ARTICLE

Parental Knowledge About Antibiotic Use: Results of a Cluster-Randomized, Multicommunity Intervention

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ABSTRACT

OBJECTIVE. The goal was to determine the impact of a community-wide educational intervention on parental misconceptions likely contributing to pediatric antibiotic overprescribing.

METHODS. We conducted a cluster-randomized trial of a 3-year, community-wide, educational intervention directed at parents of children <6 years of age in 16 Massachusetts communities to improve parental antibiotic knowledge and attitudes and to decrease unnecessary prescribing. Parents in 8 intervention communities were mailed educational newsletters and exposed to educational materials during visits to local pediatric providers, pharmacies, and child care centers. We compared responses from mailed surveys in 2000 (before the intervention) and 2003 (after the intervention) for parents in intervention and control communities. Analyses were performed on the individual level, clustered according to community.

RESULTS. There were 1106 (46%) and 2071 (40%) respondents to the 2000 and 2003 surveys, respectively. Between 2000 and 2003, the proportion of parents who answered ≥7 of 10 knowledge questions correctly increased significantly in both intervention (from 52% to 64%) and control (from 54% to 61%) communities. We did not detect a significant intervention impact on knowledge regarding appropriate antibiotic use in the population overall. In a subanalysis, we did observe a significant intervention effect among parents of Medicaid-insured children, who began with lower baseline knowledge scores.

CONCLUSIONS. Although knowledge regarding appropriate use of antibiotics is improving without additional targeted intervention among more socially advantaged populations, parents of Medicaid-insured children may benefit from educational interventions to promote judicious antibiotic use. These findings may have implications for other health education campaigns.

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Key Words
antibiotic use, parent education, randomized, prospective trial

Abbreviations
OR—odds ratio
CI—confidence interval

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HIGH RATES OF antibiotic use by young children have contributed to the increase in antibiotic-resistant infections in the community.[1–3] Among *Streptococcus pneumoniae*, the most common bacterial cause of otitis media, meningitis, and pneumonia in young children, 20% to 33% of isolates are no longer susceptible to penicillin[4–7] and 14% to 20% are not susceptible to ≥3 antibiotic classes.[5,6] A substantial portion of prescribed antibiotics is considered nonessential,[8–10] and such prescribing has been attributed partially to parental pressure (real or perceived) on physicians for antibiotic prescriptions.[11,12] One half of pediatric providers report frequent parental pressure to prescribe antibiotics that are not indicated.[11–13] In one survey, one third of physicians reported recently providing an unnecessary antibiotic in response to parental demand.[13] Although education of pediatric providers is needed to reduce perceived parental pressure when none is intended,[14,15] parental education remains necessary to reduce widespread misconceptions about the nature of respiratory tract illnesses and the benefits of antibiotic treatment.

Several studies have revealed widespread misconceptions among parents about the treatment of common pediatric respiratory illnesses.[12,16–18] We surveyed parents to evaluate baseline knowledge of antibiotics[19] before initiation of an educational intervention as part of a cluster-randomized trial in 16 Massachusetts communities to reduce unnecessary prescribing of antibiotics for young children.[20] That survey, conducted in 2000, found widespread misconceptions, including a majority of parents thinking that antibiotics are needed to treat green nasal discharge, uncomplicated cough illness, and "bronchitis," despite the fact that these illnesses are almost always caused by viruses and resolve without therapy. It also found significantly less knowledge about antibiotic indications among parents of Medicaid-insured children, compared with commercially insured children. Previous randomized trials of educational interventions to promote antibiotic knowledge assessed the impact of education on antibiotic prescribing rates[21–23] or parental satisfaction[24] but not parental knowledge. One nonrandomized, community-level study found a significant improvement in parental knowledge after a 1997 educational intervention in Wisconsin.[25] We sought to measure whether a cluster-randomized, multicommunity, educational intervention regarding judicious antibiotic use improved parental knowledge of antibiotic indications for young children.

We report the results of a follow-up survey conducted in 2003 in the same 16 communities. Our cluster-randomized, controlled intervention involved parent and physician educational campaigns to reduce unnecessary antibiotic use in 8 of 16 communities.[20] The cluster-randomized, controlled design enabled us to assess the impact of the community-level educational intervention on parental misconceptions and to describe the secular trends in parental knowledge related to respiratory tract infections and antibiotic use. Our analysis included assessment of the impact on the population overall and particularly among Medicaid-insured families, whose baseline knowledge regarding these topics was lower.

METHODS

Study Design

The 16 Massachusetts communities were selected for the trial on the basis of geographic separation, evidence that few children crossed community boundaries to seek pediatric care, and diversity of size and demographic characteristics based on US Census data.[26] Communities were dichotomized into small and large towns, paired according to a composite of percentage of Medicaid and percentage of racial minority residents (based on US Census 1990 data), and randomized in pairs to intervention or control status by using a computer routine (SAS Institute, Cary, NC).

Eight of the 16 Massachusetts communities received an educational intervention (REACH Mass) to increase knowledge of antibiotic use and to reduce unnecessary prescribing. The intervention occurred through 3 successive cold and flu seasons, from September 2000 through March 2003. Parental education in the intervention communities included 6 mailed newsletters highlighting misconceptions regarding upper respiratory illness, appropriate use of analgesics and antibiotics, and the approach of initial observation without antibiotics ("watchful waiting") for mild ear infections in low-risk patients.[24] Parents were also exposed to educational materials (stickers, posters, pamphlets, and fact sheets) in waiting rooms of local pediatric providers, pharmacies, and child care centers in intervention communities.

Similar to the preintervention parent survey in 2000,[19] we mailed postintervention surveys in 2003 to randomly selected households with children <6 years of age who were insured by 4 collaborating health plans, namely, Harvard Pilgrim Health Care, Blue Cross Blue Shield of Massachusetts, Tufts Health Plan, and Mass Health (the Massachusetts Medicaid program). Addresses were limited to the zip code areas of 16 Massachusetts communities.

The number of mailings was increased in 2003 on the basis of the response rate for the preintervention survey,[19] with the goal of achieving 100 respondents per community. Health plan enrollment files were sampled randomly to select addresses for ~200 commercially insured patients and 150 Medicaid-insured patients from each community. Medicaid-insured families were oversampled to allow for specific assessment of this subpopulation and to account for a lower expected response rate. In this repeated cross-sectional design, no attempt was made to survey (or to exclude from surveying) the same individuals in the 2 time periods or to ensure that respondents had been exposed to intervention activities or materials. In May 2003, 5580 surveys were mailed, accompanied by a letter that described the research study and offered a children's book as an incentive to participate. Respondent identity was not recorded, and response to the survey was assumed to imply consent to participate. In June and July 2003, 2 additional survey mailings were sent to nonresponders. The study was conducted with approval of the institutional review board of Harvard Pilgrim Health Care.

Survey Instrument, Outcome Measures, and Analysis

Identical survey items were used in 2000 and 2003, with many adapted from 2 previously published studies.[17,19] Questions were targeted for a seventh-grade reading level but included some medical language in specific questions assessing how respondents interpret medical terminology commonly used in public settings (eg, virus, bacteria, and antibiotics). Eight of 10 knowledge questions focused on the role of antibiotics for specific childhood upper respiratory illnesses, and 2 focused on the difference between viral and bacterial infections. Respondents were instructed to answer the questions by assuming that the child had the described symptoms for 3 to 5 days. Acceptable responses were adapted from the Centers for Disease Control and Prevention/American Academy of Pediatrics principles for judicious antibiotic use.[8] Three additional items were used to assess the proclivity of parents to demand antibiotics.

We calculated the percentages of correct responses to each of the 10 antibiotic knowledge questions and the percentages of affirmative responses to the 3 antibiotic demand questions in 2000 and 2003, stratified by intervention and control communities. Differences within each question were evaluated with χ^2 tests. We evaluated the proportion of parents with a high level of antibiotic knowledge by using an a priori threshold-based knowledge score of ≥7 of 10 questions correct. We also assessed the proportion of parents with a tendency to demand antibiotics by using a threshold of ≥1 of 3 questions answered affirmatively. Secular trends in threshold-based scores were evaluated by using 2-sample tests of binomial proportions. Because these thresholds were selected arbitrarily, we also performed an evaluation of the change in mean scores after the intervention. Finally, we performed the single subanalysis of parents of Medicaid-insured children (versus commercially insured children) as the postintervention correlate to the previously published baseline data on parental antibiotic knowledge.[19]

To test the impact of the educational intervention on parental knowledge and demand beyond secular trends, we conducted multivariate analyses of individual responses, accounting for clustering within communities and adjusting for baseline parental knowledge in each community. We also assessed additional parent (age, race, employment, and education) and child (age, Medicaid status, and group child care participation) variables as potential confounders. Models were restricted to parent responders. The impact of the intervention was determined by using mixed-effects regression models (GLIMMIX macro and PROC MIXED in SAS, version 8.2; SAS Institute, Cary, NC). Stratified analyses were performed to assess different educational effects among parents of Medicaid-insured versus commercially insured children.

RESULTS

Response Rates

Of 5580 surveys mailed in 2003, 452 were excluded (266 for incorrect address, 128 for child age outside the intended age range, and 58 for nonparent respondent). Of the remaining 5128 surveys, 2071 (40%) were returned, similar to the 46% response rate in 2000 (n = 1106).[19] Response rates were similar in control (median: 37%; range: 31%–43%) and intervention (median: 40%; range: 24%–44%) communities. Overall, Medicaid enrollees had a lower response rate, compared with commercial plan enrollees (25% vs 50% in 2003; $P < .01$). The majority of respondents were white mothers, 31 to 40 years of age, who had received some college education (Table 1). No substantial demographic differences were seen between respondents from control and intervention communities in either 2000 or 2003. Parents of Medicaid-insured children were, on average, more likely to be younger, to be nonwhite, and to have less formal education.

Secular Trends

Although large proportions of incorrect responses persisted for certain questions between the 2000 and 2003 surveys, there were several questions for which the proportions of correct responses increased substantially in control communities, which suggested secular trends toward improved knowledge without intervention (Table 2). For example, 18% in 2000 knew that green nasal discharge was not an antibiotic indication, compared with 31% in 2003 ($P < .001$). Substantial improvements in the percentage correct were seen for items on middle ear fluid (41% in 2000 vs 50% in 2003; $P < .001$) and the general question of whether antibiotics were needed for colds and flu (66% in 2000 vs 77% in 2003; $P < .001$). In control communities, the mean number of knowledge items answered correctly increased from 6.2 to 6.7 ($P < .001$), and the proportion with correct answers to ≥7 items increased from 54% in 2000 to 61% in 2003 ($P < .01$) (Table 3). Despite these improvements, we noted that most parents still thought that antibiotics were indicated for middle ear fluid and runny nose/green nasal discharge. There was less improvement in knowledge regarding bronchitis and whether colds are caused by viruses or bacteria. As in 2000, the majority of

TABLE 1 **Characteristics of Parent Respondents in 2000 and 2003, According to Randomization Arm and Child's Insurance Status**

	Study Year and Randomization Arm				Insurance Status[a]	
	2000		2003		Medicaid	Non-Medicaid
	Intervention	Control	Intervention	Control		
No.	534	537	1034	1037	802	2340
Parent						
Mother, %	91	90	91	92	95	90
Age, %						
<30 y	34	30	25	24	52	19
31–40 y	56	55	64	62	39	67
>40 y	10	16[b]	11	14[b]	9	14
Race, %						
White	90	86	86	84	73	90
Black	1	1	4	2[b]	6	1
Hispanic	2	4[b]	2	4[b]	7	2
Other	7	8	8	10	13	7
Education, %						
Less than high school	3	4	3	3	10	1
College graduate	47	39[b]	38	36	24	69
High school graduate, some college	50	57[b]	59	60	67	30
Employed, %	72	66[b]	64	62	56	68
Child						
Age, mean ± SD, y	3.3 ± 1.6	3.3 ± 1.6	3.7 ± 1.7	3.8 ± 1.6	3.9 ± 1.7	3.5 ± 1.6
Female, %	48	46	50	48	48	49
In child care, %	63	66	60	60	60	62
Healthy self-report, %[c]	86	91[b]	86	91[b]	81	91
Medicaid-insured, %	27	25	26	25	100	0

[a] Medicaid and non-Medicaid categories include children from both intervention and control communities in both survey years.

[b] $P < .05$, comparing intervention and control groups within survey year.

[c] Parent respondent reported child as having very good or excellent health.

parents knew whether antibiotics should be prescribed for sore throat, strep throat, and ear infections (Table 2).

Parents of Medicaid-insured children had significantly lower antibiotic knowledge, compared with parents of commercially insured children, on the basis of the mean number of items answered correctly and the proportion answering ≥7 of 10 items correctly at baseline ($P < .001$) (Table 3). Furthermore, there was no increase in antibiotic knowledge between 2000 and 2003 among parents of Medicaid-insured children in control communities (42% answered ≥7 of 10 items correctly in 2000, compared with 43% in 2003). Conversely, parents of commercially insured children in control communities had higher knowledge scores in 2003, compared with 2000 (58% answered ≥7 of 10 items correctly in 2000, compared with 67% in 2003; $P = .002$) (Table 3).

There was no significant difference in the mean scores or the proportions of respondents answering affirmatively to any question designed to assess parents' proclivity to demand antibiotics. There was no change in the percentage of parents responding affirmatively to ≥1 of these items (26% in 2000 and 28% in 2003; $P = .5$) in control communities.

Intervention Impact

A total of 171 respondents (17%) recalled the REACH intervention by name as a source of information regarding antibiotic use, among those surveyed in intervention communities in 2003. At baseline, there was no difference in the proportions of parents answering ≥7 of 10 questions correctly between control and intervention communities (Table 3). Among intervention communities, we found significantly higher knowledge scores in 2003, compared with 2000 (52% with ≥7 of 10 correct responses in 2000, compared with 64% in 2003; $P < .0001$). However, as noted above, control communities also showed significantly higher knowledge scores in 2003, compared with 2000 (54% with ≥7 of 10 correct responses in 2000, compared with 61% in 2003; $P < .01$). When controlling for baseline knowledge scores and additional parent and child characteristics in multivariate models that accounted for community clustering, we found no overall intervention effect (Table 4). There was also no intervention effect on mean knowledge scores of intervention communities when compared with control communities (mean score improvement: 0.1 questions; 95% confidence interval [CI]: −0.2 to 0.4 questions) in similar multivariate models. In general, parents who were college graduates, were older, were white, were nonworking, or had a commercially insured child who was ≥12 months of age were significantly more likely to answer ≥7 of the 10 questions correctly. There was no intervention effect for items designed to measure proclivity to demand antibiotics.

TABLE 2 Responses to Parent Survey Questions

	Acceptable/Affirmative Responses[a]	Proportion With Acceptable/Affirmative Response, %[a]			
		2000		2003	
		Intervention	Control	Intervention	Control
Total knowledge					
1. How often are antibiotics needed for middle ear fluid?	Sometimes or almost never	42	41	53	50
2. How often are antibiotics needed for deep cough or bronchitis?	Almost never	7	9	11	10
3. How often are antibiotics needed for colds or flu?	Almost never	70	66	79	77
4. How often are antibiotics needed for runny nose or green nasal drainage?	Almost never	26	18	35	31
5. How often are antibiotics needed for sore throat?	Sometimes or almost never	90	86	91	90
6. How often are antibiotics needed for strep throat?	Almost always	87	88	88	86
7. How often are antibiotics needed for ear infection?	Sometimes or almost always	96	96	96	95
8. If my child does not receive an antibiotic for cold, cough, and flu symptoms, he/she will be sick for a longer time.	Disagree or strongly disagree	65	67	79	77
9. Are antibiotics helpful in treating bacterial infections, viral infection, or both?	Bacterial	64	68	71	68
10. Are most cold, cough, and flu illnesses caused by bacteria or viruses?	Viruses	77	76	79	78
Demand questions					
1. If I expect an antibiotic, I am less satisfied with the doctor visit if I do not receive one.	Strongly agree or agree	13	15	14	15
2. I would rather give my child an antibiotic that may not be needed than wait to see if he/she gets better without it.	Strongly agree or agree	8	8	8	8
3. If a doctor does not prescribe an antibiotic when I think one is needed, I will take my child to another doctor.	Strongly agree or agree	9	10	12	13

Response rates for individual questions ranged from 96% to 99%.

[a] Acceptable responses for total knowledge; affirmative responses for demand questions.

TABLE 3 Scores Measuring Antibiotic Knowledge in 2000 and 2003

	Proportion With ≥7 of 10 Knowledge Questions Correct, %						Crude OR (95% CI)[a]
	Intervention			Control			
	2000	2003	Change	2000	2003	Change	
Total cohort	52	64	12[b]	54	61	7[b]	1.2 (0.9–1.6)
Medicaid	34	51	17[b]	42	43	1	1.9 (1.0–3.7)[b]
Non-Medicaid	58	68	10[b]	58	67	9[b]	1.0 (0.7–1.5)

Analyses were restricted to respondents with a sufficient number of answered questions for score calculation.

[a] Controlling only for survey year and community intervention/control status.

[b] $P < .05$.

Medicaid Subanalysis: Secular Trend and Intervention Impact

In contrast to the lack of an overall intervention effect, the data showed a significant intervention impact among parents of Medicaid-insured children. In intervention communities, the proportion of parents of Medicaid-insured children with ≥7 of 10 items correct increased 17% (from 34% in 2000 to 51% in 2003; $P = .02$) (Table 3); in contrast, the proportion of parents of Medicaid-insured children who met this threshold did not change in control communities (42% and 43% in 2001 and 2003, respectively). The mean number of correct responses increased from 5.6 questions to 6.3 questions in intervention communities ($P = .001$) and from 5.5 questions to 5.9 questions in control communities (not significant). In adjusted models accounting for community clustering (Table 4), exposure to the educational intervention increased the proportion of parents of Medicaid-insured children who had a high degree of antibiotic knowledge (answered ≥7 of 10 items correctly) (adjusted odds ratio [OR]: 2.2; 95% CI: 1.1–4.5; $P = .03$), although there was no significant intervention effect when mean knowledge scores were evaluated in the same population (mean score improvement: 0.3 points; 95% CI: −0.3 to 0.9 points; $P = .3$).

After finding the selective impact of our intervention among parents of Medicaid-insured children, we sought to identify demographic or educational explanatory variables for which Medicaid insurance coverage could be a surrogate. Parents of Medicaid-insured children were

TABLE 4 **Multivariate Models Evaluating Parental Knowledge of Antibiotics**

	OR (95% CI)		
	Total Cohort	Medicaid	Non-Medicaid
Knowledge (≥7 of 10 items correct)			
Year of survey (2003 vs 2000) among control communities	1.3 (1.0–1.6)	1.1 (0.7–1.7)	1.4 (1.1–1.9)
Parent characteristics			
Age of >30 y	1.5 (1.2–1.8)	1.5 (1.1–2.1)	1.5 (1.2–1.9)
White race	1.8 (1.4–2.3)	2.4 (1.6–3.6)	1.5 (1.1–2.1)
College graduate	2.1 (1.8–2.6)	2.5 (1.7–3.7)	2.1 (1.7–2.6)
Employed	0.8 (0.7–1.0)	0.9 (0.6–1.3)	0.8 (0.6–0.9)
Child characteristics			
Age of ≥12 mo	1.7 (1.2–2.4)	1.4 (0.7–2.8)	1.8 (1.3–2.6)
Group child care	1.1 (0.9–1.3)	1.1 (0.8–1.5)	1.2 (1.0–1.4)
Medicaid-insured	0.7 (0.6–0.8)	NA	NA
Intervention effect[a]	1.2 (0.8–1.7)	2.2 (1.1–4.5)	1.0 (0.6–1.4)

The knowledge outcome was based on answering ≥7 of 10 survey questions correctly. The model was limited to parent responders. NA indicates not applicable.

[a] The effect was measured as an interaction term between intervention/control status and time.

more likely to be younger, to be nonwhite, to be less educated, to be a stay-at-home parent, and to have an older child, compared with parents of commercially insured children. Accounting for these additional predictors in the multivariate model for the total cohort reduced the magnitude of the negative association of Medicaid insurance with higher knowledge scores by approximately one half (unadjusted OR: 0.4; 95% CI: 0.3–0.5; adjusted OR: 0.7; 95% CI: 0.6–0.8).

DISCUSSION

We found that a 3-year, multifaceted, educational intervention that targeted parents, physicians, pharmacies, and large group child care centers did not improve overall community-level parental knowledge about antibiotics beyond the noted secular trend. However, there was a significant selective intervention effect in increasing the proportion of parents of Medicaid-insured children with a high level of antibiotic knowledge.

The lack of an overall intervention effect might be attributable to concurrent national and regional efforts to increase knowledge about antibiotic prescribing for children by the Centers for Disease Control and Prevention,[27,28] professional medical organizations,[29] and state-based coalitions.[30–33] During the intervention phase, the National Committee for Quality Assurance released drafts of 2 Health Plan Employer Data and Information Set measures focusing on appropriate antibiotic prescribing for children with upper respiratory infection and pharyngitis.[34] These performance measures were adopted formally for health plan reporting in 2004. Private organizations also have served as clearinghouses for information on antibiotic resistance.[35] Complementing these efforts, or perhaps of greater importance, has been the attention of the lay press given to the issue of antibiotic resistance, often framed in dramatic terms, such as the emergence of "superbugs."[35–39] The significant increase in knowledge regarding antibiotic indications between the survey years among the control communities supports this explanation.

Despite the lack of an overall effect in these communities, the intervention had a significant impact on parents of Medicaid-insured children. Fewer parents of Medicaid-insured children had a high level of antibiotic knowledge at baseline, and there was evidence of a much smaller secular trend of increased knowledge among those respondents. The lower baseline percentage of parents of Medicaid-insured children with high antibiotic knowledge levels and the lack of secular improvement over time may be indicative of limited access to health-related information from other sources. These results highlight the possible additional benefit of focusing health education resources on Medicaid-insured families even in the presence of more global public health campaigns. Our direct-to-consumer mailings might have provided some Medicaid families with their first exposure to information related to antibiotic indications and clarification of common parental misconceptions, compared with other families, who might have received these messages through other channels. In addition, the larger proportion of parents of Medicaid-insured children who had a low level of antibiotic knowledge at baseline might have enhanced our ability to produce and to detect a significant intervention impact.

Medicaid insurance is a surrogate for other socioeconomic variables that may explain lower antibiotic knowledge. Although Medicaid insurance remained significant after adjustment for potential confounders such as parental age, education, and nonwhite race, we did not measure other important variables (such as literacy or income) that might explain the residual association of lower knowledge scores with Medicaid insurance. Future work in this area is important, because public health education should be targeted to those most likely to benefit. Although the source of health insurance per se is not an attribute that affects health-related knowledge directly, it may be an administratively simple way to identify a population more likely to benefit from targeted educational campaigns. It was not possible for us to identify whether a specific component of the educational intervention (parent mailings, Web site, or pharmacy/child care/clinic materials) was responsible for improvements in antibiotic knowledge or whether the multifaceted approach was needed.

Despite improvements in parental knowledge, frequent misconceptions related to antibiotics persist. In 2003, 30% of parents still thought that antibiotics treated viral illnesses, 70% thought that antibiotics were needed for green nasal discharge, and 90% thought that antibiotics were needed for cough illnesses. It is possible that such misconceptions will continue to diminish over time, although we think that additional concerted efforts to reduce misconceptions will continue to be necessary, particularly for less-advantaged populations. Reducing antibiotic-related misconceptions may improve a component of antibiotic overprescribing. A parent's request for information or reassurance about the natural history of an illness is often perceived by physicians as pressure for antibiotics.[14,15] Increased understanding of the uses and misuses of antibiotics may improve physician-parent discussions and prevent unnecessary prescribing. In fact, the frequency of antibiotic prescribing is declining.[40,41] Studies evaluating US antibiotic use for children demonstrated a 40% decline in antibiotic prescriptions per 1000 children per year,[41] which likely reflects information reaching prescribers and parents through a number of complementary channels.

There are several limitations to this study. Survey respondents (40% of those receiving mailings) might be more likely than others to be concerned about antibiotic overprescribing. In addition, the lower response rate for parents of Medicaid-insured children might have limited the representativeness of our sample; use of lower-literacy questions, a multilanguage questionnaire, or a small financial incentive might have increased the response rate to that seen for parents of commercially insured children.[42–45] Although similarly low response rates for mailed surveys have been reported for Medicaid populations,[19,42–44,46] we acknowledge that our findings are based on a minority (25%) of respondents and might not reflect improvement in antibiotic knowledge throughout the Medicaid population. Nevertheless, because this was a randomized trial and response rates were similar among intervention and control communities, we would not expect any differential bias in the determination of intervention effects.

A second explanation for the lack of an overall intervention effect might be our cross-sectional survey design. Because we did not collect identifiers from the parents surveyed, our analysis was not based on survey responses from the same parents before and after the intervention. This meant that we could report only community-level changes, rather than improvements on an individual level. If there was substantial flux into or out of our intervention communities, then the postintervention survey might reflect respondents who were not in the community at the time of the REACH intervention. Families of the youngest children would not have received the entire 3-year intervention. Nevertheless, the goal of this community-level campaign was to change antibiotic-related knowledge and attitudes of whole communities. The analysis reported here, although conservative, is most consistent with that goal.

In addition, when interpreting the intervention effect in improving knowledge among parents of Medicaid-insured children, we cannot comment on the actual clinical impact of a 17% increase in parents with high antibiotic knowledge levels or a twofold increase in the odds of answering 7 of 10 antibiotic-related questions correctly. Whether this increase in knowledge translates to shorter physician visits or decreased inappropriate antibiotic use will need to be studied further.

CONCLUSIONS

We report both a significant secular trend toward increased knowledge of appropriate antibiotic use among parents of young children in multiple communities and a substantial effect of a concerted educational campaign in increasing knowledge of antibiotic indications among Medicaid-insured families. Had we conducted this study in the absence of control communities, we would have concluded that the intervention had a large, successful, community-wide impact on knowledge across the study period. Instead, multivariate models accounting for baseline knowledge and secular trends revealed no significant effect of the intervention on knowledge scores over and above secular changes in similar control communities. Such community-wide education campaigns to improve health-related knowledge may still be useful for other health issues for which fewer alternative sources of information exist. Even in the context of ongoing public education, this trial supports targeted intervention for families of Medicaid-insured children, who may not receive messages distributed through other channels. Strategies for delivering key public health messages must be adjusted to reach the diverse populations within a single community effectively.

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