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Using the Medical Expenditure Panel Survey (MEPS) to Assess Antibiotic Utilization in Acute Respiratory Tract Infections

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USING THE MEDICAL EXPENDITURE PANEL SURVEY (MEPS) TO
ASSESS ANTIBIOTIC UTILIZATION IN ACUTE RESPIRATORY TRACT
INFECTIONS

BY
MUHAMMED S. AL-SULTAN

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN
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UNIVERSITY OF RHODE ISLAND

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DOCTOR OF PHILOSOPHY DISSERTATION

OF

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ABSTRACT

Background: Respiratory tract infections (RTIs) are considered to be the primary reason for prescribing antibiotics in community practice, accounting for 75% of prescribed antibiotics. Only some of these conditions, acute non-pneumonic RTIs (ARTIs), are the focus of this dissertation. ARTIs include acute cases of nasopharyngitis (common cold), sinusitis, pharyngitis (sore throat), laryngitis, and bronchitis. These conditions are, in many cases, caused by a virus and they usually resolve naturally without the use of any medication.

Objectives: Many studies have demonstrated the inappropriate overutilization of antibiotics in certain ARTIs. This practice may be associated with high unnecessary costs and potential for resistance from such use. Factors behind this practice are many. Some have been studied and many still need more exploration. The objectives of this study were to a) provide specific information on the influence of prescription drug coverage on antibiotic utilization; b) the influence of prescribing antibiotics on patient reported satisfaction; c) explore the effect of drug copayment on prescribing of antibiotics. The study also estimated the total cost in dollars that may be saved from the direct cost of antibiotics, to both the insurers and patients, when paying for these medications that may be used inappropriately.

Methods: A cross-sectional retrospective study of prescription events associated with different ARTIs was identified from the Household Component (HC) of the 1996 Medical Expenditure Panel Survey (MEPS). Descriptive and logistic regression analyses were conducted to explore the relationship between the different variables in the study with antibiotic utilization. The perspective taken in these studies was that of a healthcare insurer.

Results: The study found that the likelihood of being prescribed an antibiotic, which may be of high cost and unnecessary, is greater when patients have prescription drug coverage. However, no effects were related to drug copayment on antibiotic utilization. The study also suggests that in this population the level of patient satisfaction with the quality of care provided is not influenced by whether antibiotics are prescribed or not. It was also found that millions of dollars may be wasted yearly on these medications.

Conclusion: The findings from this study provide more insight to insurers and designers of drug coverage plans, who should closely monitor prescribing patterns for these conditions to avoid unnecessary cost as well as resistance from such antibiotics. They should not focus on antibiotic prescribing as a means of patient satisfaction, but on the appropriate use of such antibiotics and the avoidance of unwanted effects. More research is needed to examine the effect of the different copayment tier systems introduced in the last couple

of years on the utilization of these drugs and whether they may help reduce the inappropriate use of these drugs.

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PREFACE

This dissertation is prepared following the manuscript format, and it consists of two parts. Part 1 contains three studies that form the main body of the dissertation. Part 2 contains the appendices required by the University but are not usually presented in a published paper.

Part 1 includes:

Study 1: The Influence of Prescription Drug Coverage on Antibiotic Utilization in Acute Respiratory Tract Infections.

Study 2: The Influence of Antibiotic Utilization in Acute Respiratory Tract Infections on Patient Reported Satisfaction with Quality of Care.

Study 3: The Influence of Medication Copayments on Antibiotic Utilization in Acute Respiratory Tract Infections.

Part 2 includes:

Appendix A. Background and review of the problem

Appendix B. Details of the methods used

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Part 1:

Study 1: The Influence of Prescription Drug Coverage on Antibiotic Utilization in Acute Respiratory Tract Infections.

Study 2: The Influence of Antibiotic Utilization in Acute Respiratory Tract Infections on Patient Reported Satisfaction with Quality of Care.

Study 3: The Influence of Medication Copayments on Antibiotic Utilization in Acute Respiratory Tract Infections.

The Influence of Prescription Drug Coverage on Antibiotic Utilization in Acute Respiratory Tract Infections

Abstract

Background: Recognizing the effect of prescription drug coverage on the patient's ability to obtain prescription drugs is crucial and may play an important role in the health care decision making process due to the associated cost and the potential for misutilization. It is the objective of this study to provide specific information on the influence of prescription drug coverage on antibiotic utilization in acute nonpneumonic respiratory tract infections (ARTIs).

Methods: A retrospective study of (N=2534) prescription events associated with ARTIs have been identified from the Household Component (HC) of the 1996 Medical Expenditure Panel Survey (MEPS). Cases selected included acute nasopharyngitis (common cold), acute sinusitis, acute pharyngitis, acute tonsillitis, acute laryngitis and tracheitis, acute unspecified upper respiratory tract infections, and acute bronchitis and bronchiolitis. Antibiotic use and associated costs were determined by selecting oral antibiotics and the sum of payments associated with each prescription. Logistic regression was utilized to evaluate prescription drug coverage effect on prescribing an antibiotic and on the type of antibiotic prescribed.

Results: In 1996, antibiotics accounted for 47% of the prescription events for ARTIs, of which 29% were for high cost antibiotics. When compared to patients with private prescription drug coverage, patients with no drug coverage were less likely to be prescribed an antibiotic (OR=0.49; 95% CI = 0.37 - 0.65). The chance of getting a high cost antibiotic was also lower in events associated with no drug coverage (OR=0.10; 95% CI = 0.05 – 0.19). No significant difference was shown between public and private coverage.

Conclusion: The results of the study indicate that the rates of prescribing an antibiotic for ARTIs are still high, and that the likelihood of being prescribed an antibiotic, which may be of high cost and unnecessary, is greater when patients have prescription drug coverage. Providers of such coverage should closely monitor prescribing patterns for these conditions to avoid unnecessary cost as well as resistance from such antibiotics.

Introduction:

Respiratory tract infections (RTIs) are considered to be the leading cause of prescribing antibiotics in community practice, accounting for 75% of prescribed antibiotics. [1] In the year 1992, there were approximately 57 million prescriptions for antibiotics in the United States with colds, bronchitis and upper RTIs accounted to 12 million of the total prescriptions. [2] Only acute nonpneumonic respiratory tract infections (ARTIs) was the focus of this study.

ARTIs include conditions where antibiotics are generally considered to be inappropriate such as in acute nasopharyngitis (common cold), acute unspecified upper respiratory tract infections, acute bronchitis, and acute laryngitis and tracheitis.[3, 4] Most of these conditions are not life threatening and are usually caused by a virus.[3] Even when bacteria are the causative pathogen, the illness, in most cases, resolves naturally and rapidly.[4, 5] It is also important to note that antibiotics have not been shown to improve the clinical outcome of patients with these conditions.[2, 6]

Other ARTIs conditions like acute pharyngitis and acute sinusitis, antibiotics are in many cases not recommended, however it may be beneficial in some patients.[3] Even when prescribed an antibiotic the choice should be for a narrow spectrum, low cost antibiotic (e.g., penicillin) to avoid the unnecessary cost and the potential of resistance.[4] The reasons for prescribing an

antibiotic in acute pharyngitis is because it is hard to differentiate between streptococcal infection versus a viral infection, and also to prevent complications, such as acute rheumatic fever and acute glomerulonephritis.[4] However, the potential of being infected with the bacteria that causes rheumatic fever is rare in many population,[3, 4] and for acute glomerulonephritis, one meta-analysis showed that the rates have not been reduced by the use of antibiotic.[7] It is also, important to note that the natural rates for resolution without any complications are >90% for streptococcal pharyngitis,[8] and approximately 69% for acute sinusitis.[9]

Many studies have demonstrated the inappropriate overutilization of antibiotics in certain acute RTIs. [10-12] In 1998 one study estimated that 76 million office visits for acute RTIs resulted in 41 million antibiotic prescriptions. This was 55% (22.6 million) more prescriptions than were expected to be used, with an associated cost of approximately \$726 million.[13] Another study estimated that between 1989 and 1999 there were 6.7 million annual office visits by sore throat (acute pharyngitis) patients, where approximately three quarters of adults (73%) were prescribed an antibiotic and 68% of the prescribed antibiotics were for non recommended use. The study also showed that broad spectrum and more expensive antibiotics are frequently used.[14].

Recent studies have shown that the rate of prescribing inappropriate antibiotics has decreased.[15, 16] However, the rate is still high and is

associated with high unnecessary costs, as illustrated in the previous paragraph. The practice is also associated with the potential and risk for resistance from such antibiotics, which is becoming an epidemic and a global problem.[17-19]

Recognizing the problem has led to many studies that looked at factors leading to the inappropriate antibiotic prescribing. Studies that examined patients' preferences suggest that they are expecting to receive an antibiotic and consequentially pressure their physician to prescribe one. Patients may also be financially responsible for a low copayment or no copayment which may give them more incentive to fill the prescription.[20, 21] Physicians, on the other hand, try to meet the expectation of their patients and attempt to avoid any liability in case of a treatment failure, leading them to prescribe broad spectrum antibiotics.[22] Other factors may include the health care system structure, including formularies and prescribing restrictions.[23] Directed advertising and marketing to physicians and consumers by pharmaceutical companies may also lead to more prescription of high cost broad spectrum antibiotics.[24]

The influence of prescription drug coverage on the utilization is one of the potential factors that affect antibiotic prescribing. Many studies have demonstrated the influence of prescription drug coverage on the drug utilization in different patient populations.[25-31] Many of these studies

showed an increase use of medications when the study population had prescription drug coverage. However, some suggest that by not having the coverage, underutilization of essential drugs may occur.[32]

Studies that examine the effect of drug coverage on the utilization of drugs in general and in the utilization of antibiotics in ARTIs in particular, are becoming more important, knowing that the strong possibility of having a drug benefit plan for the Medicare population and with different health care plans offering drug coverage.

The objective of this study is to explore the influence of prescription drug coverage on the utilization, both in terms of frequency and type, of antibiotics in ARTIs, where studies are limited. The study will also identify the effect of other potential relevant factors such as socioeconomics and demographics. The hypothesis is that the frequency and type of antibiotics prescribed for ARTIs are greatly influenced by whether or not the person has a drug coverage policy. The results of this study will be of great value for policy and decision makers who are responsible for setting such benefits.

Methods:

Data source:

The source of data in this study was the 1996 Household Component (HC) of the Medical expenditure Panel Survey (MEPS). MEPS is a national database that is cosponsored by the Agency for Healthcare Research and Quality (AHRQ), and the National Center of Health Statistics (NCHS). The HC contains many files that are publicly available, and it contains medical expenditure data at both the person and household level and when weighted, provides nationally representative estimates of health care access, satisfaction, utilization, quality, expenditure, source of payments, and insurance coverage for the US civilian non-institutionalized population.[33]

Sampling for the HC is drawn from 10,500 household participants in the 1995 National Health Interview Survey (NHIS), conducted by NCHS. NHIS provides a nationally representative sample of the U.S. civilian non-institutionalized population, with oversampling of blacks and hispanics.[33]

The HC files that have been used in the analysis are the 1996 full year consolidated data and 1996 prescribed medicines event. The full year consolidated file contains one record for each of 22,601 persons and when weighted can be used to make national estimates of utilization and expenditures for calendar year 1996.[34] The prescribed medicine events file

provides detailed information on 147,308 prescribed medicine events of household-reported prescribed medicines, and when weighted, can be used to make estimates of prescribed medicine utilization and expenditures for calendar year 1996. In addition the prescribed medicine file contains household reported characteristics and medical conditions associated with prescribed medicine.[35]

For the purpose of this analysis both files have been merged. This allowed us to append personal characteristics such as demographic or health insurance coverage to each prescribed medicine record. Information about merging came from the data codebooks.[34, 35]

Study population:

The study population included cases of ARTIs identified by the International Classification of Diseases, Ninth Revision Clinical modification codes (ICD-9 codes), that were associated with prescribed medicine events. Each prescribed medication was associated with up to three ICD-9 codes and was reported by patients, which then were conformed by pharmacy records. The study has excluded prescription events with more than one ICD-9 code to assure that the prescription medicine of interest is for a particular ICD-9 code. The total prescription events (unit of interest) that were associated with these cases were (N=2534). Conditions selected included: acute nasopharyngitis

(common cold) (ICD-9 460), acute sinusitis (ICD-9 461), acute pharyngitis (ICD-9 462), acute tonsillitis (ICD-9 463), acute laryngitis and tracheitis (ICD-9 464), acute unspecified upper RTIs (ICD-9 465), and acute bronchitis (ICD-9 465).

Definition of variables:

Dependent Variables (DVs):

The first dependent variable of interest was defined as being prescribed an antibiotic or not, and only oral antibiotics were included in the analysis. The second dependent variable was defined as the type of antibiotic being received (i.e., high or low cost antibiotic). Antibiotic type was created by summing payments for each antibiotic prescribed and calculating the median cost. An antibiotic is considered to be high cost if the median cost was more than \$30.00, and was considered low cost if the antibiotic median cost was \$30.00 or less.

Independent Variables (IV):

The main variable of interest was prescription drug coverage, which was categorized into public, private or no drug coverage. An event is considered to have public drug coverage if the event was paid for by one of the following source of payments: Medicaid, Medicare, Veterans Affairs,

CHAMPUS/CHAMPV, other federal, state and local government, or other public. Private drug coverage is considered if the event is paid for by any of the following source of payments: private insurance, workers compensation, other insurance, or other private. No coverage was considered if the event was paid for by the person or any family member.

Other Variables:

Demographic and socioeconomic characteristics of the study population examined any possible effect on the utilization of antibiotic and whether they may be potential confounders. Variables in the study included: sex, race, age, census region, marital status, years of education, employment status, poverty level, the amount paid by the person or a family member for a medication (i.e., antibiotic) .

Statistical analysis:

A descriptive analysis of the study population was conducted. A chi-square test was carried out to examine the difference between the various independent variables on antibiotic utilization, the p-values are reported. The level of significant used for a p-value was $\alpha=0.05$.

Logistic regression analysis was used to determine the independent effect (relative risk) of different types of prescription drug coverage insurance on the

utilization of antibiotics (i.e., frequency and/or types). The final logistic regression model was run while controlling for confounders. Odds ratios and the 95% confidence interval were reported.

Several techniques were used to develop the final logistic regression model. First, variables used in the study were dichotomized and dummy variables created for the following variables: drug coverage, age, census region, poverty status, and self/family payment of prescription drugs. Second, univariate logistic regression was used to evaluate the relative contribution of each independent variable on predicting antibiotics utilization. Third, assessment of possible interaction terms (effect modifiers) was done between the primary independent variable (drug coverage insurance) and all other variables. Three, two, and one term interactions were completed and the decision was made on whether there was an interaction by examining the log likelihood ratios in the chunk test.

The fourth technique used was testing for multi-collinearity and that was completed to examine the highly correlated variables and, if necessary, remove any variable from the model. That was accomplished by examining the condition index in the SAS output. Finally, testing for potential confounders that may influence our final model was carried out by comparing the B (coefficient) of the primary independent variable (prescription drug coverage) of the full model to each reduced model (i.e., a model missing on variable).

All statistical analysis were carried out using SAS version 8.1 (SAS Institute, Cary, North Carolina) and SUDAAN software package (Research Triangle Institute, Research Triangle Park, North Carolina), both licensed to the University of Rhode Island. The results of the study have been weighted to generate 1996 national estimates of the influence of prescription drug coverage on the utilization of antibiotics in ARTIs. Many references for SAS and SUDAAN programming, methodology, and interpreting results have been used.[36-40]

Results:

The number of cases of ARTIs included in the study is presented in Table1, were around 57% of the cases were identified as the common cold. The table also shows the rate of prescribing antibiotic in each ARTIs condition and the overall rate of prescribing an antibiotic in the study population which was around 47% of the total events.

Table 2a contains a list of oral antibiotics used in the study population where low cost antibiotics (i.e., median cost less than \$30.00) are mainly generics and that of high cost antibiotics (i.e., median cost of \$30.00 or more) are brands. The high cost antibiotics were around 29% of the total antibiotics prescribed to patients with ARTIs (Table 2b).

The demographic and socioeconomic characteristics of the study population are presented in Table 3. This table indicates that, in 1996, 34% of the ARTIs events were associated with no drug coverage, 50% with private drug coverage and 16% with public drug coverage. The table also shows that 84% of events were for white Americans versus only 16% for non-whites. Approximately 44% of the cases were for children under the age of 17 years old and 63% of events had moderate to high income. Due to missing observations that may affect the analysis, two variables, years of education and employment status, have been removed from the analysis.

Table 4 illustrates the results of the cross-tabulation and the chi-square of all the variables in the study against antibiotic use and type. The unweighted chi-square test showed that when looking at the use of antibiotic (DV1), the variables that showed a significant difference in the study population were prescription drug coverage, race, age, poverty status, and self/family payment of prescription drugs. However, when the data were weighted using SUDAAN, the variables were shown to be significant were the prescription drug coverage, race, poverty status, and self/family payment of prescription drugs.

Table 4 also shows that when the same unweighted chi-square test was carried out on the type of antibiotic used (DV2) the variables that showed a significant chi-square test were the prescription drug coverage, sex, age, census region, poverty status, and self/family payment of prescription drugs.

However, when the data were weighted using SUDAAN, the variables that showed to significant, were only the prescription drug coverage, poverty status, and self/family payment of prescription drugs.

The univariate logistic regression analysis showed that many of the variables had an independent effect on both antibiotic use and type. Interaction assessment conducted for both dependent variables have concluded that no interaction terms exist between the variables. The analysis also showed that no highly correlated variables exist. Testing for confounders concluded that when looking at the use of antibiotics, race, poverty status and self/family payments of antibiotic are potential confounders. However, when examining the type of antibiotic used, poverty status and self/family payments of antibiotic are potential confounders.

The final logistic model shown in Table 5 indicated that, in 1996, before controlling for confounders, ARTIs events with both public drug coverage and with no drug coverage were at a significant lower risk (i.e., chance) of receiving an antibiotic than in events with private coverage (Public: OR=0.47; 95% CI= 0.34 - 0.65) with a p-value of 0.000 and (No coverage: OR=0.66; 95% CI=0.52 - 0.83) with a p-value of 0.0004. However, when controlling (adjusting) for potential confounders (i.e., race, poverty status, and self or family payments of antibiotics), only events associated with no drug coverage

showed a significant lower chance of receiving an antibiotic (OR=0.49; 95% CI = 0.37 - 0.65) with a p-value of 0.000.

The other logistic model shown in Table 6 also suggested that, in 1996, the chance of getting a high cost antibiotic before controlling for confounders, was also lower in events associated with public coverage events when compared to private drug coverage (Public: OR=0.48; 95% CI=0.27 – 0.48) with a p-value of 0.0097 and no significant difference was seen in events with no drug coverage (OR=0.75; 95% CI=0.49 – 1.13) with a p-value of 0.1678. However, when controlling for potential confounders (i.e., poverty status and self or family payments of antibiotics) the opposite results were found in that the chance of getting a high cost antibiotic was only lower in events with no drug coverage (OR=0.10; 95% CI = 0.05 - 0.19) with a p-value of 0.000. No significant difference was observed between public and private coverage.

Discussion:

The study demonstrates that the rate of prescribing an antibiotic for ARTIs is still high, and in 1996 it was around 13.6 million prescriptions, in which around 29% were for high cost broad spectrum antibiotics which should not be used even if antibiotics may be recommended since in many ARTIs cases they are not the drug of choice[4]. These prescriptions are, in many cases, considered unnecessary and may be associated with excessive costs and bacterial

resistant that can be easily avoided with a better management of such events. That can be accomplished by a better understanding of the different socioeconomic and behavioral factors behind such a problem.

The study also, demonstrated that the prescription drug coverage is an important and a key factor having a significant role in the utilization of antibiotics in ARTIs. Results showed that prescription drug coverage is associated with an increased utilization of antibiotics, and that was also associated with more consumption of high cost antibiotics. Findings are consistent with many of the studies that indicate the effect of having a drug coverage on the increase utilization of drugs in different diseases and populations.[26-29, 41] However, this study is different in that it looks at the utilization of antibiotics in a specific group of conditions (i.e., ARTIs), using a national database allowing us to make national estimates of utilization.

The study illustrates the need for similar studies, which is becoming more important for many reasons. First, the potential of overutilization of unnecessary medications with the unwanted risk associated with its use (e.g., antibiotic resistance). Second, the need to lower the increasing cost of the health care system in regard to medication utilization which is about 13.1% of the total health care cost. [42] Finally, these kinds of studies will help many managed care organization and health insurers who are trying to lower their costs without affecting the quality of care they provide and will also help the

United State government especially with the potential of having a Medicare prescription drug plan.

A number of potential limitations are associated with this study. First, the data used in the analysis does not provide information about the different benefits associated with each prescription drug plan, making it hard to examine at the influence of the degree of benefits (i.e., generosity level) on the utilization of antibiotics. Second, the study is cross-sectional in nature and may prevent analysts from capturing the influence of any change in the drug coverage policy over time. Third, the diagnosis information are imputed based on what was reported by the patient or the patient guardian, which may be biased (i.e., recall bias). Finally, the data does not provide information regarding the causative agent, whether it is a viral or bacterial, and it also does not provide a history of any antibiotic used.

Despite these limitations the study was able to show a significant result because we think that is reflecting what is really happening in regard of prescription practices in different clinical settings throughout the country. The results are very helpful to policy and decision makers, both in the government and the private sector, who are in charge in making and designing prescription drug benefits. It also illustrated that prescription drug coverage without the proper management may be reasons for misutilization and increasing cost that can be avoided.

Future studies using recent released MEPS or any other similar dataset should examine the effect of the different types of drug coverage on antibiotics utilization in ARTIs and if possible to compare between the change in trend over time. It is also important to explore the effect of drug coverage in other disease states and conditions, which will be of great value for people in charge of designing drug benefit plans in both private and public sectors.

Conclusion:

The results of the study indicate that the rates of prescribing an antibiotic for ARTIs are still high, and that the likelihood of being prescribed an antibiotic, which may be of high cost and unnecessary, is greater when patients have prescription drug coverage. Providers of such coverage should closely monitor prescribing patterns for these conditions to avoid unnecessary cost and consequently, resistance from such antibiotics.

Table 1.1 Study population of Acute Respiratory tract infections (ARTIs) events and the rate of antibiotic prescribing, weighted to make national estimates.

	Unweighted (N=2534)	Weighted (in millions) (N=29.28)	AB%*
	N (%)	N (%)	
<u>ARTIs conditions</u>			
Acute nasopharyngitis (common cold)	1536 (60.6)	16.60 (56.7)	38.1
Acute URI multiple sites/NOS	264 (10.4)	3.63 (12.4)	52.1
Acute bronchitis and bronchiolitis	74 (2.9)	1.06 (3.6)	38.9
Acute tonsillitis	165 (6.5)	1.74 (5.9)	69.9
Acute laryngitis and tracheitis	53 (2.1)	0.782 (2.6)	41.46
Acute sinusitis	17 (0.6)	0.218 (0.7)	82.31
Acute pharyngitis	425 (16.7)	5.21 (17.8)	62.03
<u>Antibiotic prescribing rates</u>			
No antibiotic NA**	1386 (54.7)	15.67 (53.5)	
Antibiotic	1148 (45.3)	13.60 (46.4)	NA

* AB%=rate of antibiotic prescriptions in the different ARTIs

**NA=not applicable

Table 1.2a Classification of the reported oral antibiotics used in a study population of Acute Respiratory tract infections (ARTIs) events.

Low cost (if median cost is \$30.00 & less)	High cost (if median cost is more than \$30.00)
amoxicillin ampicillin penicillins erythromycin SMZ/TMP ceftibuten (Cedax®) cephadrine cephalixin (Keftab®, Keflex®) clindamycin doxycycline	Augmentin® Zithromax® Cipro® Biaxin® cefaclor (Ceclor®) cefprozil (Cefzil®) cefadroxil cefuroxime (Ceftin®) loracarbef (Lorabid®) nitrofurantoin cefixime (Suprax®) dirithromycin (Dynabac®)

Table 1.2b Types of antibiotics used in a study population of Acute Respiratory tract infections (ARTIs) events, weighted to make national estimates.

	Unweighted (N=1148) <i>N (%)</i>	Weighted (in millions) (N=13.60) <i>N (%)</i>
Low cost antibiotics	850 (74.04)	9.64 (70.91)
High cost antibiotics	298 (25.96)	3.95 (29.09)

Note: The high/low classification was based on the median cost of the sum of payments for each prescribed antibiotic used in the study population.

Table 1.3 Demographic and Socioeconomic characteristics of a study population of Acute Respiratory tract infections (ARTIs) events, weighted to make national estimates.

	Unweighted (N=2534) N (%)	Weighted (in millions) (N=29.28) N (%)
Prescription drug coverage		
Private	1120 (44.20)	14.57 (49.78)
Public	515 (20.32)	4.61 (15.75)
No coverage	899 (35.48)	10.09 (34.47)
Sex		
Male	1070 (42.23)	12.47(42.62)
Female	1464 (57.77)	16.80 (57.38)
Race		
White	2087 (82.36)	24.70(84.36)
Non-white	447 (17.64)	4.57 (15.64)
Age		
Children (0-17)	1219 (48.18)	12.98 (44.46)
18-44 yrs	675 (26.68)	8.55 (29.29)
45-90 yrs	636 (25.14)	7.66 (26.25)
Census Region		
Northeast	438 (17.31)	5.15 (17.65)
Midwest	587 (23.20)	7.51 (25.74)
South	937 (37.04)	10.63 (36.43)
West	568 (22.45)	5.89 (20.18)
Marital Status		
Married	760 (30.04)	9.02 (30.90)
Not married	1770 (69.96)	20.18 (69.10)
Income (poverty line)		
Negative or poor	626 (24.70)	5.23 (17.87)
Near poor	168 (6.63)	1.59 (5.44)
Low income	352 (13.89)	4.24 (14.50)
Middle income	731 (28.85)	9.40 (32.12)
High income	657 (25.93)	8.80 (30.06)
Self/family payment of antibiotic		
\$0	544 (21.47)	5.12 (17.52)
>\$0 -< \$5	505 (19.93)	6.05 (20.70)
\$5 - <\$10	874 (34.49)	10.58 (36.17)
\$10 & more	611 (24.11)	7.50 (25.62)

Table 1.4 Bivariate analysis for both the antibiotic usage and type with all the other variables in a study population of Acute Respiratory tract infections (ARTIs) events, weighted to make national estimates.

Variables	Antibiotic used*		Antibiotic type**	
	Yes (%)	No (%)	High (%)	Low (%)
Prescription drug Coverage				
Any Private	22.89	21.31	15.07	35.45
Any Public	7.54	12.79	2.96	13.68
No coverage	14.88	20.60	7.93	24.91
Sex				
Male	18.82	23.4	12.11	29.44
Female	26.48	31.29	13.85	44.60
Race				
White	38.95	43.41	23.08	62.89
Non-white	6.35	11.29	2.87	11.15
Age				
Children (0-17)	22.61	25.57	12.14	37.82
18-44 yrs	12.33	14.35	6.38	20.87
45-90 yrs	10.32	14.82	7.34	15.46
Census Region				
Northeast	8.5	8.81	5.94	12.84
Midwest	10.43	12.77	6.2	16.86
South	16.76	20.28	9.96	27.07
West	9.57	12.89	3.76	17.38
Marital Status				
Married	13.68	16.36	8.82	21.4
Not married	31.58	38.38	17.03	52.75
Poverty line‡				
Negative or poor	9.00	15.71	3.83	16.03
Near poor	3.24	3.39	0.7	6.45
Low income	6.04	7.85	3.48	9.84
Middle income	14.7	14.09	9.41	23.17
High income	12.27	13.65	8.54	18.55
Self/family payment of antibiotic‡				
\$0	8.84	12.63	3.66	15.85
>\$0 -< \$5	6.12	13.81	2.18	11.32
\$5 - <\$10	16.22	18.27	3.57	32.23
\$10 & more	14.13	9.98	16.55	14.63

Level of significant used in this chi-square analysis was p-value of 0.05.

* Prescription drug coverage, race, poverty line and self/family payment of antibiotics showed to have significant p-values.

** Prescription drug coverage, poverty line and self/family payment of antibiotics showed to have significant p-values.

‡The variable showed to be significant even after dichotomizing.

Table 1.5 Final logistic model for the effect of prescription drug coverage on antibiotic utilization in a study population of Acute Respiratory tract infections (ARTIs) events, weighted to make national estimates.

	OR (95% CI)	P- value
Prescription drug Coverage		
<u><i>Without controlling for confounders</i></u>		
Private	1.00	reference
Public	0.47 (0.34 to 0.65)	0.0000
No coverage	0.66 (0.52 to 0.83)	0.0004
<u><i>Controlling for potential confounders*</i></u>		
Private	1.00	reference
Public	0.67 (0.43 to 1.06)	0.0895
No coverage	0.49 (0.37 to 0.65)	0.0000

Note: OR=odd ratios, 95% CI= 95% confidence interval

**Potential confounders were race, poverty status and self/family payment of antibiotic.*

Table 1.6 Final logistic model for the effect of prescription drug coverage on type of antibiotic utilized in a study population of Acute Respiratory tract infections (ARTIs) events, weighted to make national estimates.

	OR (95% CI)	P- value
Prescription drug Coverage		
<u>Without controlling for confounders</u>		
Private	1.00	reference
Public	0.48 (0.27 to 0.48)	0.0097
No coverage	0.75 (0.49 to 1.13)	0.1678
<u>Controlling for potential confounders</u>		
Private	1.00	reference
Public	1.23 (0.47 to 3.22)	0.6748
No coverage	0.10 (0.05 to 0.19)	0.0000

Note: OR=odd ratios, 95% CI= 95% confidence interval

**Potential confounders were poverty Status and self/family payment of antibiotic.*

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The Influence of Antibiotic Utilization in Acute Respiratory Tract Infections on Patient Reported Satisfaction with Quality of Care

Abstract

Background: In recent years, patients reporting satisfaction with their quality of care has been of a greater interest to healthcare providers and to users of the health care system. Such information is important and may play a role in the decision made by patients when choosing their provider and by physicians when making clinical decisions about prescribing antibiotics.

Objective: It is the objective of this study to provide specific information on the influence of prescribing antibiotics to patients with acute respiratory tract infections (ARTIs) on patients reporting satisfaction with their quality of care.

Methods: A total of 514 patients with ARTIs were identified from the 1996 Medical Expenditure Panel Survey (MEPS). Cases selected were for patients having a prescription record and who answered the satisfaction with quality of care question asked in round 2 of the survey. Descriptive analysis of the study population was conducted and a logistic regression analysis was used to evaluate antibiotic utilization on reported patient satisfaction with quality of care.

Results: In 1996, 75% of patients with ARTIs were overall very satisfied with the quality of care provided to them. The rate was also high when looking at antibiotic utilization against the different level of satisfaction whether antibiotics were used or not. The logistic regression model showed that before and after controlling for any variables that may influence our results, antibiotic utilization has no statistical significant on patients reported satisfaction with their quality of care.

Conclusion: The results of the study suggest that in this population the level of patient satisfaction with the quality of care provided is not influenced by whether antibiotics are prescribed or not. Health care systems and providers should not focus on antibiotic prescribing as a mean of patient satisfaction, but on the appropriate use of such antibiotics and the avoidance of unwanted effects.

Introduction:

Studies that look at satisfaction are part of a larger area of research known as outcomes research, which is a multi-dimensional approach of evaluating the outcomes of the health care system, of which not only clinical outcomes are of interest, but also information about the patient functional outcomes, patient satisfaction, and cost-effectiveness of the health care provided.[1, 2] One of these dimensions that has attracted a great deal of interest in the last couple of years is, on studies that uses satisfaction as an indicator for the quality of care.[3] Studies that examine the patient perspective are considered an important method in the evaluation and assessment of the quality of the health care system.[4]

Satisfaction shows the realities about care, as well as the expectations and preferences of the patient. Both expectations and preferences can be viewed as the determinants of satisfaction.[5] The expectation of patients have been linked to different level of satisfaction with the health care system, patients' tendency to sue the health care provider, compliance to the suggested therapy, the physician's decision for ordering different tests, and the ability to achieve the desired clinical effect. [6, 7] Patient satisfaction can be viewed as a performance evaluation of any health service.[8] Patients' satisfaction has been defined as "the reaction of the patient to the salient aspects of the context, process, and result of the service experience" [2, 9]

Satisfaction and other health care outcomes information are relevant to patients, the payers and to the providers.[10, 11] The consumers of the health care system are demanding a better service from providers and payers and decision makers are trying to follow their expectations,[12] by aiming to help patients achieve the best satisfying health outcome in the most efficient way.[7] So both the provider and the receiver of the health care service may be making decisions based on the level of satisfaction as measurable by outcome studies.[13]

The information gathered from such studies can be used in some of the following areas: to compare between different providers, examine at the provider performance over time, set priorities for projects that may improve quality, and determine the influence of changes in quality of care with changes in the healthcare delivery system.[14]

Satisfaction studies have been conducted in many disease states and conditions, for example, studies have examined patient satisfaction in HIV/AIDS, diabetes, and cancer.[15-17] Information from such studies are usually gathered from a single item or multiple item questionnaires, where the multiple item questionnaires tend to be more reliable in capturing different levels of satisfaction.[2] However, the main problem with these kinds of studies is that high satisfaction has been reported utilizing many of them and there is a potential bias involved in the collection of such data.[18]

The influence of prescribing drugs on patient satisfaction, in general, has been shown in a study that explored whether patient expectations drive drug prescribing and if that has any effect on the level of satisfaction. The study showed that meeting the expectations of the patient is not associated with higher satisfaction.[19]

Several satisfaction studies have been conducted in patients with acute nonpneumonic respiratory tract infections (ARTIs). The objective of these studies was to explore the influence of both the prescribing of an antibiotic and the patients expectations on their satisfaction. One study showed that 65% of patients with respiratory infection expected an antibiotic, 63% received them, and 97% of the patients were satisfied with their visit.[20] No association was found between an antibiotic prescription and patient satisfaction. However, the strongest association with patient satisfaction was based on whether the physician spent sufficient amount of time explaining to the patient about his illness.

A second study explored the influence of reducing antibiotic prescribing for uncomplicated acute bronchitis on patient satisfaction.[21] The study concluded that reducing antibiotic prescribing through educating both patients and clinicians was not associated with a reduction in the satisfaction of care. A third study has also concluded that in patients with upper respiratory tract infections, patients want to be diagnosed but their satisfaction with their

medical care depends on the personal interest and reassurance they receive from their provider.[22]

The over prescribing of antibiotics in ARTIs, that in many cases may be unnecessary, has been demonstrated in many studies.[23-25] This overutilization is not without the risk of getting antibiotic resistance and the high potential cost associated with such practice.[26-28] For that and for other reasons, it is important to study the influence of any factor that may lead to such a practice.

The objective of this study was to explore the influence of prescribing antibiotics to patients with ARTIs on their reported satisfaction with the provided quality of care. The hypothesis behind the study is that patients receiving antibiotics for ARTIs are more likely to be satisfied with their reported quality of care than in patients not receiving them.

The results of this study will be of a great value for both the providers and the payers, who are trying to please and retain patients in their plans and practices and, at the same time, lower their cost and avoid unnecessary use of medications. This study is unique compared to studies conducted in the past, because it attempted to study the patient satisfaction from a national dataset that allowed calculation of national estimates about satisfaction.

Methods:

Data source:

The source of data in this study was the 1996 Household Component (HC) of the Medical Expenditure Panel Survey (MEPS). MEPS is a national database that is cosponsored by the Agency of Healthcare Research and Quality (AHRQ), and the National Center of Health Statistics (NCHS). A couple of published studies have used the 1996 MEPS to examine the impact of different factors, such as managed care, health insurance and race on satisfaction.[29-31]

The HC contains many files that are publicly available, and contains medical expenditure data at both the person and household level and, when weighted, provides nationally representative estimates of health care access, satisfaction, utilization, quality, expenditure, source of payments, and insurance coverage for the United States civilian non-institutionalized population.[32] Sampling for the HC is drawn from 10,500 household participants in the 1995 National Health Interview Survey (NHIS), conducted by NCHS. NHIS provides a nationally representative sample of the U.S. civilian non-institutionalized population, with oversampling of blacks and hispanics.[32]

The HC files that have been used in the analysis are the 1996 full year consolidated data and 1996 prescribed medicine event. The full year consolidated file contains one record for each of 22,601 persons and when weighted can be used to make national estimates of utilization and expenditures for calendar year 1996.[33] The prescribed medicine events file provides detailed information on 147,308 prescribed medicine events of household-reported prescribed medicines, and when weighted, can be used to make estimates of prescribed medicine utilization and expenditures for calendar year 1996. In addition the prescribed medicine file contains household reported characteristics and medical conditions associated with prescribed medicine.[34]

For the purpose of this analysis both files were merged. This allowed us to append personal characteristics such as demographic and health insurance coverage to each prescribed medicine record. Information about merging was derived from the data codebooks.[33, 34] The data were then transposed to make the unit of interest to be patients, instead of prescription events.

Study population:

The study population was (N=514) patients with ARTIs, who answered the question about their satisfaction with the quality of care provided to them. ARTIs were identified by the International Classification of Diseases, Ninth

Revision Clinical modification codes (ICD-9 codes), that were associated with prescribed medicines. Each prescribed medication was associated with up to three ICD-9 codes. The prescribed medicines were reported by patients and were then confirmed from pharmacy records. The study only included prescriptions with one ICD-9 code to assure that the prescribed medicine of interest is for a particular ICD-9 code. Conditions included: acute nasopharyngitis (common cold), acute sinusitis, acute pharyngitis, acute tonsillitis, acute laryngitis and tracheitis, acute unspecified upper RTIs, and acute bronchitis.

Definition of variables:

Dependent Variable (DV):

The dependent variable of interest in this study was the reported patient satisfaction with their quality of care. Information about this variable was gathered from the satisfaction question only asked in the second round of the 1996 MEPS and therefore the study population was limited to only this round. This variable was reported in four different satisfaction levels and, for the purpose of this study it was dichotomized to very satisfied and to some degree of dissatisfied.

Independent Variable (IV):

The main variable of interest was whether or not an oral antibiotic was utilized for any of the ARTIs conditions explored in the study, and if that had any effect on patients' satisfaction level.

Other variables:

Demographic and socioeconomic variables were also examined for any difference in the satisfaction level and to determine whether they may be potential confounders. Variables included: sex, race, age, marital status, census region, poverty line, type of health insurance, the number of prescriptions and refills in 1996, and total health care expenditure in 1996.

The last two variables (number of prescriptions and total expenditure) were used in the analysis to try to capture both the burden of other co-morbidities and extent of overall health care utilization on the satisfaction level. The information about other conditions were not available in the data used for this study. The information about other co-morbidities can only be gathered for the medical condition file. However, the problem with that is that not all records in the medication file have a match in the prescription event file used in the study.

Statistical analysis:

This study utilizes both descriptive and analytical techniques in its analysis. A chi-square test was carried out to examine the difference between the various independent variables on the patient satisfaction level, with p-values reported. The level of significant used for a p-value was $\alpha=0.05$.

Logistic regression was used to determine the relative risk of the utilization of antibiotics on the level of patient reported satisfaction with their quality of care. The final logistic regression model was run while controlling for confounders. Odds ratios and the 95% confidence interval were used.

Several analytical techniques have been used to build the final logistic regression model. First, variables were dichotomized and dummy variables created for the following variables: age, census region, health insurance, poverty line, number of prescriptions in 1996 and the total health care expenditure in 1996. Second, univariate logistic regression was used to evaluate the relative contribution of each independent variable on predicting patient satisfaction. Third, we examined possible interaction terms between the main independent variable and other variables. Three, two, and one term interactions were done and the presence of an interaction was based on the result of log likelihood ratios in the chunk test.

The fourth technique used was testing for multi-collinearity and that was performed to examine highly correlated variables and, if necessary, remove any variable from the model. Finally, testing for potential confounders that may influence our final model was carried out by comparing the B (coefficient) of the primary independent variable (patient satisfaction) of the full model to each reduced model (i.e., a model missing on variable).

All statistical analysis were carried out using SAS version 8.1 (SAS Institute, Cary, North Carolina) and SUDAAN software package (Research Triangle Institute, Research Triangle Park, North Carolina), both licensed to the University of Rhode Island. The results of the study have been weighted to give 1996 national estimates of the influence of antibiotics utilization on the reported patient satisfaction with their quality of care in ARTIs. Many references for SAS and SUDAAN programming, methodology, and interpreting results were used.[35-39]

Results:

The study population of unweighted and weighted data of 514 patients with ARTIs is shown in Table 1. It demonstrates the high rate of satisfaction of the study population regardless of any medication use, which was around 75% versus 25% for all the other levels of satisfaction. Satisfaction, which was dichotomized into complete satisfaction (i.e., very satisfied) or to some degree

of dissatisfaction, was also reported. The table also shows the rate of antibiotic use in patients in the study population, which was around 63%.

A simple cross-tabulation, without controlling for any other variables, was conducted between the satisfaction level and antibiotic use as shown in Table 2, in which patient's satisfaction is very high whether or not antibiotics were used. It was around 75% for both groups.

The demographic characteristics of the study population are presented in Table 3, for both the weighted and unweighted data, which shows that 85% of the patients are white Americans and 57% are female. Children 17 years old and younger accounted for 45% of our study population and that was probably why the majority of patients in the study were not married (71%).

Table 4 presents the socioeconomic characteristics and shows that 73% of patients were covered by private health insurance. The table also shows the patients different income level, in which 63% of them have middle to high income. It also shows the number of prescriptions and refills in 1996 and the total health care expenditure in 1996.

The unweighted chi-square analysis demonstrated that when examining patient satisfaction, the variables that show a significant differences on the level of satisfaction were race and total health care expenditure in 1996 (Table

5). When the data were weighted using SUDAAN, none of the variables showed a significant difference on the level of satisfaction. The table shows that in all of the variables, patients were more likely to be very satisfied, rather than having some degree of dissatisfaction.

A chi-square analysis was also conducted between the main independent variable (antibiotic utilization) with all the other independent variables, in order to help verify any potential confounder. The variables that showed a significant difference were race, the type of health insurance coverage and poverty status. However, when the data was weighted using SUDAAN, the variables that showed a significant difference were only race and the type health insurance coverage.

From the results of the conducted chi-square tests, we concluded that the only potential confounder for the unweighted data was race, since it showed a significant difference when looking at both antibiotic utilization and the satisfaction variables. However, no potential confounders were found when the data was weighted with SUDAAN.

The univariate logistic models showed that race and the total number of prescriptions in 1996 was the only variables which had an independent effect on the level of satisfaction. The interaction assessment conducted concluded

that no interaction terms exist between the variables. The analysis also showed that no highly correlated variables exist.

The final logistic regression model presented in Table 6 indicated that, before controlling for other variables, antibiotics effect on the level of patient satisfaction with their quality of care is not significant with an odds ratio (OR) = and a 95% confidence interval (CI) = 0.63 - 1.63 and a p-value of 0.9707. Similar results were found, when trying to control for race, total healthcare expenditure in 1996 and the total number of prescription in 1996.

Discussion:

The results of the study demonstrate that overall satisfaction with quality of care in patients with ARTIs in 1996 were very high, which was around 75% of patients. The results also showed that patients with different demographics and socioeconomic background were very satisfied, regardless of any antibiotic use.

Our study suggested that the utilization of antibiotics in patients with ARTIs is not considered to be an important factor that may influence patient satisfaction with their quality of care. Results from our logistic regression analysis indicated that no changes in the level of satisfaction were found whether antibiotic were used or not. Findings were consistent with many of the studies

that examined the influence of medication utilization on patient satisfaction in general and in ARTIs in particular.[19-22]

A number of potential limitations are associated with this study. First, the study is a cross-sectional, which prevented examination of the change in the reported patient satisfaction over time. Second, the satisfaction level was very high in all the variables used in the study, which may suggest the presence of a bias introduced by the survey administrators (i.e., interviewer bias) or by the instrument used in the study. Third, the satisfaction question in the study was asked based on the satisfaction with the quality of care, reported by patients or by their parents, and was not specifically based on antibiotics utilization.

Despite these limitations, the methodology used in the study was able to utilize a national dataset to capture the influence of antibiotic utilization on the reported satisfaction on a national level. The results of the study may be very helpful for physicians and providers of the health care system, who are trying to use antibiotics appropriately and at the same time to satisfy their patients. The results illustrated that they should not worry about patient satisfaction when treating these illnesses and should instead concentrate on the appropriate use of antibiotics in their patients.

This research points out the need for similar studies that will take into account the problems and limitations associated with studies measuring patient

perceptions of their health care. More standardized and disease specific instruments should be used, only after being tested for both validity and reliability, which in many cases has not been done.[18, 40] That will help avoid, or at least minimize the biases introduced, and will also help interpret the study findings accurately.[18]

Researchers and people involved in the design of a future national database, whether it is MEPS or any other, should pay more attention and try to introduce new questions that will capture the influence of the medication use on patient satisfaction. That will help provide national estimates, instead of using small studies that in many cases can not be generalizable and are of limited use to health care decision makers.

CONCLUSION:

The results of the study suggest that the level of patients' satisfaction with the quality of care provided is not influenced by whether antibiotics are prescribed or not. Health care systems and providers should not be concerned about losing patients to other organizations due to antibiotic prescribing patterns, or of making their patients less satisfied if not prescribed an antibiotic. The concentration of such providers should be on the appropriate use of such antibiotics and the avoidance of any unwanted effect (e.g., antibiotic resistance). This may be accomplished through an educational program

focusing on clinicians and on patients, and by spending more time explaining to patients about their condition and the therapeutic options available, if any.

Table 2.1 Response to a satisfaction with quality of care question in a study population of patients with ARTIs*, weighted to generate national estimates.

	Unweighted (N=514) N (%)	Weighted (in millions) (N=6.01) N (%)
Satisfaction with Quality of Care		
Very satisfied	388 (75.49)	4.53 (75.39)
Somewhat satisfied	107 (20.82)	1.26 (20.95)
Not too satisfied	16 (3.11)	0.185 (3.08)
Not at all satisfied	5 (0.58)	0.034 (0.57)
Satisfaction with Quality of Care		
Very satisfied	388 (75.49)	4.53 (75.39)
Some ^a degree of dissatisfaction	126 (24.51)	1.47 (24.6)
Antibiotic received		
No	199 (38.72)	2.24 (37.26)
Yes	315 (61.28)	3.77 (62.74)

*ARTIs=Acute Respiratory Tract Infections

Table 2.2 Percentage of patient with ARTIs*, answering a satisfaction with quality of care question and antibiotic utilization status.

	Satisfaction	
	<u>Very Satisfy</u>	<u>Some degree of Dissatisfaction</u>
Antibiotic utilization		
Yes	47.3%	15.4%
No	28.1%	9.2%
Antibiotic users	75.5%	20.8%
No antibiotic used	75.3%	24.7%

*ARTIs=Acute Respiratory Tract Infections

Table 2.3 Demographic characteristics of the study population of patients with ARTIs*, weighted to obtain national estimates.

Variables	Unweighted (N=514) N (%)	Weighted (in millions) (N=6.01) N (%)
Sex		
Male	212 (41.25)	2.58(42.97)
Female	302 (58.75)	3.43 (57.03)
Race		
White	425 (82.68)	5.11(85.03)
Non-white	89 (17.32)	0.90 (14.97)
Age		
Children (0-17)	257 (50)	2.75 (45.87)
18-44 yrs	149 (28.99)	1.96 (32.63)
45-90 yrs	108 (21.01)	1.29 (21.50)
Marital Status		
Married	144 (28.02)	1.69 (28.16)
Not married	370 (71.98)	4.32 (71.84)
Census Region		
Northeast	97 (18.87)	1.09 (18.27)
Midwest	108 (21.01)	1.38 (22.94)
South	187 (36.38)	2.16 (35.91)
West	122 (23.74)	1.37 (22.87)

*ARTIs=Acute Respiratory Tract Infections

Table 2.4 Socioeconomic characteristics of the study population of patients with ARTIs*, weighted to obtain national estimates.

Variables	Unweighted (N=514) N (%)	Weighted (in millions) (N=6.01) N (%)
Income (poverty line)		
Negative or poor	118 (22.96)	1.03 (17.13)
Near poor	24 (4.67)	0.19 (3.25)
Low income	77 (14.98)	0.97 (16.20)
Middle income	163 (31.71)	2.03 (33.80)
High income	132 (25.68)	1.78 (29.62)
Health insurance		
Any private	347 (67.51)	4.42 (73.56)
Public only	131 (25.49)	1.15 (19.26)
Uninsured	36 (7)	0.43 (7.18)
Number of prescription and refills in 1996**		
1-2	122 (23.74)	1.41 (23.54)
3-4	120 (23.35)	1.30 (21.62)
5-12	174 (33.85)	2.15 (35.75)
>13	98 (19.07)	1.14 (19.09)
Total healthcare expenditure in 1996**		
\$1-\$179	90 (17.51)	0.93 (15.48)
\$180-\$524	163 (31.71)	1.82 (30.30)
\$525-\$1659	147 (28.60)	1.94 (32.39)
\$1660-\$427086	114 (22.18)	1.31 (21.82)

*ARTIs=Acute Respiratory Tract Infections

**No zero values for these variables since the data is a prescribed medication data.

Table 2.5 Bivariate analysis between the satisfaction with the quality of care and all the other variables in patients with ARTIs*, weighted to obtain national estimates.

Variables	Satisfaction		P-value**
	very Satisfy (%)	Some degree of Dissatisfaction (%)	
Sex			
Male	31.32	9.92	0.8401
Female	44.16	14.59	
Race			
White	64.40	18.29	0.0058
Non-white	11.09	6.23	
Age			
Children (0-17)	37.16	12.84	0.7212
18-44 yrs	22.57	6.42	
45-90 yrs	15.76	5.25	
Marital Status			
Married	21.60	6.42	0.5995
Not married	53.89	18.09	
Census Region			
Northeast	13.81	5.06	0.2086
Midwest	15.37	5.64	
South	29.38	7	
West	16.93	6.81	
Income (poverty line)			
Negative or poor	15.95	7	0.3072
Near poor	3.50	1.17	
Low income	12.06	2.92	
Middle income	25.10	6.61	
High income	18.87	6.81	
Health insurance			
Any private	52.53	14.98	0.1728
Public only	18.29	7.20	
Uninsured	4.67	2.33	
Number of prescription and refills in 1996			
1-2	17.90	5.84	0.0853
3-4	16.34	7	
5-12	25.10	8.75	
>13	16.15	2.92	
Total healthcare expenditure in 1996			
\$1-\$179	11.67	5.84	0.0287
\$180-\$524	22.76	8.95	
\$525-\$1659	23.15	5.45	
\$1660-\$427086	17.90	4.28	

The level of significant used is p-value of 0.05

*ARTIs=Acute Respiratory Tract Infections

** The weighted bivariate analysis showed no significant difference for any variable.

Table 2.6 Final logistic regression model for the effect of antibiotic utilization on reported patient satisfaction with their quality of care in a study population of ARTIs*, weighted to obtain national estimates.

	<i>OR (95% CI)</i>	<i>P-value</i>
Antibiotic utilization**		
Without controlling for any variables	1.01 (0.63 - 1.63)	0.9707
Controlling for health care utilization***	0.97 (0.59 - 1.59)	0.9066
Controlling for health care utilization & race	0.93 (0.56 - 1.53)	0.7669

Note: OR=odd ratios, 95% CI= 95% confidence interval

*ARTIs=Acute Respiratory Tract Infections

**No variable have shown to be a potential confounder.

***controlling for total health care expenditure and total number of prescriptions in 1996.

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The Influence of Drug Copayment on Antibiotic Utilization in Acute Respiratory Tract Infections

Abstract

Background: Identifying the influence of prescription drug copayments on the decision to obtain or prescribe an antibiotic is essential and may play an important role in the health care decision making process due to the associated cost and the potential for misutilization.

Objectives: The main objective of this study was to explore the effect of the drug copayment on the prescribing of antibiotics in acute respiratory tract infections (ARTIs) and if that may increase or decrease the inappropriate use of such antibiotics. The study also tried to estimate the total savings in dollars to both the insurers and patients when paying for these unnecessary medications prescribed for different ARTIs.

Methods: A retrospective study of (N=1635) prescription events associated with different ARTIs was identified from the 1996 Medical Expenditure Panel Survey (MEPS). Antibiotic use was determined by selecting oral antibiotics and the associated source of payment (e.g., copayments) with each prescription was also identified. A logistic regression model was developed to

evaluate prescription drug copayment effect on prescribing an antibiotic. The total cost that may have been spent on these antibiotics was also estimated.

Results: In 1996, the total spending on potentially inappropriate antibiotics for different ARTIs was around \$394 million, which could be saved for both the patient when paying copayments and to the health care insurer. The results of the logistic regression analysis concluded that medication copayments do not have a significant effect on the utilization of antibiotics in these conditions, with an odds ratio (OR) = 1.03 and a 95% confidence interval (CI) = 0.99 to 1.08 and a p-value of 0.1269.

Conclusion: The results of the study indicate that prescribing antibiotics for ARTIs, which may be unnecessary, are associated with high medication costs and could be avoided. This is especially true with the limited resources available and with the rapid increase in the health care spending. The study also showed that the likelihood of being prescribed an antibiotic is not affected by the level of drug copayment. However, more research is needed to examine the effect of the different copayment tier systems introduced in the last couple of years on the utilization of these drugs.

Introduction:

Recently, the increase in the cost of health care has reached alarming levels. In 2001, health care cost was around \$1.4 trillion, which accounted for 14% of the total United States gross domestic product (GDP), and prescription drugs accounted for about 10% of the total health care cost. The numbers are expected to rise to about \$2.8 trillion in 2011, which will account for 17% of the estimated total GDP. The figures for prescription drugs will reach 14.7% and the total spending on pharmaceuticals will be 2.5% of the total GDP.[1]

The above figures have led many people interested in this area to focus and conduct research to identify methods that may lead to the lowering of total spending on health care in general and on prescription drugs in particular. Their research is aimed at minimizing spending without affecting the level of patient satisfaction and other health care outcomes.[2-4]

Techniques that address prescription drug utilization were mainly developed by Pharmacy Benefits Management organizations (PBMs). These organizations use many tools and techniques to accomplish their goal of lowering the cost they incur for medications. The techniques include disease state management, formulary management, drug utilization reviews, delivery systems (e.g., mail order, retail), and by consumer sharing (e.g., copayments).[2, 5-7]

This study focused on one of these cost sharing techniques, drug copayment. Many copayment strategies have been initiated by public and private organizations to lower their share of prescription drug costs. For example, a survey showed that many employers intend to increase the cost sharing in their health care benefit structure, rather than eliminating drug coverage.[8] Many states are also limiting or restricting eligibility in their drug coverage programs.[9]

Copayment is defined as a fixed amount of dollars that a patient must pay per prescription.[10] Health plans may use different tier system when applying copayments. In 2000, 49% of covered workers were in plans of two-tiered structure. The rate was down to 37% in 2001.[11] The reason behind using two tiers was to differentiate between generic and brand drugs and to encourage patients to use generic drugs at a lower copayment level.[10] However, generic drug dispensing rate of 42% has not change from 1996 to 2000, with a decline in the annual sales of generic prescriptions from 20.5% in 1996 to around 17.8% in the year 2000.[12]

In order to increase the use of generics, different health care plans are now moving to simple multiple tier systems (e.g., three tier) and to more complex systems (e.g., four and five tiers) and even to coinsurance, where patient pay a percentage of the cost of the drug.[3, 10, 13, 14] Multitiered copayments were created to make a balance between what health plans need to control

pharmaceutical costs and their need to avoid public criticisms for limiting access to drugs.[15]

Research conducted in the past about cost sharing has suggested that overutilization may be decreased when patients are required to pay part of the expenses they incur.[16-20] One report that surveyed about 150 health plans with different cost sharing plans concluded that a direct relationship exists between the decrease in drug utilization with the increase in cost sharing. The respondents recommended a 5%-10% cost sharing to have an effect without having a negative outcome on the use of essential drugs.[21]

Another study indicated that an increase in drug copayments from \$5 to \$7.50 was associated with 12.3% reduction in drug spending in health maintenance organizations. [22] Also, a study that examined the effect of three tier copay systems concluded that these techniques can control drug costs.[23]

Information regarding the effect of drug cost sharing and copayments on the utilization of essential drugs are conflicting. One study showed that increased cost-sharing for prescription drugs in elderly and welfare recipients was associated with a decrease in the use of essential drugs and with higher rate of emergency department visits.[24] One survey suggested that higher out of pocket costs may causes a high non-compliance among users of prescription drugs.[25]

On the other hand, a study demonstrated that compliance rates with chronic disease medications in the period of 6 months after a copay increase of \$10 to \$15 for brand drugs was not reduced when comparing the study group to a control group.[26] Other studies have also shown no effect on the use of essential drugs when copayments are increased in certain disease states (e.g., cardiac medications).[27, 28]

To date, no study has examined the influence of drug copayments on the prescribing and/or purchasing of antibiotics in Acute Respiratory Tract Infections (ARTIs), except for one study that only examined the effect of copayment on the purchasing of drugs for children in infections in general and that was not limited to ARTIs. [29]

The importance of exploring these issues is crucial, especially in conditions like ARTIs where there are, in many cases, not only an overutilization and inappropriate use of antibiotic, but unnecessary costs resulting from both the cost of the drug and from the side effects associated with its use (e.g., antibiotic resistance).[30-32] Patients financially responsible for low or no copayments may provide more incentive to fill the prescription.[33, 34]

ARTIs include conditions where antibiotics are generally considered to be inappropriate such as in acute nasopharyngitis (common cold), acute unspecified upper respiratory tract infections, acute bronchitis, and acute

laryngitis and tracheitis.[35, 36] In other ARTIs conditions, such as acute pharyngitis and acute sinusitis, antibiotics are in many cases not recommended, but may be beneficial in some patients.[35]

The objective of this study was to explore the effect of the drug copayment on the prescribing of antibiotics in ARTIs and if there is an increase or decrease the inappropriate use of such antibiotics. One hypothesis was that patients responsible for no copayments were more likely to receive an antibiotic for one of the ARTIs conditions compared to patient with copayments. The study also tried to estimate the total savings in dollars to both the insurers and patients when paying for these unnecessary medications in the different ARTIs.

Methods:

Data source:

The 1996 Household Component (HC) of the Medical Expenditure Panel Survey (MEPS) provided the data for this study. MEPS is a national publicly available database that is cosponsored by the Agency for Healthcare Research and Quality (AHRQ), and the National Center of Health Statistics (NCHS). The HC contains many files that provide medical expenditure data at both the person and household level and, when weighted, provide nationally representative estimates of health care access, satisfaction, utilization, quality, expenditure, source of payments, and insurance coverage for the United States civilian non-institutionalized population.[37]

Files used in the analysis were for the 1996 full year consolidated data and 1996 prescribed medicine event. The full year consolidated file contains one record for each of 22,601 persons and when weighted, can be used to make national estimates of utilization and expenditures for calendar year 1996.[38]

The prescribed medicine events file provides detailed information on 147,308 prescribed medicine events of household-reported prescribed medicines, and when weighted, can be used to make estimates of prescribed medicine utilization and expenditures for calendar year 1996. In addition the prescribed medicine file contains household reported characteristics and medical conditions associated with prescribed medicine.[39]

For the purpose of this analysis both files were merged. This allowed us to append personal characteristics, such as demographic and health insurance coverage, to each prescribed medicine record. Information about merging was derived from the data codebooks.[38, 39]

Study population:

The study population was for 1635 prescription events associated with one of the following ARTIs: acute nasopharyngitis (common cold), acute sinusitis, acute pharyngitis, acute tonsillitis, acute laryngitis and tracheitis, acute unspecified upper RTIs, and acute bronchitis. These conditions were identified from 1996 MEPS by using the International Classification of Diseases, Ninth Revision Clinical modification codes (ICD-9 codes).

Exclusion criteria:

Since each prescribed medication was associated with up to three ICD-9 codes, any event with more than one ICD-9 code was excluded to assure that the prescribed medicine of interest was for a particular ICD-9. The study also excluded any prescription event where the patient or any family member paid for the prescription in full, since the study was only examining the influence of copayments.

Definition of variables:

Dependent Variable (DV):

The dependent variable of interest was defined as having been prescribed an antibiotic or not, and only oral antibiotics were included in the analysis.

Independent Variable (IV):

Copayment was the independent variable of interest in this study. Information about this variable was constructed from prescription drugs payment information available in the data. Copayment was examined both continuously and categorically. In the latter case, the variable was designated as no copayment or copayment. Two categories were created because many of the copayments in the study population were between \$5 and \$10, and it was difficult to determine more break points.

Other variables:

Demographic and socioeconomic variables were also examined for any association with antibiotic utilization and to determine whether may confound the effect of copayment on the utilization of antibiotics in ARTIs. Variables included: sex (male or female), race (white or non-white), age (less than 17 years old or older than 18), census region (northeast, west, south, or

midwest), poverty status (poor to low income or moderate to high income), type of health insurance (any private, any public, or no insurance).

Statistical analysis:

A simple descriptive analysis of the study population was conducted, and included examining the different demographic and socioeconomic characteristics in this population.

The analysis also estimated the total savings to patients and to public or private drug coverage insurers, if antibiotics have been avoided in the different conditions of ARTIs. The unweighted total savings were calculated by summing up all antibiotics payments, both by patients and by health insurers, and then the total number of antibiotic prescriptions and the total dollar value were weighted using SUDAAN to obtain national estimates.

Other analysis:

A bivariate analysis was conducted between the different study variables with antibiotic utilization, and a chi-square test was carried with p-values reported.

The level of significant used for a p-value was $\alpha=0.05$.

Logistic regression analysis was utilized to evaluate prescription drug copayment effect on prescribing an antibiotic. The final logistic regression

model was run while controlling for confounders. Odds ratios and the 95% confidence interval were reported.

Several analytical techniques were used to build the final logistic regression model. First, variables were dichotomized and dummy variables created for the following variables: age, census region, health insurance, income level. Second, univariate logistic regression was used to evaluate the relative contribution of each independent variable on predicting antibiotic utilization. Third, testing for multi-collinearity was performed to examine highly correlated variables and, if necessary, remove any variable from the model. Finally, testing for potential confounders that may influence our final model was carried out by comparing the B (coefficient) of the primary independent variable (antibiotic utilization) of the full model to each reduced model (i.e., a model missing one variable).

All statistical analysis was performed using SAS version 8.1 (SAS Institute, Cary, North Carolina) and SUDAAN software package (Research Triangle Institute, Research Triangle Park, North Carolina), both licensed to the University of Rhode Island. The results of the study were weighted to give 1996 national estimates of the influence of antibiotics utilization on the reported patient satisfaction with their quality of care in ARTIs. Many references for SAS and SUDAAN programming, methodology, and interpreting results were used.[40-44]

Results:

Information about the study population including demographic and socioeconomic characteristics are presented in Table 1, which shows both the weighted and unweighted data for (N=1635) medication events with different types of ARTIs. The table also highlights that in 1996 around 73% of medication events for ARTIs were associated with a copayment. The rate of antibiotic prescribing for these conditions was 49%.

The analysis also estimated the total direct cost in dollars that can theoretically be saved by eliminating unnecessary antibiotic use in ARTIs (Table 2) and it shows that in 1996, the total savings to patients from copayments in conditions like common cold, acute tonsillitis, acute laryngitis and tracheitis, acute unspecified upper RTIs, and acute bronchitis, where antibiotics are always considered unnecessary, was around \$71 million. Potential savings for different drug coverage programs were estimated at \$243 million.

Table 2 also shows that in 1996, the total saving to patients from copayments in conditions like acute sinusitis and acute pharyngitis, where antibiotics may be used but in many cases are considered unnecessary was around \$17 million and \$63 million would accrue to the benefit of providers and payers of different drug coverage programs. The total cost that could have been saved in 1996 from inappropriate antibiotic prescribing in ARTIs was approximately \$394 million.

The results of the weighted cross tabulation between copayment and antibiotic utilization against the different study variables are presented in Table 3, which also shows the results of the chi-square test. The variables that demonstrated a significant effect (p-value less than 0.05) with drug copayment were health insurance, income level, age and race. Variables with a significant effect on antibiotic utilization were health insurance, income level and race.

The results from the different techniques for logistic regression showed no correlation between variables in the study population. Univariate logistic regression showed that the variables that have an independent effect on antibiotic utilization were only health insurance, income and race. Table 4, present information regarding the results of confounders assessment, in which income level, health insurance and race were potential confounders that need to be controlled for in the final logistic model.

The results of the final model showed that before controlling for the potential confounder, copayments had a significant effect on antibiotic utilization in different events of ARTIs with an odds ratio (OR)=1.06 and a 95% confidence interval of 1.01 to 1.11 and a p-value of 0.0171. However, after controlling for potential confounders (i.e., health insurance, income and race) the effect of copayment on the utilization of antibiotics disappeared, with an odds ratio (OR)=1.03 and a 95% confidence interval (CI) = 0.99 to 1.08 and a p-value of 0.1269.

Discussion:

The findings from this study suggest that in 1996, patients or a family member paid a copayment for antibiotics prescribed for different ARTIs in around 66% of events. The study also showed that the effect of copayment level on the utilization of antibiotics in these conditions disappeared after controlling for potential confounders.

The reason that in 1996 drug copayments has no effect on the utilization of antibiotics in ARTIs may be due to 1) patients may have a perception that they need antibiotics regardless of copayment level, and 2) copayment levels were low, in many cases less than \$10 per prescription.

This study is the first that has used a national dataset that allow the calculation of national estimates of the effect of drug copayment on antibiotic use in ARTIs. The study also was able to calculate a national estimate of the direct cost in dollars that can be saved by both the patient and the prescription drug provider when these drugs are avoided, which was around \$394 million in 1996. This figure was lower than the expenditure reported for 1998, which was around \$726 million, suggesting an increase in the spending on antibiotics associated with treating these conditions from 1996 to 1998. [30]

A number of potential limitations are associated with this study. First, the data used in the analysis does not provide information about the different benefits and copayment tier systems associated with each prescription drug plan. Second, the study is cross-sectional in nature and may prevent analysts from capturing the influence of any change in the copayment tier system on antibiotic utilization over time. Finally, the data does not provide information regarding the causative agent, whether it is viral or bacterial, and also does not provide a history of other antibiotic use.

Despite these limitations the study was able to show results that will assist policy and decision makers, both in the government and the private sector, who are responsible for designing the different copayment tier systems. It also illustrated that without the proper management of these conditions, significant levels of waste in the health care system can occur. This is of particular concern especially with the rapid increase in the cost of health care system with limited and scarce resources.

Future research should focus on factors that may change the way ARTIs are being managed. This research might include examination of a large national data (e.g., MEPS) to determine what level of copayment will change patient behaviors toward receiving antibiotics.[45] Other research might examine recently released MEPS data and compare it to the results of this study, knowing that many tier systems have changed since 1996 and newer systems

of cost containment have been introduced.[2, 10] It would also be helpful to estimate the overall cost associated with treating these conditions, and not concentrate only on the direct cost of medications.

The copayment tier system available for prescription drugs is expected to evolve in the future to a newer system that is based on the overall benefits gained and risks avoided from medications both in terms of clinical and economic outcome.[46]

Conclusion:

The results of the study indicate that prescribing antibiotics for ARTIs which may be unnecessary are associated with high medication cost that should be avoided especially with the limited resources available and with the rapid increases in the health care spending. The study also demonstrated that the likelihood of being prescribed an antibiotic is not affected by drug copayment. However, more research is needed to examine the effect on the different copayment tier systems introduced in the last couple of years on the utilization of these drugs.

Table 3.1 Study population of ARTIs* events showing the demographic and socioeconomic characteristics, weighted to obtain national estimates.

Variables	Unweighted (N=1635) (%)	Weighted** (N=19.2 million) (%)
Drug Copayment:		
No copayment	33.3	26.7
Copayment	66.7	73.3
Antibiotic utilization:		
No	52.8	51.5
Yes	47.2	48.5
Health insurance:		
Any private	69.1	76.1
Any public*	29.9	22.9
Uninsured	1.1	1.04
Income level:		
Poor to low income	45.7	38
Moderate to high income	54.3	62
Gender:		
Male	42.6	44.3
Female	57.4	55.7
Race:		
White	82.9	84.8
Non-white	17.1	16.2
Age:		
Less than 17	50	45.3
18 and more	50	54.7
Region:		
Northeast	18.1	18.7
Midwest	23	25.2
South	37.9	36.4
West	21	19.7

*ARTIs =Acute Respiratory Tract Infections

**In millions

Table 3.2 Total cost savings per year to insurer and patient, if antibiotics were avoided in different ARTIs*, weighted to make national estimates.

	Unweighted (N=1635) (\$)	Weighted** (N=19.2 million) (\$)
<i>When antibiotics are always considered unnecessary:**</i>		
Total amount paid		
By patient or pay family	5,392	70,950,958
By provider	20,771	242,854,627
<i>When antibiotics may be used but in many cases is considered unnecessary:‡</i>		
Total amount paid		
By patient or pay family	1,207	17,098,202
By provider	5,022	62,654,462
<i>For all ARTIs:</i>		
Total amount paid		
By patient or pay family	6,599	88,049,161
By provider	25,793	305,509,089
Total saving per year	32,392	393,558,250

*ARTIs =Acute Respiratory Tract Infections

** Includes: acute nasopharyngitis (common cold), acute tonsillitis, acute laryngitis and tracheitis, acute unspecified upper RTIs, and acute bronchitis.

‡ Includes: acute sinusitis and acute pharyngitis.

Table 3.3 Drug copayments and antibiotic use stratified by health insurance, income level, gender, race, age and census region*, weighted to make national estimates.

Variables	Drug Copayment**		Antibiotic use‡	
	Yes (%)	No (%)	Yes (%)	No (%)
Health insurance:				
Any private	66.7	9.4	40.1	36
Any public	5.79	17.12	8.13	14.8
Uninsured	0.8	0.25	0.33	0.7
Income level:				
Poor to low income	18.2	19.8	15	23
Moderate to high income	55	7	33.6	28.4
Gender:				
Male	33.6	10.7	22	22.3
Female	39.7	16	26.6	29.1
Race:				
White	64.6	20.2	43	41.8
Non-white	8.7	6.6	5.6	9.6
Age:				
Less than 17	27.4	18	23.4	22
18 and more	45.8	8.9	25.2	29.4
Region:				
Northeast	14.6	4	9.7	9
Midwest	20.1	5	12.3	13
South	26.3	10.1	18	18.3
West	12.1	7.6	8.6	19.7

*ARTIs =Acute Respiratory Tract Infections

Note: The level of significant used in the analysis was P-value of less than 0.05

**The variables that showed significant different were health insurance, race, age, and income level.

‡The variables that showed significant different were health insurance, race and income level.

Table 3.4 B (coefficient) of the primary independent variable (Copayment) for the full model, and the different models that are missing one variable.

<i>Models</i>	β	<i>P-value</i>
Full model	0.04	0.7861
Full – health insurance	0.22*	0.1348
Full – Age	0.06	0.7131
Full – Income level	0.13*	0.3915
Full – gender	0.04	0.8010
Full – Race	0.07*	0.6433
Full – Region	0.06	0.7029

*Potential confounders are health insurance, income level, and race.

Table 3.5 Results of the final logistic regression showing the odds of being prescribed antibiotics when examining drug copayments, weighted to make national estimates.

	<i>OR (95% CI)</i>	<i>P- value</i>
Prescription drug copayment		
<i>Before controlling for confounders</i>	<i>1.06 (1.01-1.11)</i>	<i>0.0171</i>
<i>Controlling for potential confounders</i>	<i>1.03 (0.99-1.08)</i>	<i>0.1269</i>

Note: OR=odd ratios, 95% CI= 95% confidence interval

**Potential confounders were health insurance, race, and income level.*

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Part 2:

Appendix A. Background and review of the problem

Appendix B. Details of the methods used

Appendix A. Background and review of the problem:

Respiratory tract infections (RTIs) are considered to be the leading cause of prescribing antibiotics in community practice, counting for 75% of prescribed antibiotics. [1] These infections can be divided, based on the location of the infection, into lower respiratory tract infections (LRTIs) such as pneumonia and bronchitis, and to upper respiratory tract infections (URTIs) which includes rhinitis (common cold), sinusitis, pharyngitis (sore throat), and laryngitis.[1, 2]

LRTIs are considered to be one of the main reasons for morbidity and mortality, and for the increased health care utilization due to infections. It is estimated that 3.8 million deaths occurred in 1998 worldwide due to LRTIs. [3] It is also estimated that in the United States, at least 500,000 hospitalizations occur each year with an estimated cost of \$8.4 billion and with an additional \$8.4 billion spent on community acquired pneumonia. [4]

These infections are mainly caused by *Streptococcus pneumoniae*. Other pathogens may include *Haemophilus influenzae*, *Moraxella catarrhalis*, or in some cases, viruses. [5] Antibiotics are usually recommended in these kinds of bacterial infections and the choice of antibiotic depends on the causing pathogen, and ranges from inexpensive first generation penicillins to more costly broad spectrum drugs such as fluoroquinolones. [5, 6]

The case is different for bronchitis and URTIs since most of these conditions are not life threatening and they are usually caused by a virus, especially in acute illness. However, bacteria (e.g., *Streptococcus pneumoniae*) may be behind the infection in chronic illness. [7] For that reason, antibiotics are usually not indicated in acute infections, regardless on whether or not it is caused by a virus or a bacteria, since in most cases the illness resolves naturally and fast. [8] It is also important to note that antibiotics have not been shown to improve the clinical outcome of these patients. [1, 2] However, patients with chronic bronchitis and some patients with chronic sinusitis and/or pharyngitis may still benefit from an antibiotic. [7]

Many studies have demonstrated the inappropriate overutilization of antibiotics in certain acute RTIs. [9, 10] In 1998 it was estimated that 76 million office visits for acute RTIs resulted in 41 million antibiotic prescriptions. This was 55% (22.6 million) more prescriptions than were expected to be used, with an associated cost of approximately \$726 million. [11] Another study showed that between 1989 and 1999 there were 6.7 million annual office visits by sore throat (pharyngitis) patients, where approximately three quarters of adults (73%) were prescribed an antibiotic and 68% of the prescribed antibiotics were for non recommended use. The study also showed that broad spectrum and more expensive antibiotics are frequently used. [12]

The overutilization and inappropriate use of antibiotics in the community has not only led to higher treatment costs but has consequently led to the emergence of antibiotic resistant bacteria, which is becoming an epidemic and global problem. [7, 13-15] That is especially noted for one of the most common respiratory tract pathogen *Streptococcus pneumoniae*. However, resistance is not limited to one pathogen, it also includes resistance to *Haemophilus influenzae*, *Moraxella catarrhalis*, and other bacteria. [13] The level and the mechanism of bacteria resistance to antibiotics vary between different antibiotic classes. [13]

Many factors have played a role in the over prescribing of antibiotics. Patients, for instance, have an expectation of receiving an antibiotic and are consequentially pressure their physician to prescribe one. They may also be financially responsible for a low or no copayment for their medications which may give them more incentive to fill the prescription.[16, 17] Physicians, on the other hand, try to meet the expectation of their patients and try to avoid any liability in the case of treatment failure, leading them to prescribe broad spectrum antibiotics. [18] Other factors may include the health care system structure, formularies and prescribing restrictions.[19] Also, directed advertising and marketing to physicians and consumers by pharmaceutical companies may lead to more prescription of high cost broad spectrum antibiotics.[20]

With the high cost associated with the overuse of antibiotics and for the fear of more antibiotic resistant bacteria it becomes important, from the perspective of the decision and policy makers, to explore more of the factors and components that may affect the prescribing pattern of antibiotics. It was the intent of this study to explore the effect of drug coverage type, copayment, and patient reported satisfaction with their health care when prescribed an antibiotic. So far, a limited number of studies have been conducted on these factors.

Studies that explored the health insurance effect on prescribing antibiotics were either limited to a small group of patients, or did not look specifically at patients with acute respiratory tract infections. [21-23] Studies that examined the copayment effect demonstrated that an increase in the patient co-payment led to a decrease in the drug prescription and/or purchase. However, most of these studies were conducted on various classes of medications in a managed care organization setting and did not examine prescribing differences between different health care types. [24-26]

The association between patient satisfaction and receiving an antibiotic was only demonstrated in two studies that have shown no association between getting an antibiotic and patient satisfaction. [27, 28] However, these studies had a limited number of patients enrolled and only examined satisfaction based on the patient expectation, and not on overall health care service.

The uniqueness of this study derives from its ability to use a large national survey that is actually designed to help study the effect of drug coverage, copayments and patients satisfaction on the use of health care services. The result of this study provided decision and policy makers with more insight and information on what may be done in practice to avoid excess cost and antibiotic resistance caused by inappropriate use of antibiotics.

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Appendix B. Details of the methods used:

Many statistical techniques have been used in this analysis, which include simple descriptive analysis about the study population in the different studies, it also include bivariate analysis between the different study variables, Chi-square test have also been conducted to look if any variable have a significant effect on the main variable of interest.

Logistic regression was the main analytical test used in the three studies. Logistic regression models are so popular to analysts because of the ability of the model to describe a probability that is always some number between 0 and 1. In epidemiological terms, such a probability gives the risk of an individual getting a disease or a condition when exposed to any risk factor.[1]

Several techniques were used to develop the final logistic regression models. First, variables used in the study were dichotomized and dummy variables created for many of the variables. Second, univariate logistic regression was used to evaluate the relative contribution of each independent variable on predicting the influence of the main independent variable. Third, assessment of possible interaction terms (effect modifiers) was done between the primary independent variable and all other variables. Three, two, and one term interactions were completed and the decision was made on whether there was an interaction by examining at the log likelihood ratios in the chunk test.

The fourth technique used was testing for multi-collinearity and that was completed to examine the highly correlated variables and, if necessary, remove any variable from the model. That was accomplished by examining the condition index in the SAS output. Finally, testing for potential confounders that may influence our final model was carried out by comparing the B (coefficient) of the primary independent variable of the full model to each reduced model (i.e., a model missing on variable).

All statistical analysis were carried out using SAS version 8.1 (SAS Institute, Cary North Carolina) and SUDAAN software package (Research Triangle Institute, Research Triangle Park, North Carolina), both licensed to the University of Rhode Island. The results of the study have been weighted to generate 1996 national estimates. Many references for SAS and SUDAAN programming, methodology, and interpreting results have used.[1-5]

Weighting of the study population was completed using SUDAAN, which is a unique software package. It enables us to use survey and other types of clustered data (e.g., MEPS) to obtain estimates using the proper design parameters (e.g., variance estimation strata and the variance estimation PSU) and to compute appropriate standard errors of these estimates. Other software packages (e.g., SAS) are not able to use complex sample designs when computing variance estimates and test statistics.[5]

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