

The Parental Use of Antibiotics in Children in Saudi Arabia

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Abstract

Background: The overuse of antibiotics especially in children is becoming one of the most important public health issues worldwide. This study aims to assess the factors underlying the parental use of antibiotics for children in Saudi Arabia.

Methods: This is a cross-sectional study design. The study included 1104 Parents (52% were mothers) of children younger than 12 years old recruited from schools parental meetings in the Eastern Province of Saudi Arabia. Ordinal logistic regression was used to identify the factors influencing the parental use of antibiotics in children. Risk factors considered included parents' demographic information, child health-related information, along with the validated Parents Perceptions on Antibiotics (PAPA) scales, an instrument that measures parents' knowledge and beliefs, behaviors, adherence, seeking information, and awareness about antibiotic resistance.

Results: There is a high association between the frequency of cold episodes and the number of antibiotics used for the youngest child in the family during the previous year. Three parent-related psychosocial aspects appeared to be significantly associated with the parents' tendency to use an antibiotic in their children: Knowledge and beliefs, behaviors, and seeking health-related information. Also, parent's geographical background is associated with their use of antibiotics.

Conclusion: The strong association between the number of cold incidence and the amount of antibiotics used suggests an evidence for antibiotic misuse in Saudi Arabia. In addition, to stronger regulations relating to dispensing antibiotics, the Saudi government should implement public health interventions aimed at advocating parents to appropriate use of antibiotics, and the potential dangers in their misuse.

Keywords: Antibiotics use; Parents; Saudi Arabia; Multivariable models

Introduction

Antibiotics are helpful in treating bacterial infections, but have been widely used inappropriately to treat viral infections such as most Upper Respiratory Tract Infections (URTIs) otherwise known as the common cold infection, the most common infections around the world [1-3]. The common cold is a viral infection that can be caused by many viruses, such as: rhinovirus [4]. It usually involved symptoms related to the upper respiratory system, some of which are: lowered temperature, congestion of the mucosa, runny nose, general malaise, and sore throat [4]. This type of inappropriate use or overuse is increasingly high in children [5].

In many countries around the world, the distribution of antibiotics is not adequately regulated, where antibiotics can be purchased over-the-counter without a doctor's prescription. In Saudi Arabia, the law states that antibiotics need doctors' prescription to be dispensed to

patients [6]. However, studies have revealed that pharmacies often do not follow these regulations and a huge amount of antibiotics are dispensed without prescriptions [7,8]. Furthermore, antibiotics are frequently inappropriately dispensed by the pharmacists for viral infections, with and without the patient/parent's request [7].

With the lack of implementation on enforcement of regulations on over-the-counter dispensing of antibiotics, the choice of using an antibiotic relies almost entirely on the patient/parent. In such a setting, minimizing inappropriate use can only be through addressing public awareness regarding the use of antibiotics.

The inappropriate use of antibiotics, or overuse, causes several harmful effects at both the community level and individual level. These harmful effects include: the development of antibacterial resistance [1,9,10], the development of preventable adverse drug reactions such as gastrointestinal effects [8,11], and raising the burden of chronic diseases which leads to raising the expenditure of health services [2,12,13].

Antibiotics resistance is currently one of the most important growing public health issues worldwide, mainly caused by antibiotics overuse [14]. Antibiotic resistance places both the community and the individual at risk [15-17]. Teng et al. [1] assert that the inappropriate use or the overuse of antibiotics to treat viral URTIs is one of the main reasons for the development of antibiotic resistance. Promoting parental judicious use of antibiotics could protect children from bacterial resistance.

Several studies have attempted to evaluate the factors influencing the overuse of antibiotics, focusing on either the community level or the health professional level. Factors discussed in the literature that are at the health professionals' level include: parental pressure [5,18], lack of health education [19], and lack of patient-doctor interaction [20]. Factors related to the patients and/or parents include: attitudes regarding antibiotics use [21,22], knowledge and beliefs regarding antibiotics [22-24], behaviors such as self-medication [25], parents or patients' adherence to antibiotics [26], and awareness about antibiotics resistance [27]. However, an extensive literature review [24] found that no studies have used a valid and reliable instrument to measure these factors.

This study aims to evaluate the factors influencing the parental use of antibiotics in children in Saudi Arabia. The Parental Perceptions on Antibiotics [PAPA] Scales [28] was used to assess parental psychosocial factors influencing this overuse, as well as other demographic factors and children's health-related history factors.

Materials and Methods

Study design

The study was conducted in the Eastern Province of Saudi Arabia using a cross-sectional study design from September 2012 to January 2013.

Participants

Parents of children younger than 12 years old were recruited from primary schools' parental meetings in the Eastern Province of Saudi Arabia. Schools in Saudi Arabia are single sex schools. Stratified random sampling was used in this study where 14 girls schools (8 public and 6 private) and 19 boys schools (8 public and 11 private) were included.

Participants' consent was implied in the return of the completed questionnaire as shown in the questionnaire's cover page. Only questionnaires completed by one of the parents or a legal guardian were included in the study. Therefore, 7 questionnaires were excluded since they were completed by grandfathers, brothers, sisters, and/or aunts. 1104 questionnaires completed by parents were included in the study.

Since the analysis involved multivariable modeling, we were unable to use formal sample size calculations. Instead, two 'rule of thumb' approaches were used to select the sample size in this study. First, the rule of thumb advocated by Comrey and Lee [29], which states that 100=fair, 200=good, 500=very good, and >1000=excellent. The second approach used is to determine regression sample sizes, promoted by Green [30], which is: $N > 50 + 8m$ (where m is the number of independent variables). Sample size was inflated because of a likely clustering effect.

Measures

The Parental Perceptions on Antibiotics [PAPA] instrument [28], was used to measure the psychosocial factors influencing the parental use of antibiotics in children with URTIs. The PAPA instrument consists of 33 items distributed across five scales: [1] Knowledge and beliefs includes 10 items, [2] Behaviors scale has 5 items, [3] Antibiotics Adherence includes 5 items [4], Seeking information is a 7-items scale, and [5] Awareness about antibiotics resistance includes 4 items. Parents were asked to rate on 5-point Likert scale ranging from strongly disagree to strongly agree, and for the behaviors and adherence scales, from never to always. The development and validation of the instrument of the PAPA instrument is reported elsewhere [29-32]. A higher score on any scale is generally desirable. For example: a higher score on the Behavior means better behavior regarding appropriate use of antibiotics.

The outcome variable in the study is the number of antibiotic courses used in the youngest child in the family during the last year. Covariates in the study include: [1] the parent-related psychosocial scores measured in the PAPA instrument: knowledge and beliefs, behaviors, adherence, seeking information, and awareness about antibiotics resistance; [2] demographic variables: gender of parent, number of girls and boys in the family, parents health training, parent's age, parents employment status, parent's education level, parent's geographical background, when the parent moved to the Eastern Province, and parent's monthly income; and [3] child's health-history information, including: number of cold episodes for the youngest child during the last year, and whether any of the children in the family has ever had a serious infectious disease or a chronic disease.

Procedure

In this study a previously developed [32] and validated instrument was used in a cross-sectional study design [28,31]. Ethical clearance was obtained from the Department of Development and Planning in the Ministry of Education in the Eastern Province in Saudi Arabia (Ethical approval number: 33505889) and Queensland University of Technology, Australia (Ethical approval number: 1200000022).

Statistical analysis

Proportional odds ordinal logistic regression was performed to obtain both crude and adjusted odds ratios, where the study effects are the psychosocial scales in the PAPA instrument. Multivariable model building was conducted using Purposeful Selection of Covariates (PSC) [33], which allows for detection and adjustment for confounders. All model standard errors were adjusted for the schools clustering effect using the Huber Sandwich with robust estimator [34]. Model adequacy was assessed by using the Likelihood Ratio tests and pseudo R^2 .

All data analysis was conducted using Stata SE/v1 [35] and Statistical Package for Social Sciences (SPSS v19) [36]. All individual effect standard errors were adjusted for the school clustering effect.

To obtain adjusted estimates, purposeful selection of covariates was used to develop the best ordinal logistic regression model for the outcome at hand. Final estimates were adjusted for the school clustering effect the adjusted odds ratio from the final ordinal logistic regression model [obtained by Purposeful Selection of Covariates]. Likelihood Ratios are used to report the overall model significance.

The model was significant [$\chi^2LR(32)=693.84$, $p<0.0001$, Pseudo $R^2=0.2686$] with 11 variables. Global tests were performed for multi-category predictors using Likelihood Ratio tests before considering the significance of their individual contrasts.

Results

Parents' baseline characteristics are shown in Table 1. Half of the participants are mothers [52%]. The average age of parents in the

study was 38 years old [SD=8], with age ranging from 19 to 72 years. 10% of parents were trained in health fields such as medical, nursing, and/or paramedical fields. More than half of the parents in the study are employed [57%]. Most participants have Diploma or Bachelor degrees [63%], and only 1% of them are illiterate. The average reported monthly income in the study sample is from 1,000 USD to 3,199 USD representing 33% of the sample, followed by 3,200 to 5,900 USD [32%].

Variable	Amount of antibiotics (times/Year)					Total
	Never	Once	2-3	4-5	>6	
Parent						
Mother	5.4	13.5	23.3	6.5	3.2	52
Father	7	13.3	20.6	5.3	1.7	48
Health Trained						
Yes	2	2.8	4.4	1.1	0.3	10.6
No	10.4	24.1	39.5	10.8	4.7	89.4
Employment						
Employed	6.7	15.5	26.3	6.7	2.4	57.6
Unemployed	0.3	0.3	1	0.3	0.1	1.9
Student	0.3	0.3	0.3	0	0	0.8
Housewife	3.1	7.5	11.9	3.8	2	28.3
Private Business	1.3	2.5	3	0.8	0.5	8.1
Retired	0.7	0.8	1.4	0.3	0	3.2
Education						
Illiterate	0.1	0.2	0.5	0.1	0.1	0.9
No Formal Certificate	0.3	0.6	1	0.6	0.2	2.6
Intermediate School	0.5	1.1	2.1	0.6	0.5	4.7
High School	1.7	5	9.3	2.2	1.4	19.5
Diploma or Bachelor	8	17.5	26.9	7.8	2.7	62.9
Higher Degree	1.9	2.5	4.2	0.6	0.2	9.4
Geographical Background						
Eastern Province	5.6	12.3	19.4	5.1	2	44.4
Western Province	1.2	2.8	2.6	0.8	0.2	7.6
Central Province	1.9	4.4	5.8	2.2	0.6	14.9
Northern Province	0.6	0.6	1.9	0.6	0	3.6
Southern Province	1.8	3.9	8.4	1.9	0.9	16.9
Non-Saudi	1.4	3	5.6	1.3	1.3	12.5
Move to Eastern Province						
Childhood	1.5	5.5	9.6	2.1	0.9	19.7

Adolescent	0.7	2.1	1.5	0.4	0.1	4.7
Adulthood	4.7	8.3	13	4.1	1.7	31.8
NA ^a	5.5	12	19.2	5	2.1	43.8
Monthly income						
Low	0.9	2.1	4.8	1.7	0.7	10.1
Medium-low	4.1	8	16.3	4.5	2.1	35.1
Medium	4.1	9.6	14.1	4.3	1.3	33.4
Medium-high	2.5	5.8	5.5	1.1	0.8	15.8
High	1	1.3	3.2	0.2	0	5.6
^a NA: originally from the Eastern Province						

Table 1: Parents baseline characteristics.

In terms of child health history, 39 parents [3.5%] reported having at least one child who had experienced a serious infectious disease in the past. These infectious diseases included: chicken pox, flu including swine flu, and mumps and measles. For chronic diseases, 141 [12.8%] of parents reported having at least 1 child with a disease, such as: asthma, eczema, blood disorders such as Thalassemia and Anemia [including Hemolytic anemia and Sickle cell anemia], allergies [including skin allergies], diabetes, Glucose-6-phosphate dehydrogenase [G6PD] deficiency, and heart diseases including arrhythmia.

Means and standard deviations of the PAPA scales along with Spearman's correlation coefficient of each scale with the number of

antibiotics courses is given in Table 2. Overall, 43.9% of the parents in the study gave their child 2 to 3 courses of antibiotics during the last year for the youngest child in the family, followed by once a year [26.8%]. A total of 133 parents [12.4%] indicated that they never used an antibiotic for their youngest child in the past year, and 128 [11.7%] reported the use of antibiotics for their youngest child four to five times a year, and only 53 [5%] reported to have used an antibiotic more than 6 times a year for their youngest child. Table 3 shows the relationship between the number of antibiotics used for the youngest child in the family during last year and the number of cold episodes for the same child in the same period.

	Mean	Median	SD	Range	Spearman's rho
Knowledge and believes	23.5	23.6	6.1	32.448	-0.3010**
Behaviors	19.6	20.9	3.7	18.34	-0.1189**
Adherence	29.9	30.8	7.4	32.352	-0.1413**
Seeking Information	27.4	28.4	8.7	40.532	0.018
Awareness about Antibiotics Resistance	13.8	14	2.6	15.256	-0.0429
**p<0.001					

Table 2: Summary statistics of the psychosocial scales and spearman's coefficient of each scale with the number of antibiotics use.

The results from the 2 test of independence (Table 3) reveal a significant association between the number of cold episodes and the frequency of antibiotics used. After conducting the bivariate analysis, the frequency of antibiotics used for the youngest child in the family in

the last year was analyzed against a set of covariates, including: demographic variables, child health-related history, parents-related psychosocial factors, and antibiotic use. The crude odds ratios resulting from this analysis are given in Table 4.

	Antibiotic Use (times/year)						Total
	Never	Once	02-Mar	04-Jun	>6		
Cold Episodes (times/year)	Never	46	7	8	0	0	61
	Once	47	156	43	8	3	257

	02-Mar	38	122	364	44	7	575
	04-Jun	2	6	54	64	13	139
	> 6	0	1	5	12	30	48
	Total	133	292	474	128	53	1080
$\chi^2(16)=1040$ P<0.001							

Table 3: Cross tabulation of the frequency of antibiotics use and common cold episodes for the youngest child in the past year.

The ordinal logistic regression (Table 4) from the outcome, number of antibiotics used was significant and revealed that knowledge and beliefs, behaviors, and seeking information were negatively associated with antibiotic use in their children [ORKB: 0.92, p<0.0001, 95%CI:

0.89, 0.94; ORB: 0.95, p<0.05, 95%CI: 0.92, 0.99; ORSI: 0.98, p<0.01, 95%CI: 0.96, 0.99]. For all three of these scales, a unit increase was associated with an 8%, 5%, and 2% decrease in the odds of being in the next highest antibiotic use category.

Effect	OR _{crude} ^a	OR _{adjusted}	95%CI ^c
Knowledge and beliefs	0.905***	0.918***	0.897 0.941
Behaviors	0.937***	0.952*	0.915 0.991
Adherence	0.963***	0.992	0.973 1.013
Seeking information	1.004	0.976**	0.961 0.991
Awareness about antibiotics resistance	0.968	1.048	0.995 1.105
Fathers	0.752		
Number of Girls	1.034		
Number of Boys	1.018		
Parent not health trained	1.431		
Age	0.983*	1.011	0.990 1.032
Employment	χ^2 LR= 98.01***	χ^2 LR= 7.59	
Employed	1	1	
Unemployed	1.311	1.191	0.458 3.096
Student	0.281*	0.298	0.059 1.506
Housewife	1.145	0.762	0.535 1.085
Private business	0.782	0.666	0.409 1.083
Retired	0.576	0.559	0.246 1.270
Education	χ^2 LR= 98.74***	χ^2 LR=7.76	
Illiterate	1	1	
No formal certificate	1.112	0.973	0.191 4.966
Intermediate School	0.955	0.777	0.168 3.597
High school	0.876	0.99	0.233 4.215
Diploma or Bachelor	0.678	0.629	0.147 2.688
Higher Degree	0.457*	0.473	0.103 2.168
Geographical background	χ^2 LR= 95.03***	χ^2 LR= 3.56	

Eastern Province	1	1	1
Western Province	0.679	0.567*	0.340 0.945
Central province	1.004	1.011	0.688 1.484
Northern province	1.168	0.986	0.479 2.026
Southern province	1.228	1.018	0.702 1.477
Non-Saudi	1.334	1.169	0.740 1.846
Move to Eastern Province	χ^2 LR= 85.90***		
Childhood	1		
Adolescent	0.64		
Adulthood	0.846		
NA ^b	0.863		
Monthly income	χ^2 LR= 104.87***	χ^2 LR = 2.96	
Low	1	1	
Medium-low	0.765	0.781	0.467 1.306
Medium	0.621*	0.74	0.427 1.280
Medium High	0.410***	0.615	0.332 1.139
High	0.456**	0.862	0.396 1.877
Cold Episodes/year	χ^2 LR= 739.31***	χ^2 LR= 637.42***	
Never	1	1	
Once a year	8.642***	10.313***	5.028 21.155
2-3 times/yr	54.480***	70.499***	33.875 146.717
4-6 times/yr	526.762***	766.572***	329.001 1786.113
> 6 times/yr	5850.312***	6233.587***	2179.287 17830.42
No serious infec. Dis.	0.82		
No chronic disease	0.506**		
*p<0.05, **p<0.01, ***p<0.001			
a Crude odds ratios in bold were there with p<0.25; b originally from the Eastern Province; c Using robust estimates of standard errors.			

Table 4: Determinants of Antibiotic Use in Children by their Parents LR 2(32)=693.84, p<0.0001, Pseudo R²=0.2686.

The most profound effect in the model was the number of cold episodes in the previous year. As the frequency of children's cold events increase, there was a progressive and substantial increase in the odds of increased antibiotic use [χ^2 LRT=637.42, df=4, p<0.001]. Relative to children who had no cold events, parents with children experiencing one cold episode per year had 10.313 times the odds of going up to the next higher antibiotic use category [ORcolds2=10.31, p<0.0001, 95%CI: 5.02, 21.15]. For children who had greater than 6 cold episodes in the previous year, the odds of a category increase in antibiotic use was 6233.587 times that of parents whose child has no cold episodes [OR=6233.59, p<0.0001, 95%CI: 2179.28, 17830 [37-42].

It is noteworthy that a number of demographic risk factors identified as highly significant at the bivariate level [Parental age,

employment, education, geographical background, when they moved to the eastern province, and monthly income], did not retain significance [or dropped out as non-significant] in the final model; this maybe because the relationship of these factors to antibiotics use may be captured by the PAPA scales. However, a number of these factors were still retained in the model as confounders.

The parent's original geographical background was significantly associated with the number of antibiotics used. The odds of using antibiotics one level higher decreased by 43% in those originally from the Western Province compared to the Eastern Province [ORgeo2=0.57; p<0.05; CI: 0.34, 0.95].

Several covariates influence the number of antibiotics used for the youngest child in the family during the last year. These covariates are not significantly associated with the outcome variable; however, they are considered as confounders. These confounders include: parent's age, parent's education level, parent's employment status, and parent's monthly income.

Discussion

This is the first population-based study in Saudi Arabia that measures the factors influencing the parental use of antibiotics, including psychosocial factors. The study revealed a strong association between the number of cold incidence and the prevalence of antibiotics used, suggesting misuse and overuse of antibiotics in Saudi Arabia.

The study is also the first to assess the prevalence of antibiotic use in relation to antibiotic-specific psychosocial factors. Parent's knowledge and beliefs about the appropriate use of antibiotics, parent's appropriate behaviors regarding antibiotic use, and parent's eagerness to seek health-related information were all shown to be significantly associated with the parental use of antibiotics.

Perhaps, the most compelling finding in the present study is the high positive association between the number of cold episodes occurring, and the number of antibiotics used, for the youngest child in the family in the last year. While difficulties in measurement permitted the authors from attempting to link specific cold episodes to specific antibiotic courses, we feel that this association provides a strong indication of use of antibiotics in Saudi Arabia to treat cold episodes in children; a misuse of antibiotics to treat viral infections. It is important to note that this association was demonstrated significant even after adjusting for the parental psychosocial aspects, which means that this strong positive association between cold episodes and antibiotic use in Saudi Arabia is not in any way confounded by parent-related psychosocial aspects such as: their knowledge and beliefs, their behaviors and so on, and it is a pure association between cold infections and antibiotics usage.

It is also important to note that parent's originally from the Western Province appear to have lower prevalence of antibiotic usage compared to the Eastern Province which in turn does not differ from other provinces and non-Saudis in the study. This may be because of social determinants such as the diversity of cultures in the Western Province.

A number of factors were identified as potentially important at the bivariate level, but after adjusting for other covariates they could not be identified as significant predictors of antibiotic use. For instance, parent's gender, health-related training, and whether any of the children has a chronic disease were all significantly associated at the crude level with parental use of antibiotics, but were no longer significant after adjusting for other covariates, this may be due to the pertinent variation explained by these factors are captured by the PAPA scales. Other variables were significant or potentially important at the crude level of association, such as: parent's monthly income, parent's level of education, parent's age, and parent's employment status, these variables were no longer significant after adjusting for the rest of the covariates but were confounders on the parental use of antibiotics in children. Furthermore, parent's age, parent's education level, parent's employment status, and parent's monthly income are considered confounders on the parental use of antibiotics.

The problem of using antibiotics to treat common colds is apparent in many countries around the world. A study in Vietnam revealed that most children with common colds had been given antibiotics, where 71% of mild Acute Respiratory Infections were inappropriately treated with antibiotics [37]. A study in Saudi Arabia [7] showed that antibiotics were dispensed without a medical prescription for 75% cases of UTIs. 54.5% of children younger than 5 years old with cough were prescribed antibiotics in a study conducted in Gambia [38]. In Panagakou et al. [39], when parents were asked for possible treatment options for URTIs, 74% of the time antibiotics were chosen as a possible therapy. This unjustified use of antibiotics for treating viral infections needs to be addressed and policy makers need to develop intervention strategies targeted to reduce this problem.

The overuse or unjustified use of antibiotics is one of the primary causes in the development of antibacterial resistance worldwide and many studies discuss the overuse of antibiotics as one of the most important aspects in the development of antibacterial resistance [14,40]. A study conducted in Nepal, found that the total community use of antibiotics more strongly influences the development of antibacterial resistance than individual use [41]. Discovering the factors influencing this overuse leads to formulation of policies and implementation of strict regulations that might help in the reduction of the antibacterial resistance, and therefore decreasing the burden of diseases around the world.

The current study showed that the increase in parents' knowledge and beliefs [i.e. better knowledge and beliefs about appropriate antibiotic use], and their behavior [i.e. better judicious behavior] regarding antibiotic use, is associated with their use of antibiotics decreases. Several studies have assessed patients'/parents' knowledge and beliefs regarding the use of antibiotics. Similar to the current study, Larson et al. [42] found that almost half of the participants in the study believed that antibiotics cure all types of infections including viral and fungal infections. In the present study, almost half of the parents believed that antibiotics cure common colds in children; a results consistent with other studies [21,43]. These findings suggest that patients and/or parents around the world lack the appropriate knowledge and beliefs about antibiotic use. However, this lack of knowledge is likely to have more profound effects in countries with limited regulations of antibiotics availability. It is important to implement instructions that decrease the misuse of antibiotics; firstly through regulations [and its policy], and secondly through awareness.

The influence of Adherence to appropriate antibiotic doses on the parental use of antibiotics is needed by the parent's education level and monthly income, this is consistent with the results from a submitted manuscript which showed that Education was a confounder in the model and parent's monthly income was significantly associated with Adherence. This result is consistent with several studies suggest that adherence to medication is largely explained by someone's socioeconomic status [44-47]. However, this study adjusted for monthly income and education levels, so Adherence levels in relation to the parental use of antibiotics is purely after adjusting for these socioeconomic effects.

One of the most important strengths of this study is adjusting for schools clustering effect; which ultimately reduces the standard error in our model. Using Purposeful selection of covariates in the study retains essential confounding variables, leading to a stronger model.

It is important to note that in this study there is no direct link between cold events and antibiotics events; hence, causality cannot be

proven. However, this limitation is inevitable, since obtaining these associations requires clinical tests that were not within the scope of this study. In addition, in the current study the use of antibiotics is left solely in the hands of the parents, therefore, antibiotics misuse is more likely.

Conclusion

The factors influencing the parental use of antibiotics in children in Saudi Arabia are assessed in this study. Several variables were significantly associated with the frequency of antibiotics use, these include: parents' knowledge and beliefs about appropriate antibiotics use, appropriate parental behaviors regarding the use of antibiotics, and parental eagerness to seek health-related information, and the number of cold episodes.

This study provides evidence for future intervention strategies targeted at reducing the use of antibiotics in Saudi Arabia, by: strengthening antibiotic dispensing regulations, advocating parents' judicious use of antibiotic, and raising the community's awareness about the potential dangers in the misuse of antibiotics. This in turn should help in reducing the levels of antibacterial resistance in the community which will lead to a reduction in the burden of health care in Saudi Arabia and the cost of health services.

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