care costs, the cost of ribavirin therapy ($1100 per day for just the drug) is a major portion of the overall cost of hospitalization for patients admitted to a general pediatrics ward with RSV lower-respiratory-tract infection. The decreased use of ribavirin and antimicrobials did not appear to prolong the hospital length of stay or increase the readmission rate, which remained at 0%. In addition, antimicrobials were still frequently prescribed in patients without an indication for use, although less so than before.

We did not want to restrict ribavirin use or require justification and preapproval for use. We believed education could work and would be better received than placing a clinical pharmacist or infectious diseases physician in the role of “the medication police.” Many factors probably contributed to the limited success of our multifaceted educational intervention program and helped achieve changes in both physicians’ knowledge and behavior. A number of the strategies discussed previously were employed. Several different channels of communication provided multiple and repeated reinforcements of the desired prescribing practices. Even though our program did not include face-to-face personal educational visits (academic detailing), the combination of printed materials and evidence-based presentations as well as the active involvement of residents helped achieve the goals.

The effect of the multifaceted educational intervention program on ribavirin use was much greater than the effect on antimicrobial use. After the program, only 1.6% of patients without an indication for ribavirin received the drug, while 60.6% of patients were still prescribed an antimicrobial agent. However, the appropriate use of ribavirin also decreased. This was an unexpected and unintended result. It underscores the difficulty of relaying complex messages (e.g., treat only patients with one or more of the following risk factors) versus simple messages (e.g., treat all or treat none). Of potential concern, 97.8% of patients with three or more risk factors received ribavirin before the program, compared with only 39.2% afterward. In addition, 97.8% of the patients admitted to the PICU with two or more risk factors received ribavirin before the program, compared with 36.0% after the program. However, we are unsure if the decreased use of ribavirin in high-risk patients admitted to a general pediatrics ward caused the twofold higher PICU admission rate. A previous study found that only 1.8% of previously healthy full-term infants admitted with RSV lower-respiratory-tract infection were subsequently transferred to the PICU because their condition deteriorated. Other factors, such as admitting only the sickest children to the hospital due to managed care pressures or a more virulent strain of RSV in a given year, may also have been responsible for this finding.

More education needs to be conducted to improve the overall prescribing patterns for ribavirin. This is particularly important because of the trends seen during this seven-year study period. Proportionally, the patients hospitalized appeared to be sicker and have more risk factors over time. This phenomenon is consistent with national health care trends and may be attributable to the fact that more prematurely born babies are being saved and many of them have comorbidities. Therefore, the appropriate use of ribavirin when necessary must be emphasized.

Although the antimicrobial prescribing rate decreased from 85.6% to 60.6%, most of the infants and children treated did not need antimicrobial therapy. Only 1.8% of the patients in the study had a positive bacterial culture. The positive blood cultures were probably caused by contaminants and did not represent bacteremia or sepsis. The positive urine cultures may have represented concurrent urinary tract infections or simply asymptomatic bacteriuria. It is difficult to change deeply held beliefs and fears of undertreating bacterial infections. Data regarding the prevalence of concurrent serious bacterial infections from our own institution have not yet been formally presented to the medical and house staffs and may be helpful in changing such beliefs.

No decay effect was seen during the three-year period following the educational program. The reduction in ribavirin use was maintained. Antimicrobial use varied from year to year, but the decrease was also main-
tained. This is very unusual, as most educational and academic detailing programs have a short-lived effect.19,20 Some of the components of the program (morning report discussions, noon conference lectures, and teaching rounds) were continued during the three-year period afterward, but the overall educational intensity was less. Despite the long-term sustained effects, we do believe “booster” programs are needed to reinforce the messages.

Our program had several weaknesses. First, no formal survey was initially conducted to determine baseline knowledge and motivations for physicians’ current prescribing patterns. This information is critical to the design of the program and the creation of the key educational messages. We used informal conversations as a surrogate for a formal survey. Second, not all attending physicians were present at every educational meeting or presentation. Thus, some pediatricians may have received only the printed materials. Third, no prescriber profiling and targeting of specific attending physicians were conducted, which could have resulted in better outcomes. Fourth, no face-to-face meetings with individual attending physicians were performed. Finally, attending physicians were not given periodic feedback or praise on changes made in their prescribing patterns for ribavirin and antimicrobials.

This study also had several limitations. First, the retrospective study design relied on chart reviews and had all the inherent weaknesses of such. Second, no random allocation or control group (e.g., another hospital or a group of physicians who did not receive materials and attend meetings) was established to curb the effect of potential confounders and allow for a strong causal association to be made. Third, it is impossible to determine which components of the educational program were effective and what roles other environmental influences played (e.g., managed care, consensus guidelines, physician turnover, and hospitalwide programs). Managed care penetration in Corpus Christi during this time period was low and was probably minimally contributive. However, hospital length of stay for all patients (including those hospitalized with RSV lower-respiratory-tract infection) slowly and steadily decreased during this period, possibly due to pressures from managed care organizations.

Publication of the AAP guidelines for ribavirin use in 1993 and the revised AAP guidelines in 19962 may have been partially responsible for the reduction in ribavirin prescribing over time. The wording change from “should be used” in 1993 to “may be considered” in 1996 was significant in the minds of pediatricians. Pediatricians perceived that the revised guidelines gave them more flexibility in deciding whether or not to initiate ribavirin therapy. However, as stated earlier, consensus statements and practice guidelines have not been shown to be effective on their own.14,15 In addition, the 1996 AAP guidelines were published after the peak of the 1995–96 RSV season and this could not have substantially contributed to the significant decrease in ribavirin prescribing during that season. Attending-physician turnover was very low during the seven-year study period. Also, no similar hospitalwide programs were conducted for antimicrobial prescribing or management of RSV.

Conclusion

A multifaceted educational intervention program may have been somewhat effective in modifying physicians’ prescribing habits for the treatment of RSV lower-respiratory-tract infection.

References

17. Peststein PH, Kotagal UR, Bolling C et al. Evaluation of an evidence-based guide-