

# Impact of a Child Care Educational Intervention on Parent Knowledge about Appropriate Antibiotic Use

Donita R. Croft, MD, MS; Mary Jo Knobloch, MPH; Po-Huang Chyou, PhD; Darcy Vanden Elzen; Carolyn Janette, MEd; Jeffrey P. Davis, MD; Richard E. Besser, MD; Edward A. Belongia, MD

## ABSTRACT

**Background:** Parent education is an integral component to promoting judicious antibiotic use. Opportunities to educate parents directly are limited. Child care providers are in a position to relay information to parents.

**Methods:** A group-randomized trial assessed the impact of a child care center staff intervention on parental knowledge and attitudes regarding appropriate antibiotic use. A 9-point knowledge score and 3 attitude items were measured.

**Results:** Surveys were returned by 151 (51%) of 298 intervention center parents and 150 (42%) of 361 control center parents. Intervention center respondents were significantly more likely than control center respondents to be college graduates, non-Hispanic white, and insured. Among college graduates, the median knowledge score was 7.0 at intervention centers and 6.5 at control centers ( $P < 0.01$ ). No significant differences were found in knowledge scores among noncollege educated parents ( $P = 0.11$ ). After adjusting for clustering within child care centers, multivariate analysis demonstrated high knowledge score was associated with white race ( $P = 0.02$ ), being a college graduate ( $P = 0.02$ ), and being in the intervention group ( $P = 0.06$ ).

**Conclusion:** An appropriate antibiotic use program for

child care providers promotes better knowledge among parents of children aged  $< 5$  years, particularly among highly educated parents.

## INTRODUCTION

The growing problem of antimicrobial resistance has focused attention on the importance of judicious antimicrobial use. Although the overall rate of antimicrobial prescribing for children has declined since 1990, children with viral respiratory illnesses are still frequently prescribed antibiotics that provide no benefit.<sup>1-4</sup> Approximately a quarter of adults in the United States believe an antibiotic will cure a cold, and widespread public misconceptions exist regarding the appropriate use of antibiotics for cough and flu symptoms.<sup>5-7</sup> Patient expectations influence physician prescribing behavior,<sup>8</sup> and interventions to improve antibiotic prescribing have been successful when they include both physician education and patient or community education.<sup>9-13</sup>

Parents of children attending group child care facilities represent a target audience for education regarding appropriate antibiotic use because children in these settings have high rates of respiratory illness and frequent carriage of drug-resistant *Streptococcus pneumoniae*.<sup>14-18</sup> Transmission of antibiotic-resistant pathogens in group child care settings is a particular concern because of the frequent hand-to-mouth behavior of young children, limited personal hygiene skills, and crowded conditions.

Child care providers are easily identified and are often interested in educational programs regarding children's health issues. An educational program for child care providers and parents was developed and implemented by the Wisconsin Antibiotic Resistance Network (WARN) during 2000-2001 as part of a state-wide project to educate Wisconsin physicians and the general public on appropriate antibiotic use. These on-site presentations regarding appropriate antibiotic use and infection control were well received by child care

**Author Affiliations:** Epidemic Intelligence Service assigned to the Wisconsin Division of Public Health, Centers for Disease Control and Prevention, Atlanta, Ga (Croft); Bureau of Communicable Diseases and Prevention, Wisconsin Division of Public Health, Madison, Wis (Croft, Davis); Marshfield Clinic Research Foundation, Marshfield, Wis (Knobloch, Chyou, Vanden Elzen, Belongia); Meriter Hospital, Madison, Wis (Janette); Respiratory Diseases Branch, Division of Bacterial and Mycotic Diseases, National Center for Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Ga (Besser).

**Corresponding Author:** Donita R. Croft, MD, MS, 600 Highland Ave #9988, Madison, WI 53792; e-mail dc2@@medicine.wisc.edu.

providers. Attendance by parents was very low and opportunities to reach them directly in other ways were limited. However, child care providers were in a unique position to pass along information about antibiotic use to parents. For these reasons, we initiated an educational intervention for child care providers, expecting them to disseminate information and materials to parents. To assess the impact of this novel intervention, we conducted a controlled, group-randomized study in licensed child care facilities. The primary objectives of the study were to determine whether child care staff passed along information and materials to parents after a presentation on appropriate antibiotic use and whether on-site presentations to child care center staff led to improved parent knowledge and attitudes regarding appropriate antibiotic use.

## METHODS

### *Identification and Recruitment of Child Care Facilities*

A database of licensed facilities was obtained from the Wisconsin Department of Regulation and Licensing. Group child care centers in Wisconsin were eligible to be selected for this study if they had a licensed capacity of 50-70 children, which represented the 67th to 80th percentile in size. The capacity restriction eliminated the largest and smallest facilities, and the eligible group represented those facilities thought to be large enough to justify the travel and expense of on-site presentations while still providing broad geographic representation in urban and rural regions of the state. Among 547 child care facilities meeting the initial capacity criteria, 265 (48%) were excluded because they met 1 or more exclusion criteria: (1) they had no children aged <5 years (n=56), (2) they were open <12 months each year (n=29), (3) they had previously received WARN educational materials or presentations (n=56), or (4) they had participated in a previous WARN survey of child care administrators regarding institutional policies for acute respiratory illness in children (n=124). The remaining 282 facilities comprised the sampling frame of eligible facilities.

During the first quarter of 2001, the centers were randomly assigned to the intervention and control groups and recruited sequentially until at least 300 parents were represented per group. WARN staff telephoned the administrator of each facility to assess interest in participation. The initial messages were different for intervention and control facilities. Intervention facilities were asked if they would allow an on-site presentation by WARN staff to discuss respiratory infections in children, appropriate antibiotic use, and infection control. This inquiry

was followed by a formal letter requesting an on-site presentation. To minimize selection bias, we did not tell staff at facilities that agreed to the presentation they would be invited to participate in a subsequent survey of parents. Within 30 days after the presentation, the child care administrators were recontacted and asked if they would be willing to distribute a survey to parents regarding "management of respiratory infections in children." In discussions with child care administrators and staff, the on-site presentation and the subsequent parent survey were represented as independent, unrelated activities. To reduce the likelihood that the survey itself would alter staff behavior and communication with parents, we did not disclose the primary hypothesis regarding distribution of WARN materials and information to parents. Control group administrators were also invited to distribute a parent survey on "management of respiratory infections in children." The control child care centers received no information or materials regarding appropriate antibiotic use or antibiotic resistance. Survey packets and reminder cards were sent to control site administrators during the same 10-week period they were sent to intervention sites.

### *Educational Intervention and Materials*

Two WARN health educators, each involved with development of the WARN child care program and experienced in giving the presentation, individually traveled to the intervention child care facilities and presented the program to child care providers. Parents were not invited to these presentations because the primary hypothesis related to distribution of materials and information by child care staff. Each WARN health educator used a scripted, 45-minute slide show that addressed the differences between bacterial and viral infections, infection control methods within child care facilities, and basic principles regarding antimicrobial resistance and appropriate antibiotic use. Minor variations in the program occurred depending on the health educator, audience questions, and the child care center environment during the presentation. Health educators provided the intervention center staff with a standard set of WARN materials for distribution to parents. These materials included stickers, brochures, coloring sheets, posters, and parent handouts in sufficient quantities to distribute to all parents of children aged <5 years.

### *Parent Survey*

Survey packets and reminder cards were sent to intervention site administrators at least 30 days after the presentation with written instructions about procedures and expectations. Each survey packet included a cover letter,

**Table 1.** Questions Used to Assess Knowledge of Appropriate Antibiotic Use for Pediatric Respiratory Illness

Question*	Correct Response(s)
1. Most cough, cold and flu illnesses are caused by: Bacteria/Viruses.	Viruses
2. Antibiotics, such as penicillin, are used to treat: Bacterial Infections/ Viral Infections/Both.	Bacterial Infections
3. My child will be sick for a longer time if he/she does not receive an antibiotic for cough, cold or flu symptoms: Agree/Disagree	Disagree
<b>How often do you believe antibiotics are needed for the following symptoms. Assume that your child's symptoms have been present for less than one week.</b>	
4. Middle ear infection	Always/Almost Always/Sometimes
5. Sore throat not caused by Strep	Never/Almost Never
6. Cold	Never/Almost Never
7. Cough without fever	Never/Almost Never
8. Runny nose with green or yellow mucous	Never/Almost Never/Sometimes
9. Bronchitis	Never/Almost Never

\* Items 4-9 were answered using a 5-point Likert scale, ranging from "always" to "never." The knowledge score was defined as the number of items answered correctly (possible scores were 0-9).

a survey with a nominal incentive attached, and a return envelope. The number of survey packets sent to each child care administrator for distribution to parents/primary caregivers was based on the administrator's report of how many children aged <5 years attended the facility.

Parents were eligible to participate if they had a child who was not yet in kindergarten and who attended the child care facility at least 1 day per week. One parent of each child (the mother or primary care giver) was asked to complete the survey. Respondents were instructed to fill out the survey only once no matter how many children in their family attended the facility. Parents who were also child care providers at their child's facility were excluded.

The child care center administrators did not supply identifying or demographic information about their clients because this was proprietary information. The administrators were responsible for distributing survey packets to parents because investigators did not have access to parents' names and addresses. After completion, survey forms were mailed directly to the Marshfield Clinic Research Foundation in a business-reply envelope. To maximize participation, each facility was asked to distribute reminder cards 1 week after distributing survey packets. After completion of the surveys, each facility received a payment of \$50 as partial compensation for time spent on the project. Control group child care facilities were offered the WARN child care educational program after the study was completed.

The survey instrument was adapted from a previous telephone survey to assess knowledge, attitudes, and beliefs regarding respiratory illness and antibiotic use.<sup>7</sup> A knowledge score was created to assess familiarity with

bacterial versus viral infections and knowledge of antibiotic indications for different respiratory diagnoses or symptoms (Table 1). The survey included 3 attitude/belief questions, each rated on a 5-point scale from "strongly agree" to "strongly disagree." In addition, questions were asked about the respondent's exposure to information about antibiotic resistance and about their demographic characteristics. The reading level of the survey instrument was grade 7.7 (Flesch-Kincaid test).

### *Statistical Analysis*

Primary outcome measures were receipt of information from the child care center, the cumulative 9-point knowledge score, and responses to the 3 attitude/belief questions. Intervention and control facilities were initially compared by using univariate logistic regression, with stratification based on education level. Continuous variables were compared by using the Wilcoxon rank sum test. A multiple logistic regression model was created to identify independent predictors of a high knowledge score (> median) after adjustment for child care clusters and other covariates. Data were analyzed by using SAS 8.0 (SAS Institute, Cary, NC) and SUDAAN.

A sample of 150 intervention parents and 150 control parents was selected to provide 80% power to detect a 20% difference in the proportion answering a specific item correctly ( $\alpha=0.05$ ). We anticipated a response rate of 50%, so the initial sample included 300 parents each in the intervention and control groups.

### *Human Subjects Protection*

Respondents in this survey were anonymous, and this study was determined to be exempt from review by the Marshfield Clinic and the CDC Institutional Review Board.

**Table 2.** Demographic Characteristics of Parent Respondents from Intervention and Control Child Care Facilities

	Intervention Group (n=151)	Control Group (n=150)	P-value
Age (mean +/- SD)	32.4 +/- 5.7	32.0 +/- 5.6	0.54
Mother	147 (97%)	143 (95%)	0.35
Non-Hispanic white	146 (97%)	129 (83%)	0.01
Medical assistance/uninsured	9 (6%)	24 (16%)	<0.01
College graduate	82 (54%)	49 (33%)	<0.01

SD=standard deviation.

**Table 3.** Univariate Comparison of Antibiotic Knowledge and Attitudes Among College Graduate Parents at Intervention and Control Child Care Facilities

	Intervention Parents (n=82)	Control Parents (n=49)*	P-value
Read or saw information about antibiotic resistant infections at child's day care center	34 (44%)	11 (23%)	0.02
Day care center gave parent a brochure or other educational materials about careful use of antibiotics	43 (55%)	14 (29%)	<0.01
Knowledge score on appropriate antibiotic use (median; 25 <sup>th</sup> to 75 <sup>th</sup> percentile)	7 (6 to 7)	6.5 (5 to 7)	<0.01
	<b>Attitudes and Beliefs</b>	<b>No. (%) Agreeing</b>	<b>No. (%) Agreeing</b>
My child is more likely to develop an infection that is hard to treat if he/she takes antibiotics when they are not needed	72 (88%)	35 (73%)	0.03
I may ask my child's doctor for an antibiotic when my child has cough, cold or flu symptoms.	1 (1%)	3 (6%)	0.12
I usually know if my child needs an antibiotic before I take him/her to the doctor for cough, cold or flu symptoms.	26 (32%)	24 (49%)	0.05

\* One respondent in the control group did not answer the educational level question and was excluded from these analyses.

## RESULTS

Seven child care facilities were recruited in the intervention facilities group, and 9 were recruited into the control facilities group. All facilities agreed to participate, except 1 intervention facility that received the educational presentation but declined to distribute the parent survey. The median number of children aged <5 years was 50 (range: 39-60) at the intervention facilities and 40 (range: 30-50) at the control facilities.

Surveys were completed and returned by 151 (51%) of 298 parents at intervention facilities and 150 (42%) of 361 parents at the control facilities. Significant differences were noted in the demographic characteristics of the 2 groups. Among respondents, parents of children at the intervention facilities were more likely than parents of children attending control facilities to be college graduates, insured, and non-Hispanic white (Table 2). No difference was observed in the respondents' ages, and nearly all were mothers of 1 or more children attending the child care center.

Differences in education and socioeconomic status between the groups were greater than expected, largely as a result of the clustering of these characteristics within

child care facilities and the limited number of facilities that were sampled. We therefore elected to conduct a stratified analysis by using college education as a surrogate for socioeconomic status. This analysis included 131 college graduates and 169 noncollege graduates, which provided 80% power within each group to detect a 25% absolute difference in a categorical outcome measure ( $\alpha=0.05$ ). One respondent from the control group did not answer the educational level question and was excluded from these analyses. Racial/ethnic diversity and variability in health insurance status was insufficient to stratify the analyses by these variables.

### College Graduates

The college graduate intervention parents recalled receiving the educational materials significantly more frequently than the college graduate control parents, and they were more likely to report reading or seeing information on careful antibiotic use at the child care center (Table 3). Compared with control parents, college graduate intervention parents scored higher on the cumulative 9-point knowledge score, and less variation was noted in their scores.

**Table 4.** Univariate Comparison of Antibiotic Knowledge and Attitudes Among Non-College Graduate Parents at Intervention and Control Child Care Facilities

	Intervention Parents (n=69)	Control Parents (n=100)*	P-value
Read or saw information about antibiotic resistant infections at child's day care center	19 (28%)	18 (18%)	0.15
Day care center gave parent a brochure or other educational materials about careful use of antibiotics	20 (29%)	18 (18%)	0.09
Knowledge score on appropriate antibiotic use (median; 25 <sup>th</sup> to 75 <sup>th</sup> percentile)	6 (5 to 7)	6 (5 to 7)	0.20
	Attitudes and Beliefs	No. (%) Agreeing	No. Agreeing
My child is more likely to develop an infection that is hard to treat if he/she takes antibiotics when they are not needed.	50 (72%)	57 (58%)	0.06
I may ask my child's doctor for an antibiotic when my child has cough, cold or flu symptoms.	6 (9%)	20 (20%)	0.05
I usually know if my child needs an antibiotic before I take him/her to the doctor for cough, cold or flu symptoms.	31 (46%)	51 (51%)	0.55

\* One respondent in the control group did not answer the educational level question and was excluded from these analyses.

Significant differences were found between the intervention and control groups on some of the attitude and belief questions. Intervention parents were significantly more likely to agree with the statement that their child is more likely to develop a hard-to-treat infection if the child takes antibiotics when not needed. They were less likely to believe they know when their child needs an antibiotic before seeing a physician. Only a small proportion of college graduate parents indicated that they might ask their doctor to prescribe antibiotics for cough, cold, or flu illness in their children, and no significant difference was found between the intervention and control groups.

#### *Noncollege Graduates*

Fewer differences were noted in outcome measures between intervention and control facilities when the analysis was restricted to persons who were not college graduates. A greater proportion of intervention parents recalled receiving a brochure or written information from the child care center, but the difference did not reach statistical significance (Table 4). The differences between intervention facility parents' and control facility parents' responses approached statistical significance when asked if they might ask for antibiotics in the future to treat cough, cold, or flu symptoms in their child, and if they were more likely to agree with the statement that their child might develop a hard-to-treat infection if the child takes antibiotics when not needed. No significant difference was found in the cumulative 9-point knowledge scores between the noncollege graduate intervention and control parents.

#### *Multivariate Analysis*

Multivariate analysis was performed to identify fac-

tors associated with greater knowledge after adjusting for the design effect of child care facility clusters. This analysis included both college-educated and noncollege-educated parents, and the primary hypothesis was that parents in the intervention group were more likely to have a high knowledge score after controlling for child care clusters and other covariates. For this analysis, a high knowledge score was defined as a score at or above the median score for the entire group (i.e., score >6). In the final multivariate model, a high knowledge score was associated with non-Hispanic white race ( $P=0.02$ ), being a college graduate ( $P=0.02$ ), and belonging to the intervention group ( $P=0.06$ ). These factors were not significantly associated with the beliefs/attitude outcome measures.

## DISCUSSION

This study suggests that education of child care staff can have a modest influence on parental knowledge and beliefs regarding appropriate antibiotic use for respiratory illness. Although these changes alone are unlikely to have a direct effect on antibiotic prescribing by physicians, evidence indicates that patient expectations (real or perceived) can significantly influence physician antibiotic prescribing behavior.<sup>8,19,20</sup> In this study, we found that parents with children in the intervention centers were more aware of the increased risk for a resistant infection when antibiotics are used inappropriately. If this awareness translates into fewer visits for typical cold symptoms and a lowered expectation for antibiotics, physicians might be more restrictive in their use of antibiotics. For this reason, improved knowledge and awareness among parents

of children in child care is a desirable outcome in the context of physician and public education regarding appropriate antibiotic use.

The stratified analysis of college graduates and non-college graduates demonstrated that the impact of the intervention varied with the level of parent education. Both college graduates and nongraduates had a significant improvement in at least 1 attitude and belief item, but only college graduates had a significant improvement in the antibiotic use knowledge score. In addition, only college-educated parents in the intervention group were significantly more likely to recall receiving a brochure regarding appropriate antibiotic use. Parents with a higher educational level might have been more likely to review and recall the information in the brochure. Interestingly, a relatively high percentage of control center respondents reported having read or seen information about antibiotic resistance at their child care center despite the fact that our educational materials were not distributed at the control centers. No other known educational intervention about antibiotics was undertaken at the child care centers during our study.

The majority of readers find medically related information more difficult to read and comprehend than non-medically related information, and this might have impeded comprehension and recall for parents with less formal education.<sup>21</sup> Educational materials should incorporate a high graphics-to-text ratio and use multiple modalities such as pictures, models, video, and audiotapes to reinforce key messages.<sup>22</sup> Multifaceted educational materials and modalities provide the greatest opportunity to reach different audiences and have been shown to improve knowledge of appropriate antibiotic use.<sup>10</sup> The majority of successful intervention studies regarding appropriate antibiotic use have used a multifaceted approach with a variety of educational materials and modalities.<sup>9-12,23</sup> In this study, we attempted to maximize this effect by combining oral presentations (to staff) with a variety of printed materials for parents, including stickers, brochures, coloring sheets, posters, and handouts. However, we were unable to measure the literacy levels of the parents, and the materials might have been less effective with the noncollege-educated parents than with the college-educated parents.

This study is subject to several limitations. First, we recruited a relatively small group of child care facilities, and random sampling variation led to significant differences between the intervention and control groups in terms of education, race, ethnicity, and insurance status. Second, although our stratified analysis controlled

for education, other factors related to sampling might have contributed to the observed differences between the intervention and control groups. Third, the study population was largely white and non-Hispanic, and whether the intervention would be more or less successful in child care settings with more racial and ethnic diversity is not known. Fourth, the survey response rate was relatively low, especially among the control group. Because we did not have access to information about the parents we had to rely on the child care administrators to distribute the survey and we cannot verify that the surveys were completely distributed. Also, we were unable to make any comparisons between the respondents and the non-respondents. Finally, selection bias might have occurred if staff at the intervention facilities anticipated the survey or distributed the parent educational materials after receiving the surveys for distribution. However, staff at the intervention facilities were not notified about the parent survey until after the presentation, and the survey objectives were not disclosed to them.

This study focused on moderately large child care facilities to make most efficient use of staff and resources. Whether the findings can be generalized to child care facilities with larger and smaller capacities is not known. Facilities with larger capacities might tend to have more organized systems for distributing information to parents because of the larger volume of information generated for more children. On the other hand, staff at facilities with smaller capacities might have a more personal relationship with the parents of the children and might be more apt to discuss the topic and distribute information to them.

## CONCLUSION

We conclude that on-site presentation and distribution of materials in child care facilities can be a moderately effective supplement to an education program regarding appropriate antibiotic use, particularly for more highly educated parents. Health care professionals and public health officials might consider incorporating parent education through child care facility staff as part of judicious antibiotic use efforts and including them as partners in coalitions to reduce inappropriate antimicrobial prescribing.

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