Effectiveness of an Educational Intervention in Modifying Parental Attitudes About Antibiotic Usage in Children

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ABSTRACT. *Objective.* **To determine the effectiveness of educational materials in improving the attitudes of parents of young children about the judicious use of antibiotics.**

Methods. **We conducted a randomized controlled trial by recruiting parents of children who were younger than 24 months and being seen for any reason in primary care pediatric offices. At the time of enrollment, study parents indicated their level of agreement with 16 statements, including 9 statements about antibiotic usage and 7 about injury prevention. After being randomized, parents received either a pamphlet and a videotape promoting the judicious use of antibiotics (intervention group) or brochures about effective injury prevention (control group). Six weeks after enrollment, each group received another copy of the pamphlet or brochures and a follow-up questionnaire with the identical 16 statements. Responses on both questionnaires were transformed to an ordinal scale for analysis. Scores on the follow-up questionnaire for each statement about antibiotic use and injury prevention in the 2 groups were compared using linear regression, after controlling for the score obtained for the statement at enrollment.**

Results. **We enrolled a total of 499 eligible parents in the study; 358 (72%) completed the follow-up questionnaires. At study entry, there were no significant differences between parents in the intervention and control groups regarding attitudes for 15 of the 16 statements assessed. However, 6 weeks after receiving the antibiotic educational materials, parents in the intervention group had significantly different attitude scores for 5 of the 9 statements about the antibiotic use. In each case, the scores reflected attitudes that would promote the judicious use of antibiotics. We found significant attitudinal change for statements about the use of antibiotics for specific conditions in children; there were no differences between the 2 groups for more general or theoretical statements about antibiotic use.**

Conclusions. **A simple educational effort was successful in modifying parental attitudes about the judicious use of antibiotics. Information about specific childhood conditions may be more effective in changing attitudes than more general information about antibiotic usage.** *Pediatrics* **2003;111:e548–e554. URL: http://www.pediatrics.org/cgi/content/full/111/5/e548;** ***antibiotics, patient education, upper respiratory tract infections.***

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Received for publication Nov 5, 2002; accepted Jan 16, 2003.

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ABBREVIATIONS. DRSP, drug-resistant *Streptococcus pneumoniae*; URI, upper respiratory tract infection; PSPRN, Puget Sound Pediatric Research Network; TIPP, Toward Injury Prevention Program.

The emergence of antibiotic-resistant bacterial pathogens, particularly drug-resistant *Streptococcus pneumoniae* (DRSP), is cause for serious and growing concern.[1–5] Although the emergence of DRSP[6–8] is probably multifactorial, recent evidence suggests that the injudicious use of antibiotics is partly responsible for the increasing prevalence of these bacterial strains.[2,9,10] Curbing this excessive use of antibiotics will be an important part of any effort designed to reduce the prevalence of DRSP.

In an attempt to decrease the overuse of antibiotics in children, practice guidelines for the appropriate use of these medications in the management of otitis media, sinusitis, and upper respiratory tract infections (URIs) have been published.[11–15] Other methods of disseminating information to pediatricians and family physicians have been advocated, including "academic detailing," the use of physician peer leaders and drug educators, feedback to physicians comparing their antibiotic prescribing practices with those of colleagues, and computer-assisted decision support.[16] Some of these techniques have been shown to be effective in modifying physician behavior.[17]

However, much of the overprescribing of antibiotics is driven by parental expectations and physician perception of these expectations. In a survey of a random sample of practicing pediatricians in the United States, 96% of respondents indicated that parents had requested unnecessary antibiotics for their child during the previous month; 40% reported receiving 10 or more such requests. When pressured to prescribe these medications, 30% of pediatricians reported complying with this request "occasionally" or more frequently.[18] The effect of perception of parental expectations for antibiotics on physician behavior is striking. Mangione-Smith et al[19] found that private practice pediatricians prescribed antibiotics to 52% of children who were 2 to 10 years of age and presenting with URI symptoms and received a diagnosis of a viral illness when the physician reported that she or he perceived that the parent desired these medications versus 9% when he or she did not have this perception. In another study, when asked to identify the single most important program to reduce inappropriate antibiotic use in children, 78% of surveyed

pediatricians indicated that educating parents about the judicious use of the antibiotics would be most efficacious.[18]

We need effective techniques for educating parents about the judicious use of antibiotics. The American Academy of Pediatrics, the Centers for Disease Control and Prevention, and the American Society of Microbiology have developed an educational pamphlet entitled "Your Child and Antibiotics" for distribution in health care providers' offices.[20] The pamphlet features color illustrations and photographs, describes the differences between viral and bacterial illnesses, lists common illnesses such as URIs for which antibiotics are usually not needed, explains the relationship between overuse of antibiotics and bacterial resistance, and encourages parents to discuss these issues with their child's doctor. Videotape educational messages have also been shown to be an effective method to improve knowledge of health issues.[21]

We conducted a randomized controlled trial to determine whether "Your Child and Antibiotics," accompanied by a short videotape message reinforcing the key points in the pamphlet, would be effective in improving parental attitudes about the judicious use of antibiotics. The study was conducted in the offices of practicing pediatricians. In each practice, the videotape message was "personalized": 1 of the pediatricians in the office was featured in the presentation. Before the study, we hypothesized that this intervention would result in more positive attitudes on the judicious use of antibiotics among parents randomized to the antibiotic education intervention than in parents in the control group.

METHODS

The Puget Sound Pediatric Research Network (PSPRN), a practice-based research organization composed of pediatricians in the Seattle, Washington, area, conducted this study. Eight PSPRN practices, including 7 private offices and 1 inner-city pediatric clinic, volunteered to participate. Parents of children who were younger than 24 months and being seen in the office of a participating practice for any reason were eligible for the study. A study research coordinator visited each office on a regularly scheduled basis to recruit parents and collect data. Parents of children with complex medical conditions such as cystic fibrosis, bronchopulmonary dysplasia, or congenital anomalies were excluded from the study as were those who did not speak English.

At the time of enrollment, study parents completed a questionnaire that included demographic items such as the age of their child, ages of other children, use of child care, smokers in the household, parental education level, and their child's previous use of antibiotics. The questionnaire also included 9 statements about appropriate antibiotic usage and 7 statements about injury prevention in young children. After each statement, the parent indicated her or his level of agreement by means of a 6-point Likert scale, with possible responses ranging from "completely agree" to "completely disagree."

After completing the questionnaire, parents were randomized to receive educational materials about the judicious use of antibiotics (antibiotic education, or intervention, group) or injury prevention (injury prevention, or control, group). The antibiotic educational materials consisted of a copy of the pamphlet "Your Child and Antibiotics" and a videotape featuring 1 of the physicians from their child's pediatric practice discussing the topics covered in the pamphlet. Each videotape was professionally produced and ran approximately 5 minutes following a standardized script. Charts and graphic representations of antibiotic-resistant bacteria accompanied the pediatrician's spoken message.

Parents who were randomized to the injury prevention group received pamphlets prepared by the American Academy of Pediatrics designed to help prevent injuries in young children. The pamphlets were developed as part of the "Toward Injury Prevention Program" (TIPP).[22] Three separate TIPP pamphlets were prepared for children 0 to 6 months, 6 to 12 months, and 1 to 2 years of age and were given to each parent in the injury prevention group regardless of the age of their child.

The study research coordinator encouraged parents in both the intervention and the control groups to review the materials provided and counseled them to discuss any of the issues described in the educational materials with their child's doctor. The practicing pediatricians were not informed by the study research coordinator about which parents were enrolled in the study or the randomization of any parent.

Approximately 6 weeks after enrollment, parents who were randomized to the intervention group were mailed another copy of the pamphlet "Your Child and Antibiotics." Similarly, control parents were sent another copy of the TIPP pamphlets. This mailing included a second questionnaire regarding antibiotic use and injury prevention identical in format and content to the questionnaire completed by the study parents at enrollment. Parents were asked to complete the follow-up questionnaire and return it to the study research coordinator by mail. No attempt was made to recontact parents who did not return the second questionnaire because we believed that a second mailing or contact from the research staff might alter the parents' responses.

For the analysis, parental responses to the statements were transformed to an ordinal scale, with scores ranging from 6 for a response of "completely agree" to 1 for a response of "completely disagree." There were 4 statements about antibiotic use for which parental agreement was indicative of attitudes supportive of the judicious use of antibiotics. Thus, for these statements, higher numerical scores were associated with attitudes more supportive of the judicious use of antibiotics. Conversely, there were 5 statements about antibiotic use for which parental disagreement supported the judicious use of antibiotics. For these statements, lower scores were indicative of attitudes supportive of the judicious use of antibiotics.

A similar schema was used for the statements on injury prevention. Three statements were worded such that parental agreement—and higher numerical scores—indicated an attitude associated with effective injury prevention. Conversely, 4 statements about injury prevention were worded such that a response of "completely disagree"—and lower numerical scores—were associated with attitudes consistent with effective injury prevention.

The main study outcomes were the attitude scores of parents regarding the judicious use of antibiotics 6 weeks after enrollment and receipt of the educational materials. Scores for attitudes regarding each particular statement for parents who had received information about the judicious use of antibiotics were compared with scores from those randomized to receive TIPP sheets using linear regression, after controlling for the score obtained for that statement before randomization. For assessing the impact of the intervention in parents of differing educational levels, regression analyses including education-intervention interaction terms were also performed.

In all analyses, we adjusted for the effect of clustering into different pediatric practices using generalized estimating equations techniques.[23] Scores of parental attitudes regarding each of the 7 statements about injury prevention were similarly analyzed. For placing the results in context, differences in attitudes about antibiotic use between parents in the 2 groups were considered to be statistically significant at $P < .0055$ (.05 divided by 9 statements), using the technique described by Bonferroni.[24] Similarly, differences in attitudes about injury prevention were considered to be statistically significant at $P < .0071$ (.05 divided by 7 statements).

For assessing potential confounding that might have occurred despite randomization, the characteristics of parents and their children in the antibiotic education and injury prevention groups were assessed with the use of χ^2 and t tests. In the main analyses, we adjusted for any characteristic for which there was a statistically significant difference in prevalence between the 2 groups. Finally, differences in characteristics between parents who completed the follow-up questionnaire and those who enrolled in the project but did not return the questionnaire were also evaluated. The study was approved by the Institutional Review Boards of

Children's Hospital and Regional Medical Center and the Virginia Mason Medical Center.

RESULTS

We enrolled a total of 500 parent-child dyads from the 8 participating PSPRN practices. Study data were collected between March 2000 and October 2001. One child who was initially enrolled in the study was later found to have complex congenital heart disease; data from this child and his parent were excluded from the analyses. Initial mean attitude scores for each of the antibiotic and injury prevention statements are shown in Table 1. In general, parental attitudes were supportive of the judicious use of antibiotics.

Follow-up questionnaires were returned by 358 parents (response rate of 72%). The educational level of parents who completed and returned the follow-up questionnaire was significantly higher than that of nonresponders ($P < .001$), and children of responders tended to be younger (mean age 8.5 months vs 9.6 months; $P = .08$). There were no other differences in measured characteristics between the 2 groups. However, parents who completed the follow-up questionnaire had some attitudes more supportive of the judicious use of antibiotics at study entry than parents who did not return the follow-up questionnaire. Specifically, those who returned the follow-up questionnaires had significantly more disagreement with the statements regarding the efficacy of antibiotics in resolving URI symptoms (mean score 2.30 vs 2.75 for parents not returning the questionnaire; $P = .005$) and the utility of administering antibiotics to their child when URI symptoms have persisted for 5 days (mean scores 2.78 and 3.33, respectively; $P = .001$). There were no differences in attitudes regarding injury prevention at enrollment between parents who returned or did not return the follow-up questionnaire.

Among 252 parents who were randomized to receive the antibiotic education materials, 174 returned the follow-up questionnaire (69.0%) compared with 184 (74.5%) of 247 of those who received injury prevention educational materials ($P = .177$). The characteristics of parent-child dyads in the 2 groups who returned the follow-up questionnaire are compared in Table 2. There were no statistically significant differences between the groups. Overall, parents who returned questionnaires were highly educated, with 72% having graduated from college. At study entry, parents who were later randomized to the antibiotic education group had significantly more agreement with the statement, "Too many children are treated with antibiotics when not necessary," than those who received injury prevention information (mean scores 4.90 and 4.67, respectively; $P = .005$). There were no statistically significant differences between the 2 groups for any other antibiotic or injury prevention attitude score at the time of enrollment.

Attitudes regarding the judicious use of antibiotics among parents who received the antibiotic education materials 6 weeks after study enrollment are compared with attitudes in those who were randomized to the injury prevention group (Table 3). Parents in the intervention group had significantly different attitude scores for 5 of the 9 statements about antibiotic use in their children from those in the control group. In each case, these scores were indicative of attitudes that would promote the judicious use of antibiotics. Thus, parents who received the antibiotic education materials were statistically less likely to agree that antibiotics are necessary when a child's nasal discharge turns to green in color, that it is worth trying

TABLE 1. Attitude Scores Regarding the Judicious Use of Antibiotics and Injury Prevention Among Study Parents at Enrollment

	*n**	Attitude Score†
Statements for which complete *agreement* (score = 6) was indicative of attitudes supportive of judicious use of antibiotics or effective injury prevention		
Too many children are treated with antibiotics when not necessary	486	4.73 ± .94
Parents should not try to persuade a doctor to prescribe antibiotics	493	5.01 ± .96
Physicians should never prescribe antibiotics when they are unnecessary	493	5.46 ± .80
Overuse of antibiotics can make bacteria more resistant to antibiotics	494	5.40 ± .93
Most deaths from accidents in your children can be prevented	492	5.15 ± .75
It is dangerous to feed whole grapes to children <1 year old	492	5.58 ± .70
Decreasing the temperature of hot water tap to 125 degrees will help prevent serious burns in young children	482	4.59 ± 1.46
Statements for which complete *disagreement* (score = 1) was indicative of attitudes supportive of judicious use of antibiotics or effective injury prevention		
Giving an antibiotic to a child with cold symptoms can prevent an infection from occurring	475	2.57 ± 1.19
It is worth trying an antibiotic when my child has cold symptoms for 5 days	491	2.93 ± 1.43
Treatment with antibiotics is necessary when a child's nasal discharge turns from yellow to green in color	478	3.64 ± 1.34
Antibiotics help a child's cold symptoms clear up more quickly	488	2.42 ± 1.15
Antibiotics are helpful in treating colds	491	2.13 ± 1.18
Teaching toddlers to swim can help to prevent deaths from drowning in this age group	486	3.34 ± 1.53
The first thing to do if a child swallows something poisonous is to give syrup of ipecac	484	2.53 ± 1.56
Baby walkers are useful to teach children how to walk	491	2.22 ± 1.28
Children 1–2 years old can be taught to understand what is dangerous and what is not dangerous	491	3.72 ± 1.51

* Number of parents who responded to the statement.
† Values presented are means ± standard deviation.

TABLE 2. Characteristics of Parents and Their Children Who Completed Initial and Follow-up Questionnaires ($n = 358$)*

Characteristic	Antibiotic Education Group ($n = 174$)	Injury Prevention Group ($n = 184$)	*P* Value
Child's age (mo)	8.8 ± 6.3†	8.2 ± 5.9†	.35
Antibiotic prescriptions in previous year	1.10 ± 1.92†	1.02 ± 1.83†	.70
Siblings in household (%)	55.5	57.6	.69
Smoker in household (%)	9.8	10.4	.88
Child care >20 h/wk (%)	10.3	10.9	.87
Parental education level			.49
High school graduate (%)	7.5	4.9	
Some college (%)	23.0	20.8	
College graduate (%)	69.5	74.3	

* Summary values shown do not include information for parent–child dyads with missing data for a characteristic, including 7 children missing previous antibiotic prescription data, 2 dyads with missing cigarette smokers in the household data, 2 children with missing sibling data, and 2 parents with missing educational level data.
† Data presented are means ± standard deviation.

TABLE 3. Parental Attitude Scores Regarding the Judicious Use of Antibiotics 6 Weeks After Receiving Educational Materials About Antibiotics or Injury Prevention

	*n**	Antibiotic Education Group Scores	Injury Prevention Group Scores	*P* Value†
Statements for which complete *agreement* (score = 6) indicated attitudes supportive of judicious use of antibiotics				
Too many children are treated with antibiotics when not necessary	350	5.18‡	4.86	.065
Parents should not try to persuade a doctor to prescribe antibiotics	354	5.26	4.99	.075
Physicians should never prescribe antibiotics when they are unnecessary	356	5.64	5.47	.102
Overuse of antibiotics can make bacteria more resistant to antibiotics	355	5.78	5.52	.021
Statements for which complete *disagreement* (score = 1) indicated attitudes supportive of judicious use of antibiotics				
Giving an antibiotic to a child with cold symptoms can prevent an infection from occurring	343	1.86	2.16	.005§
It is worth trying an antibiotic when my child has cold symptoms for 5 days	352	1.93	2.34	.001§
Treatment with antibiotics is necessary when a child's nasal discharge turns from yellow to green in color	347	2.61	3.47	.001§
Antibiotics help a child's cold symptoms clear up more quickly	352	1.64	2.01	.001§
Antibiotics are helpful in treating colds	354	1.52	1.87	<.001§

* Number of parents who responded to the statement on both the initial and the follow-up questionnaires.
† *P* values computed with the use of regression analysis and adjusting for the clustering of parent–child dyads into different practices.
‡ Values presented are group means.
§ Statistically significant *P* values after correcting for multiple tests.

an antibiotic in their children when URI symptoms persist for 5 days, that antibiotics are useful in treating colds, that giving antibiotics to a child with a URI can prevent a bacterial infection, and that antibiotics help URI symptoms clear up more quickly than parents who did not receive these materials. There were no statistically significant differences between groups for the remaining 4 statements.

The effect of the intervention was similar in parents of differing educational levels for 7 of the 9 statements on antibiotic usage. However, there was a significant interaction between education level and the intervention for the statement, "Parents should not try to persuade a doctor to prescribe antibiotics," ($P = .005$), and the statement, "Physicians should never prescribe antibiotics when they are unnecessary," ($P = .004$). In both cases, the intervention was more effective in parents who had no education beyond high school than in those with more education.

Finally, parental attitude scores regarding injury prevention in their children, based on responses to the follow-up questionnaires, are shown in Table 4. Parents who received TIPP sheets had significantly more disagreement with the statements regarding the effectiveness of swimming lessons in toddlers in preventing drowning and the usefulness of walkers in teaching children how to ambulate than those who received the antibiotic education materials. There were no statistically significant differences between the 2 groups of parents for the remaining 5 statements about effective injury prevention.

DISCUSSION

The results of this study suggest that a simple educational intervention can significantly alter parental attitudes regarding the use of antibiotics in their children. The process of distributing a brochure, augmented by brief discussion and/or a videotape message, is compatible with busy office practice. Our results indicate that the intervention was more successful in modifying parental beliefs about the need for antibiotics for specific conditions in their children (eg, green nasal discharge) than in changing attitudes about more general, or theoretical, issues related to

TABLE 4. Parental Attitude Scores Regarding Injury Prevention in Their Children 6 Weeks After Receiving Information About the Judicious Use of Antibiotics or Injury Prevention

	*n**	Antibiotic Education Group Scores	Injury Prevention Group Scores	*P* Value†
Statements for which complete *agreement* (score = 6) indicated attitudes supportive of effective injury prevention				
Most deaths from accidents in your children can be prevented	354	5.30‡	5.31	.256
It is dangerous to feed whole grapes to children < 1 year old	355	5.67	5.69	.571
Decreasing the temperature of hot water tap to 125 degrees will help prevent serious burns in young children	346	4.80	5.17	.013
Statements for which complete *disagreement* (score = 1) indicated attitudes supportive of effective injury prevention				
Teaching toddlers to swim can help to prevent deaths from drowning in this age group	349	3.04	2.59	.001§
The first thing to do if a child swallows something poisonous is to give syrup of ipecac	350	2.14	1.97	.056
Baby walkers are useful to teach children how to walk	350	2.07	1.55	.001§
Children 1–2 years old can be taught to understand what is dangerous and what is not dangerous	354	3.16	2.92	.071

* Number of parents who responded to the statement on both the initial and the follow-up questionnaires.
† *P* values computed with the use of regression analysis and adjusting for the clustering of parent-child dyads into different practices.
‡ Values presented are group means.
§ Statistically significant *P* values after correcting for multiple tests.

overuse of antibiotics. Although not a main focus of the project, we also found that the TIPP pamphlets had at least a modest effect in changing parental attitudes about effective injury prevention.

Previous studies of the effect of interventions designed to educate parents about the appropriate use of antibiotics in children have had mixed results. Trepka et al[25] assessed the impact of a multifaceted community-wide effort to reduce the inappropriate use of antibiotics. The intervention consisted of distribution of the pamphlet "Your Child and Antibiotics" (the same pamphlet used in our study) and presentations to groups of parents and providers. Parents of young children who resided in the intervention and a control community were surveyed before and after the educational effort. Parents who lived in the exposed community had a significantly greater increase in awareness about antibiotic resistance than those in the control community. In addition, the reduction in the number of viral respiratory illness diagnoses for which parents thought antibiotics were indicated was greater in the intervention community.

In a study of similar design as ours, Bauchner et al[26] conducted a randomized controlled trial of the effectiveness of an educational 20-minute videotape and accompanying brochure in modifying parental knowledge and attitudes about antibiotics.[26] Parents were recruited from pediatric primary care offices and completed a questionnaire at the time of enrollment. Those who were randomized to the intervention group received the educational materials, whereas those in the control group did not get any materials. After a 2-month study period, parents completed a second questionnaire that assessed knowledge, attitudes, and reported behaviors regarding antibiotic use. After responses on the initial questionnaires were adjusted for, there were few differences found between parents in the intervention and control groups on the second questionnaire in this study.

Several differences may account for the different results found in the study by Bauchner et al[26] and our project. For example, we recruited a more highly educated population of parents, with 94% having education beyond high school compared with 68% in the study by Bauchner et al. The specific items that we included in our questionnaire may have been more sensitive in detecting changes in attitude than those used by the other investigators. Our study also had a larger sample size and a shorter time period between the initial and follow-up questionnaires, both characteristics that would increase the chance of detecting differences between a control and intervention group. Finally, it is possible that differences in educational content in the 2 studies might have led to different results.

One way to interpret our results is to apply the transtheoretical model of behavior change.[27] This model has been a useful concept for studying many health behaviors, including smoking cessation, physical activity, and diet.[28–30] One case study in Australia examined a change in antibiotic prescribing patterns using the transtheoretical model.[31] According to this model, individuals consider the decisional balance (weighing the pros and cons) of a behavior while progressing in a series of states known as the "stages of change" (precontemplation, contemplation, preparation, action, and maintenance) that result in changed behavior. To facilitate stages of change, people consciously and subconsciously engage in "processes of change": consciousness raising, counterconditioning, dramatic relief, environmental reevaluation, helping relationships, reinforcement management, self-liberation, self-reevaluation, social liberation, and stimulus control.[27]

Applying the transtheoretical model to decreasing parental demand for antibiotics, we found that an educational intervention resulted in no significant effect on agreement with statements reflecting different processes of change, such as consciousness raising ("Too many children are treated with antibiotics

when not necessary," "Physicians should never prescribe antibiotics when they are not necessary"), environmental reevaluation ("Overuse of antibiotics can make bacteria resistant to antibiotics"), and helping relationships ("Parent should not try to persuade a doctor to prescribe antibiotics"). However, the intervention did result in changes in agreement with statements reflecting the decisional balance (pros and cons) of antibiotic use. Specifically, as a result of the intervention, parents agreed less with some of the statements representing perceived advantages to using antibiotics ("Giving an antibiotic to a child with cold symptoms can prevent an infection from occurring," "It is worth trying an antibiotic when my child has cold symptoms for 5 days," "Treatment with antibiotics is necessary when a child's nasal discharge turns from yellow to green in color"). Changing the decisional balance is potentially important in reducing antibiotic demand because it motivates parents to move along the stages of behavioral change. In this way, reducing the parents' expectations of the utility of antibiotics may subsequently reduce their demands for unnecessary antibiotics for their children.

Parents likely use information from a variety of sources to weigh the "pros and cons" of antibiotic use, and this information in turn shapes their attitudes. Ideally, the information communicated by primary care physicians should be current, evidence-based knowledge. However, in 1 survey, 53% of pediatricians and 71% of responding family physicians indicated that they would prescribe an antibiotic for a child with a 1-day history of purulent rhinorrhea,[32] although evidence to support such prescribing is lacking.[33] Thus, it is reasonable to suspect that when parents have inaccurate knowledge about antibiotics, their primary care physicians may be partly responsible either by the omission of accurate information or by the transmission of inaccurate information. Standardized interventions could help offset the unavoidable variability in information received from physicians during office visits. Our results indicate that standardized written and videotape material can change parental attitudes about antibiotics by increasing their knowledge about the pros and cons of antibiotic use in specific conditions.

There are several other possible explanations for our findings. First, familiarity with the design and statements on the initial questionnaire might have resulted in scores indicative of attitudes supporting the judicious use of antibiotics that were seen on the follow-up questionnaires. "Measurement-induced improvement" may have occurred as respondents experienced the questionnaire for a second time, allowing them to become better able to discern the meaning of the statements, thus producing better scores.[34] Alternatively, the statements on the initial questionnaire might have been a de facto intervention causing study parents to seek out information specifically about the issues addressed in the statements. However, both of these phenomena should have influenced the intervention and control parents similarly and would not explain the differences observed between the 2 groups. Because parents received another copy of either the antibiotic or the TIPP pamphlet, depending on randomization, along with the follow-up questionnaire, parents may have used the pamphlet as a "study aid" in responding to the statements on the questionnaire. That differences between the intervention and control groups were only statistically different for 5 of the 9 statements on antibiotic use suggests that this was not a widespread practice. Finally, statistically significant differences between the 2 groups of parents were found for the 5 statements in which a response of "completely disagree" was indicative of attitudes supporting the judicious use of these medications. There were no differences for the 4 statements in which a response of "completely agree" was indicative of attitudes supportive of the judicious use of antibiotics. The use of negatively worded statements or reversing the orders of the responses has been used in surveys to detect acquiescent behaviors and the tendency for respondents to agree with statements more than disagree.[35] Although importance of this effect is controversial, it is possible that parents who received the educational materials about antibiotics, cognizant that they were being "tested" on this subject, were more attentive in their responses on the follow-up questionnaire items on antibiotic use that were negatively worded or scored than those in the control group.

Because our follow-up occurred only 6 weeks after enrollment and implementation of the intervention, it is unknown whether the changes in attitudes found in parents who received the antibiotic educational materials were sustained. It is also unclear whether our educational intervention would lead to similar changes in attitudes in other groups of parents with different demographic characteristics. However, the results of our study may provide guidance for future parental educational efforts regarding antibiotic usage, injury prevention, and other topics. In particular, parents may be more responsive to information specific to conditions that they encounter in their children, which may influence their decisional balance, than to information related to a more theoretical or societal benefit.

ACKNOWLEDGMENTS

Funding for this study was provided by GlaxoSmithKline in conjunction with the Aetna Foundation's Quality Care Research Fund.

Members of the Puget Sound Pediatric Research Network who participated in this study are Matthew Allen, MD; Cynthia Brown, ARNP; Pakhi Chaudhuri, MD; T. Michael Claudson, MD; Ruth A. Conn, MD; Benjamin Danielson, MD; Steven Dassel, MD; Kathryn Del Beccaro, MD; Christianne Eldred, MD; JoEllen Estvold, MD; Robert T. Fukura, MD; Kathryn Koelemay, MD; Lenna Liu, MD, MPH; Ourania Malliris, MD; Jo Montgomery, ARNP; Sarah F. Munson, MD; Elizabeth K. Neuzil, MD; Catherine Nobis, MD; Tracie O'Neill, MD; Zaiga Phillips, MD; Rob Roskin, MD; Jeffrey R. Scott, MD; Don Shifrin, MD; James Stout, MD, MPH; Roberta L. Winch, MD; Agnes Wong, MD; Kyle E. Yasuda, MD; and Marina S. Zeiber, MD.

We thank Danika Claudson for help in conducting the study.

REFERENCES

1. Breiman RF, Butler JC, Tenover FC, et al. Emergence of drug-resistant pneumococcal infections in the United States. *JAMA*. 1994;271:1831–1835

2. Duchin JS, Breiman RF, Diamond A, et al. High prevalence of multidrug-resistant *Streptococcus pneumoniae* among children in a rural Kentucky community. *Pediatr Infect Dis J.* 1995;14:745–750
3. Appelbaum PC. Epidemiology and in vitro susceptibility of drug-resistant *Streptococcus pneumoniae*. *Pediatr Infect Dis J.* 1996;15:932–939
4. Tomasz A. Antibiotic resistance in *Streptococcus pneumoniae*. *Clin Infect Dis.* 1997;24:S85–S88
5. Centers for Disease Control and Prevention. Defining the public health impact of drug-resistant *Streptococcus pneumoniae*: report of the working group. *MMWR Recomm Rep.* 1996;45:1–20
6. Bedos J, Chevret S, Chastang C, Geslin P, Regnier B. Epidemiological features of and risk factors for infection by *Streptococcus pneumoniae* with diminished susceptibility to penicillin: findings of a French survey. *Clin Infect Dis.* 1996;22:63–72
7. Pallares R, Gudiol F, Linares J, et al. Risk factors and response to antibiotic therapy in adults with bacteremic pneumonia caused by penicillin-resistant pneumococci. *N Engl J Med.* 1987;317:18–22
8. Clavo-Sanchez AJ, Giron-Gonzales JA, Lopez-Prieto D, et al. Multivariate analysis of risk factors for infection due to penicillin-resistant and multidrug resistant *Streptococcus pneumoniae*: a multicenter study. *Clin Infect Dis.* 1997;24:1052–1059
9. Hoffman J, Cetron MS, Farley MM, et al. The prevalence of drug-resistant *Streptococcus pneumoniae* in Atlanta. *N Engl J Med.* 1995;333:481–486
10. Wenzel RP, Edmond MB. Managing antibiotic resistance. *N Engl J Med.* 2000;343:1961–1963
11. Dowell SF, Marcy SM, Phillips WR, Gerber MA, Schwartz B. Principles of judicious use of antimicrobial agents for pediatric upper respiratory tract infections. *Pediatrics.* 1998;101(suppl):163–165
12. Dowell SF, Schwartz B, Phillips WR. Appropriate use of antibiotics for URIs in children: part I. Otitis media and acute sinusitis. *Am Fam Physician.* 1998;54:1113–1118, 1123
13. Dowell SF, Marcy SM, Phillips WR, Gerber MA, Schwartz B. Otitis media—principles of judicious use of antimicrobial agents. *Pediatrics.* 1998;101(suppl):165–171
14. O'Brien KL, Dowell SF, Schwartz B, Marcy SM, Phillips WR, Gerber MA. Acute sinusitis—principles of judicious use of antimicrobial agents. *Pediatrics.* 1998;101(suppl):174–177
15. Rosenstein N, Phillips WR, Gerber MA, Marcy SM, Schwartz B, Dowell SF. The common cold—principles of judicious use of antimicrobial agents. *Pediatrics.* 1998;101(suppl):181–184
16. Schwartz B, Bell DM, Hughes JM. Preventing the emergence of antimicrobial resistance: a call for action by clinicians, public health officials, and patients. *JAMA.* 1997;278:944–945
17. Davis DA, Thompson TA, Oxman AD, Haynes B. Changing physician performance—a systematic review of the effect of continuing medical education strategies. *JAMA.* 1995;274:700–705
18. Bauchner H, Pelton SI, Klein JO. Parents, physicians, and antibiotic use. *Pediatrics.* 1999;103:395–401
19. Mangione-Smith R, McGlynn EA, Elliott MN, Krogstad P, Brook RH. The relationship between perceived parental expectations and pediatrician antimicrobial prescribing behavior. *Pediatrics.* 1999;103:711–718
20. American Academy of Pediatrics, Centers for Disease Control and Prevention, American Society for Microbiology. *Your Child and Antibiotics.* 1997
21. Nielsen E, Sheppard MA. Television as a patient education tool: a review of its effectiveness. *Patient Educ Couns.* 1988;11:13–16
22. American Academy of Pediatrics, Committee on Injury and Poison Prevention. Office-based counseling for injury prevention. *Pediatrics.* 1994;94:566–567
23. Diggle PJ, Kiang KY, Zeger SL. *Analysis of Longitudinal Data.* Oxford, UK: Clarendon Press; 1994:146–168
24. Rosner B. Multisample Inference. In: *Fundamentals of Biostatistics.* 4th ed. Belmont, CA: Wadworth Publishing Company; 1995:314–317
25. Trepka MJ, Belongia EA, Po-Huang C, Davis JP, Schwartz B. The effect of a community intervention trial on parental knowledge and awareness of antibiotic resistance and appropriate antibiotic use in children. *Pediatrics.* 2001;107(1). Available at: www.pediatrics.org/cgi/content/full/107/1/e6
26. Bauchner H, Osganian S, Smith K, Triant R. Improving parent knowledge about antibiotics: a video intervention. *Pediatrics.* 2001;108:845–850
27. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. *Am J Health Promot.* 1997;12:38–48
28. Spencer L, Parcell F, Hallion ME, Adams TB. Applying the transtheoretical model to tobacco cessation and prevention: a review of the literature. *Am J Health Promot.* 2002;17:7–71
29. Ma J, Betts NM, Horacek T, Georgiou L, White A, Nitzke S. The importance of decisional balance and self-efficacy in relation to stages of change for fruit and vegetable intakes by young adults. *Am J Health Promot.* 2002;16:157–166
30. Woods C, Mutrie N, Scott M. Physical activity intervention: a transtheoretical model-based intervention designed to help sedentary adults become active. *Health Educ Res.* 2002;17:451–460
31. Roughead EE, Gilbert AL, Primrose JG. Improving drug use: a case study of events which led to changes in the use of flucoxacillin in Australia. *Soc Sci Med.* 1999;48;845–853
32. Schwartz RH, Freij BJ, Ziai M, Sheridan MJ. Antimicrobial prescribing for acute purulent rhinitis in children: a survey of pediatricians and family practitioners. *Pediatr Infect Dis J.* 1997;16:185–190
33. Todd JK, Todd N, Damato J, Todd WA. Bacteriology and treatment of purulent nasopharyngitis: a double blind, placebo-controlled evaluation. *Pediatr Infect Dis.* 1984;3:226–232
34. Knowles ES, Coker MC, Scott RA, et al. Measurement-induced improvement in anxiety: mean shifts with repeated assessment. *J Pers Soc Psychol.* 1996;71:352–363
35. Barnette JJ. Effects of stem and Likert response option reversals on survey internal consistency: if you feel the need, there is a better alternative to using those negatively worded stems. *Educ Psychol Measur.* 2000;60:361–370

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