The Effect of Antibiotic and Resistance Education on Patient Knowledge

Karen Niemchick

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THE EFFECT OF ANTIBIOTIC AND RESISTANCE EDUCATION ON PATIENT KNOWLEDGE

By

Karen Niemchick

THESIS

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at Grand Valley State University
Allendale, Michigan
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for the degree of

MASTER OF HEALTH SCIENCE

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The Effect of Antibiotic and Resistance Education on Patient Knowledge

Abstract

Our society, which has enjoyed the benefits of antibiotics for over fifty years, is now experiencing an increase in bacterial resistance. One contributing factor is a lack of patient understanding about antibiotics resulting in their inappropriate usage. This study examined the effect of patient education in antibiotics and bacterial resistance on patient knowledge.

Adults from various medical facilities (a student health services clinic, an urgent care office, a family practice, and a community convenience sample) were given a ten-question survey designed to assess their knowledge of antibiotics and resistance. Half of the participants were randomly given an educational brochure to read before taking the survey, the other half received the survey and the brochure.

The control group contained 34 subjects and had a mean score of 9.00 with 1.371 for the standard deviation. The experimental group contained 31 subjects with a mean score of 9.77 and .425 for the standard deviation. The t-test statistic was -3.132 with a P value of .0015. The control group answered 36 questions incorrectly in comparison to 6 in the experimental group.

This demonstrated the effectiveness of patient education on patient knowledge of antibiotics and bacterial resistance.
ACKNOWLEDGEMENTS

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Karen Niemchick
Chapter 1

INTRODUCTION

Our society has enjoyed the benefits of what most physicians would call the wonder drug. For the last 56 years since the antibiotic penicillin was first used, bacterial assaults on us have been controlled, diminished, and cured. The great power of the antibiotic, however, is failing. This failure is due to what has been called an international public health nightmare: increasing bacterial resistance to many antibiotics that once cured bacterial diseases readily. In other words, the antibiotic is unable to destroy the bacteria. Diseases that are hardly considered as a problem have the potential to become dangerous, and perhaps even deadly.

Since antibiotics were first introduced, it was noticed that some bacteria would not respond to them. Bacterial resistance has always been around. Resistance genes pre­existed in nature, in soil, and water, and their presence was probably related to the production of antibacterial agents, synthesized naturally in the environment. Today, resistance is gained either by intrinsic methods, or acquired methods. Intrinsic resistance, as defined above, is present naturally, and acquired resistance occurs when bacteria exposed to an antibiotic develop a mechanism to overcome the activity of that antibiotic. Bacterial exposure to antibiotics has soared. In 1954, 2 million pounds of antibiotics were produced in the U.S. In 1998 more than 50 million pounds were produced. The bacteria, due to such high exposure, have developed several strategies of resistance. These include the ability to pump out antibiotics that get inside them, making enzymes that deactivate the drugs, and changing themselves so the drug cannot bind and work. The bacteria have responded brilliantly to our arsenal of drugs. These mechanisms account for almost every
disease-causing bacterium to have developed resistance to one or more of the 150-plus antibiotics in use today.\textsuperscript{4}

Many are now calling for strategies to combat this worldwide problem. It has been suggested that new classes of antibiotics need to be developed, tighter regulations for veterinary and agricultural uses of antibiotics be defined, doctor prescribing practices be changed, and antibiotic and resistance education for health care providers and patients be implemented. The area of patient education is one of great importance. Patients often seek medical attention for viral illnesses. In fact, upper respiratory infections, (the common cold), is one of the five most common diagnoses in ambulatory care physician office visits.\textsuperscript{5} In 1997, 818 billion prescriptions were written for respiratory tract infections, totaling approximately 75\% of all prescriptions written worldwide.\textsuperscript{6} Furthermore, these respiratory illnesses have been caused by a virus in more than 90\% of the cases.\textsuperscript{7} Antibiotics do not work against viruses.

This author believes the problem is that patients do not have a good understanding of antibiotics or bacterial resistance. This lack of knowledge most likely plays a role in the widespread use of antibiotics. This author believes that a greater understanding of antibiotics is necessary for patients to try other avenues of coping with their viral illnesses. An awareness of the resistance problem could be a motivation for lessening the desire for antibiotics. Increasing their knowledge may aid in the strategies to reverse bacterial resistance.

Several other contributing factors have been identified as furthering bacterial resistance. Antibiotics are extremely overused. It is estimated that up to 75\% of all antibiotic use is questionable.\textsuperscript{1} Of those prescriptions written, many are for broad-spectrum
antibiotics. These drugs promote resistance because they work on a broad range of bacteria. Furthermore, doctors admit to being bothered by giving antibiotics to misguided patients against their own better judgement. The following is a typical interaction as described by a physician:

A patient comes to the doctor with an infection he thinks is sinusitis and the medical exam is questionable. It could be caused by bacteria, virus or allergy. You tell the patient to get some decongestant nasal spray. But the patient feels the visit has been useless, and he might say, 'well, last year I had this same problem, and Dr. X gave me amoxicillin and it went right away.' Because the physician doesn't want to lose the patient, or maybe out of genuine sympathy, I sometimes succumb, and my colleagues do, too. The patient is dictating which antibiotics we give him.

Another area of overuse is in agricultural settings. Farmers spray large areas of fruit trees with antibiotics to ward off potential diseases in the fruit. Animals are given antibiotics in their feed to promote growth, although this benefit has not been proven. Both of these practices can encourage the growth of resistant bacteria. These bacteria then can make their way into people through the food chain. How much resistant bacteria do we consume? Levy cites a study of human volunteers who ate only bacteria-free foods. The number of resistant bacteria in their feces decreased 1000-fold. This suggests that we are ingesting significant amounts of resistant bacteria.

To further spread the resistant strains throughout the community, our cultural choices play a part. Today we crowd the most vulnerable members of society in day care centers and nursing homes. These people are the most susceptible to acquiring and spreading a resistant strain.

Finally, overuse is also seen in the new wave of consumer products. Antibacterial soaps and cleaners have flooded the market and most homes. These provide for more
opportunity of bacterial exposure to antibacterial agents, and consequently increase the chance of breeding drug resistant bacteria.

The purpose of this study is to examine the effects of antibiotic and bacterial resistance education on patient knowledge. The results may show that patients presented with information on antibiotics and drug resistance have more knowledge about these subjects than patients who do not receive the information. This study is designed to gather data on patient knowledge in the Grand Rapids area. Other studies have been conducted in other areas of the country. The results should reveal a greater understanding for health care providers in dealing with their patients in antibiotic therapy. It is undeniable these are complex behaviors. Patients learn to associate recovery from illness with antibiotics, and expect the same treatment on subsequent office visits. Doctors seek to satisfy their patients and give the prescriptions. However, if patient demand decreases due to an increased understanding, doctor-prescribing practices should follow suit.

The author feels this study is significant because a bleak antibiotic future exists. Patient education, as one component, becomes more important. Any decrease in the overuse of antibiotics certainly is not only viewed as beneficial, but necessary. Bruce Levin, a researcher in bacterial resistance states, “we may be stuck with what we have sown. It’s not clear to me that we can even slow down this process of evolving resistance.”

My hypothesis states that patients who are given adequate education on antibiotics and the bacterial resistance problem will gain knowledge in these areas. It is the hope of the author, that although beyond the scope of this paper, the patients will use that knowledge in changing their expectations for receiving antibiotics in the future.
Most of the literature read was from professional journal articles. Other sources included newspaper articles and Internet sites. In reviewing these, several main subjects became apparent. These subjects form the organizational basis for this chapter. Within these subjects, prominent themes also emerged. These were analyzed and discussed.

**Antibiotics and the Resistance Problem**

Most articles were in agreement that there is a very real, and serious threat emerging in health care. Levy, a prominent authority on the subject stated, "we’re in the midst of a crisis, we have to change things." In Denmark, the chief medical officer called colleagues from the European Union for a conference on the microbial threat to assess strategies to prevent and control emergence and spread of antimicrobial-resistant organisms. He addressed the gathering with, "a nightmare scenario of multi-drug resistant bacteria laying waste the human race in the next millennium is a real possibility. If we don’t make serious attempts to address this issue, it won’t matter that we have antibiotics in 20 years time; they simply won’t work. We are running out of time and need to act now."

Antibiotic resistance is not a new phenomenon. Since the introduction of penicillin, bacteria have been noted to express some resistance. This resistance almost always follows the introduction of new drugs. It is the frequency of resistance that is currently observed which causes alarm. Two main forces determine whether bacteria become resistant. These are 1) prevalence of resistance genes, and 2) the extent of antibiotic use. To understand the genetics of resistance, Burk, Canales, Rahr and Ayachi cited that for *Mycobacterium tuberculosis*, resistance occurs spontaneously in approximately 1 in 100,000-1,000,000 bacilli.
Most authors, however, focused on the overuse of antibiotics. It is this use which allows exposure of the bacteria to the drug and promotes resistant strains. Hafeez, Saltus, Perreten et al, Cohen, Rex, and Anderson, and Wise et al all recognize that antibiotics are overused and misused on a global scale. One specific area of overuse is upper respiratory infections and bronchitis. Viruses most often cause these illnesses. Gonzalez, Steiner, and Sande studied the antibiotic misuse problem in this area. They found that prescribing antibiotics for viral illness is broad based, spanning a wide geographical area and range of medical specialties, and varies little with sociodemographic or financial characteristics. Wise et al agrees that "in the past 50 years people worldwide have accepted antibiotics as their right to get a prescription at the first sign of a trivial infection." How serious is this problem? Radetsky points out that over 2 million people contract bacterial infections in the hospital, where some 90,000 die. Approximately 70% of these are infected by drug resistant bacteria. It is believed that if exposure to an antibiotic is decreased or stopped, the future bacterial generations will revert back to being susceptible. This evidence is inconclusive. Morell cites a study where over a 10-year period, 20,000 generations of bacteria were cultured and studied to observe resistant strains converting back to being susceptible strains. The bacteria never reverted back to being susceptible.

Besides taking antibiotics and promoting resistant strains in our bodies, humans pick up resistant bacteria in other ways. Levy conducted a study that shows that when 1 member of a household chronically takes an antibiotic to treat acne, the concentration of antibiotic resistant bacteria on the skin of family members rises.
There were contradictory articles reviewed as well. Bergogne\textsuperscript{2} and Bax et al\textsuperscript{16} all disagreed with the idea that antibiotic use is the main cause of bacterial resistance. Bax et al goes as far to say that "the problem is incompletely understood and there is not enough evidence to support specific prescribing or control policies."\textsuperscript{16} Bergogne places more emphasis on the genetic factors of the organism involved and intrinsic resistance.

**Contributing Factors**

Although causes to the resistant problem have been mentioned, these articles focused sole attention on contributing factors. Ackerman\textsuperscript{47}, Eden\textsuperscript{48}, and Kunin\textsuperscript{17} all listed increased antibiotic use and dosages as significant. Kunin believes that "the opportunity to prolong the effective life of each new antimicrobial drug by more appropriate use was squandered by excessive use."\textsuperscript{17} The underlying cause for this excessive use was seen as unnecessary prescribing by physicians. Monmaney writes that doctors are partly to blame. In a survey of 1500 physicians with 29,000 patient visits, more than half with a cold or upper respiratory infection got an antibiotic, or 1 in 5 prescribed antibiotics for conditions they don't help.\textsuperscript{19} Gonzales, Steiner, and Sande agreed and place blame on doctors. They revealed that despite sufficient data, (7 randomized double-blind studies), showing no major clinical role for antibiotics in uncomplicated acute bronchitis, practitioners continue to prescribe at an alarming rate.\textsuperscript{7} In an in depth look at prescribing practices, Belongia and Schwartz quoted a widely held physician's sentiment, "to write prescriptions is easy, but to come to an understanding with people is hard."\textsuperscript{18}

The physician prescribing habits can be further understood when patient expectations are taken into account. Gonzales states that physicians surveyed about antibiotic prescribing list patient pressure as a main reason for giving them.\textsuperscript{21} Treese agreed
with the patient expectation problem and Butler et al gave a clearer understanding of patient and doctor thoughts. In a qualitative study on patient and doctor perceptions, doctors found changing patient beliefs and expectations to be time consuming and unrewarding. Most doctors did try to explain that antibiotics do not work against viruses, but the patients were confused and did not understand. Of all the patients surveyed, 1/3 had a clear expectation of receiving antibiotics. One patient said, “I know what I want; speed is essential. I have to get penicillin.” It seemed to be a cycle where the patient wanted antibiotics, so the doctor prescribed them. This was reinforced each time the patient was sick and saw the doctor.

One article disagreed somewhat with the others. Smaglik placed equal responsibility for overprescribing on patients and a health care system that emphasizes treatment over education. He placed emphasis on education of both patients and doctors.

Patient Knowledge

The third subject seen in the literature was what patients know about taking drugs. This area was found to be the least studied. Patient knowledge actually is related to and affects other factors such as compliance, attitudes, and behaviors. Kunin et al determined specific patient beliefs about antibiotics. They pointed out current thinking which includes a pill for every ill, antibiotics are a wonder drug able to heal a wide variety of illnesses, and antibiotics are faster than other agents. This particular study showed great significance due to the fact that world populations were studied. Mainous et al also examined specific beliefs about antibiotics and upper respiratory infections. They concluded that patients lack understanding of the normal presentation of upper respiratory infections and antibiotic
effects as treatment. They further stated that this lack of knowledge may play a role in the widespread use of antibiotics for illnesses they won’t help.\textsuperscript{5}

\textbf{Patient Use/Behavior}

Patient knowledge has a direct influence on patient use and behavior concerning antibiotics. This can be seen in a study conducted in Spain, which sought to find how prevalent household antibiotic storage was. Of 1000 households, 42\% contained 1 or more antibiotics. Only 19\% had a person in the house currently under physician care with antibiotics.\textsuperscript{27} This showed an obvious misuse of antibiotics. Patients thought it was perfectly acceptable to keep some for later use.

The remaining articles discussed patient compliance. Compliance is the patient’s adherence to a drug regimen. Patient non-compliance rates have been measured and studied. Morris and Halperin reported non-compliance rates ranging from 30-80\%, and blamed failure of communication between the health care provider and patient.\textsuperscript{24} German et al supported communication especially for elderly patients. In a study conducted on people over 65, they concluded that they were more likely to be correct about the action and purpose of their drugs and to comply with prescribed regimens when they perceived an ongoing state of communication with their health care providers.\textsuperscript{25} When asked directly why they might be noncompliant, 4/5 of the patients in a study by Donovan and Blake said they dislike having to take drugs at all.\textsuperscript{30} Articles by Stephenson et al and DiMatteo expressed the same reasons. The patients believe the regimens are inconvenient, embarrassing, and impractical.\textsuperscript{31,32}
Solutions

To address the resistance problem, most articles were studies done to show the effectiveness of trial solutions. Carbon and Bax outlined two different programs, both based on removing certain antibiotics from use or greatly decreasing their use. The first was conducted in Iceland where a nationwide campaign against inappropriate antibiotic use was begun after a multi-drug resistant strain of *S. pneumoniae* was seen. Once antibiotic consumption started to decline, pneumococcal resistance also started to decrease as tested by nasopharyngeal carriage in day care centers. The second successful trial occurred in Finland. A national recommendation to reduce the use of macrolide antibiotics was issued. This was done because of a resistant strain of group A streptococcus to erythromycin. Erythromycin resistance peaked at 19% in 1993, then dropped to 8.6% in 1996. Both decreases in resistance were attributed to regulation of antibiotic use. A direct contradiction to these findings was described by Morell, as mentioned earlier. Reducing or eliminating the antibiotic did not reverse the effects and resistant strains remained.

Roter and Hall viewed the doctors as the solution. They suggested comprehensive discussion to explain treatment to patients and motivating patients to adhere to treatments. These were outlined with specific objectives and examples of what the health care providers should say. Cohen, Rex and Anderson also placed responsibility with physicians. In the case of a viral respiratory infection, they believe a straightforward explanation of why, given clinical findings, an antibiotic is unlikely to be useful. For those patients who still demanded an antibiotic prescription, they suggested to give it but with patient instructions to call the office after 48 hours to find out whether or not to fill it. Realizing the direct influence physicians have in antibiotic use, LDS Hospital in Utah
conducted a trial program and subsequent study into the results. A bedside computer system was installed to help physicians select the most appropriate antibiotics for hospitalized patients. Computer terminals and monitors were placed in every patient room and each clinical area. These terminals were linked to a hospital-wide database and decision support program. In a 7-year, 160,000 patient study, they found several benefits. These were that antibiotic use decreased by 22.8%, mortality rates decreased from 3.65% to 2.65%, antibiotic associated adverse drug events decreased 30%, antibiotic resistance patterns remained stable, the percentage of surgical patients who received appropriately timed pre-operative antibiotics increased from 40% to 99.1%, antibiotic cost per patient decreased from $122.66 to $51.90, and total antibiotic acquisition costs decreased from 24.8% to 12.9%. This article focused on improving doctor use of antibiotics over restricting doctor use of antibiotics.

Another solution, although limited to only one article, was new drug development. Glausiusz found a relatively new pharmaceutical company developing the next generation of antibiotics from a compound found in frog skin, salamanders, snakes, sharks, and honey bees. The compound has been called magainin and shows great promise. It functions against bacteria differently than other classes of drugs. There are, however, hurdles to overcome as with any new drug. Glausiusz quotes the CDC, “every year we see poster after poster of new drugs, some totally synthetic, some natural products, that inhibit wide ranges of bacteria at very low concentrations. But 3 years later they’re never heard of again because they’re either too toxic or cause significant side effects, or trigger an immune response. It’s hard to look into the crystal ball and say these really are the future of antibiotic therapy…” Overall, the discovery and development into new classes of
antimicrobial drugs active against drug resistant organisms has slowed. Wood, Gold and Moellering explained that cost is a major reason for this. It currently costs approximately $300 million to bring a new drug to market. Radetsky added that an informal survey of pharmaceutical companies in the U.S. and Japan showed at least 50% of them had either diminished greatly or completely gotten out of antibiotic research.

Huovinen and Cars specifically listed targeting diagnosis and treatment of respiratory tract infections and other viral illnesses, and improving public knowledge of the risks and benefits of antibiotic therapy. There is an organization, the Alliance for Prudent Use of Antibiotics which is actively involved in the resistance problem. They are an international grassroots organization with members in more than 90 countries. They specifically promote global public health in antibiotic resistance through education of health care personnel and patients, via conferences, publications, and research.

Finally, almost all articles listed patient education as a necessary addition to solutions. To begin the review on this topic, a quote from the Joint Commission on Accreditation of Health Care organizations was offered by Bernier: "the patient and /or when appropriate, his/her significant others are provided with education that can enhance their knowledge, skills, and those behaviors necessary to fully benefit from the health care interventions provided by the organization." Collier called this "the patient’s right to education." He adopts the WHO’s principle whereby patients need this information to allow them to decide whether they want to receive the therapy. Avorn et al expanded on the subject by including other factors. They believe that the disciplines of anthropology and sociology need to be applied to studies of patients’ perceptions of what illnesses require antibiotic therapy. Further, more needs to be learned about epidemiology of correct
and incorrect beliefs and how such beliefs vary across cultures and across strata within cultures. As an example of this, DiMatteo discussed social science research on physician-patient relationships. He asserted that >90% of patients want as much information about their health care as their physicians are willing to provide. Micelli et al agreed and pointed out that the desire for simple, understandable straightforward educational messages is impressive in that it was shared by the wide majority regardless of age, sex, degree of education and geographic location.

Further benefits of patient education were listed by Bernier. They are one of the most economical and effective instructional mediums available. Turnridge rested all other solution strategies on patient education. He goes as far to say that none (solution strategies) will work until the public is better educated in infectious diseases and the role of antibiotics, and the difference between a virus and bacteria.

Finally, the literature gave guidelines on how to write more effective patient education materials. Obviously, the materials are only useful if patients can read and understand them. Mumford explained that many leaflets are written at the university or post-graduate level. This article explained ways to design educational materials at appropriate grade levels. Miselli et al conceded that the information available to the public is the result of a trade off between technical jargon and commercial promotion.

The remaining articles were actual examples of educational information for the patient regarding antibiotics and resistance. They were available for reproduction without specific permission required. The first was titled “The Right Way to Use Antibiotics.” It consisted of 10 questions and answers, along with some definitions. The second was “You, Your Family and Antibiotics: The Untold Story.” This was also a question and answer
format but with only 6 questions. The last example was from The Alliance for the Prudent Use of Antibiotics. This was a very lengthy question and answer document. This information is freely accessible and encouraged to be used in part or completely.
Chapter 3

RESEARCH METHOD

Much emphasis has been placed on patient education as one solution to the problem of bacterial resistance to antibiotics. This investigation was based on the need to address patient understanding of antibiotics and bacterial resistance. As stated by Wise et al., "patients must be educated that most such infections (upper respiratory) do not require antibiotics." Patient education is one of the most significant yet most bypassed aspect regarding bacterial resistance. It is also one of the simplest and most economical solutions. Patients acquiring knowledge in these areas will have important implications for the worldwide problem of bacterial resistance.

My hypothesis stated that a simple educational tool in the form of a brochure would increase or add to patient knowledge in the area of antibiotics and bacterial resistance. To test this, a research design was needed that determined what patients know without the aid of the education, and what they know after reading the educational material. It was assumed that patient knowledge was consistent across the population and that most patients had a limited understanding of the information. Furthermore, because of this limited knowledge, they would seek medical attention and even demand antibiotics. It was also assumed that patient educational materials dealing with these problems were not being used. Finally, it was assumed that the questionnaire was sufficiently reliable to assess the patients’ knowledge.

Study Design

The actual experimental design chosen was the classic design with an omitted pre-test. The experimental design included random assignment of subjects to either a control
or experimental group. This was accomplished simply by alternating the patients as they came into the facility into the control group and then the experimental group. In the control group, subjects were given a ten-question survey, (Appendix A) which was designed to assess their knowledge of antibiotics and bacterial resistance. The subjects in the experimental group were first given a brochure (Appendix B) to read which explained the use of antibiotics and the development of antibiotic resistance. After reading the brochure, the experimental subjects completed the ten-question survey on antibiotic resistance.

This research project was reviewed and approved as a study given exempt status by the Grand Valley State University Human Research Review Committee. This document can be found in Appendix C.

**Study Site and Subjects**

After approval from various locations, the subjects were recruited from four different sites. These sites were a family practice office, an urgent care facility, a health service clinic, and a convenience sample from a community meeting. These sites were chosen to recruit a wide range of subjects who would be representative of the population.

The inclusion criterion for the subjects was adults aged 18 years to 65 years. Although the elderly population is a much needed research group, they were not sought as subjects due to factors which may play a part in their lack of knowledge: re: age, illness, and difficulty in comprehension. Adults in the 18-65 year old group have been those seeking medical attention for viral illnesses, such as colds. It has been these patients who in the past have received antibiotics for a cold or acute bronchitis and now pair the resolution of their illness with the receipt of antibiotics. In one survey of
patients in an ambulatory care practice, 60% of eligible patients, (those diagnosed with acute bronchitis), refused entry to a randomized controlled trial of antibiotics because they felt that antibiotics were absolutely necessary for their condition to improve. Most studies reviewed had targeted this age group as well.

Equipment and Instruments

Two different instruments were used. The first instrument used was a brochure, developed to educate the adult population on antibiotics and bacterial resistance. The brochure was the independent variable of the study and was carefully designed with a number of important guidelines in mind. These guidelines were taken from literature describing successful patient education materials. Bernier outlined the SMOG formula for estimating the readability of educational material. The readability is computed by examining 30 sentences in the brochure. Ten are selected from the beginning, 10 from the middle and 10 near the end. The numbers of words with 3 or more syllables are counted in the 30 sentences (including repeated words). The nearest square root of the 3 or more syllable words is determined and the number three is added. The final numerical value determines the grade level. For this brochure, the number of 3 or more syllable words was 58. The nearest square root of 58 is 7. Adding 3 gives a grade level of 10. The difficult terms in the brochure that caused this level were defined, thus improving the readability. The font size was at 13, as suggested by Bernier. The number of characters per line was kept between 50 and 70. Both upper and lower case letters were used to increase ease of reading. Bold print was used for headings and color was added to be pleasing to the eye. Main ideas were limited to 3, and active voice and pronouns were
used to engage the reader. Finally, the information was written in a question and answer format to encourage learning. The brochure can be found in Appendix B.

The answers to the ten questions are addressed in the brochure. The second instrument used was a survey, which included a demographic section, followed by 10 true or false questions regarding information on antibiotics and bacterial resistance. The demographic data included age, race, gender, occupation, education level, and annual income level. The questions were designed with the guidelines previously outlined. The survey tested the dependent variable, the subjects' knowledge of antibiotics and bacterial resistance. The survey can be found in Appendix A.

Survey Response Rate

Of the 69 persons approached for participation, only 4 declined. Those who declined were all from the urgent care facility. Data was collected on 5 separate occasions, once at each location and twice at the urgent care facility in February and March.

Procedures

The procedure for data collection was simple and straightforward. To encourage consistency, one tester visited all 4 sites. As patients arrived for their appointment, they were approached and it was explained that a research project was being conducted in that facility that day. The tester informed the potential subjects that the project dealt with antibiotics. The subjects were then asked if they would be willing to participate in the study. If they agreed, the tester alternately assigned each to the control or experimental group. The control group received only the survey, while the experimental group received the brochure to read first, followed by the survey. The patients were told they
could fill out the survey while they waited, as it would only take a few minutes. They were also told they could finish the survey when their appointment was over if they were called in. Due to the length of the questionnaire, most subjects were able to finish before being called in for their appointment. The surveys were collected, and subjects were thanked for their participation.

**Data Analysis**

Both descriptive and inferential statistics were used. The individual scores, as number correct, were described using the mean, and standard deviation. This showed the central tendency and relative position of the data. The tests were also evaluated according to particular questions that were answered incorrectly. The demographic data collected was analyzed with frequencies and percentages. For inferential statistics, significant differences between control and experimental group scores were sought. An independent two samples t-test was done to compare the number correct of the 10 true or false questions between control and experimental groups. The scores of those not receiving the brochure, (control), compared to those receiving the brochure before taking the survey, (experimental), were studied. The hypothesis of the study stated that the experimental group would have higher scores in comparison to the control group.
Chapter 4

RESULTS

The target population was adults aged 18 to approximately 65 years of age. The sample was taken from this age group. Sixty-five subjects participated in the study. The sample consisted of 29 men and 36 women, with 62 being Caucasian, 2 African-American, and 1 Asian American. Their ages ranged from 18 to 69 with a mean age of 34 years (standard deviation 13.12). For level of education, 40% had some college, 24.6% and 29.2% were high school and college graduates, respectively. Only 6.2% had not graduated from high school. Annual income levels ranged from less than $15,000 to more than $50,000 with the highest proportions in the under $15,000 level (28.6%) and the greater than $50,000 level (25.4%). More than half the respondents, 60.3%, made $35,000 per year or less. The demographic data is summarized in Table 1.

Table 1
Demographic Characteristics of Sample

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<th>Percent</th>
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<tr>
<td>Female</td>
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</tr>
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<td>Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;15,000</td>
<td>18</td>
<td>28.6</td>
</tr>
<tr>
<td>15,001 – 25,000</td>
<td>9</td>
<td>14.3</td>
</tr>
<tr>
<td>25,001 – 35,000</td>
<td>11</td>
<td>17.5</td>
</tr>
<tr>
<td>35,000 – 50,000</td>
<td>9</td>
<td>14.3</td>
</tr>
<tr>
<td>&gt;50,000</td>
<td>16</td>
<td>25.4</td>
</tr>
</tbody>
</table>
My research hypothesis is that antibiotic and bacterial resistance education will increase patient’s knowledge in these areas. Sixty-five subjects were randomly divided into two groups. The control group contained 34 subjects; the experimental group contained 31. The mean test score for the control group was 9.0 with a standard deviation of 1.37. The mean test score for the experimental group was 9.77 with a standard deviation of .425. These statistics are summarized in Table 2. The collective scores of the control group and experimental group can be seen in the boxplot diagram of Figure 1.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>34</td>
<td>9.00</td>
<td>1.37</td>
</tr>
<tr>
<td>Experimental</td>
<td>31</td>
<td>9.77</td>
<td>.425</td>
</tr>
</tbody>
</table>

Table 2

T-Test Statistics

Figure 1

Collective Scores Plot

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A two independent samples t-test was performed. The t value was -3.132 with equal variances not assumed. The resulting P-value associated with the test statistic t of -3.132 was .0015. The data show sufficient evidence that antibiotic and bacterial resistance education increased patient's knowledge.

In the control group, the question most often missed was number 4, (antibiotics are good medicine for colds or flu) with 12 participants out of 34 answering incorrectly. This was 35% of the respondents. The next most missed question was number 3 with 6 answering incorrectly, or 18% of the respondents. Finally, number 2 had 5 answering incorrectly, or 15%. The total number of incorrect responses was 36.

In the experimental group, the question most often missed was number 8 (our society does not have a bacterial resistance problem) with 2 respondents out of 31 answering incorrectly or .06%. This was followed by questions 2, 5, 9, and 10, each with 1 respondent answering incorrectly. The total number of incorrect responses was 6. The specific questions missed can be found in Table 3.

<table>
<thead>
<tr>
<th>Question #</th>
<th>Control Incorrect Answers</th>
<th>Experimental Incorrect Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>8</td>
</tr>
</tbody>
</table>
In regard to the demographic data some significant differences in the control group can be noted. Those subjects with less than a high school diploma had the lowest mean with 7.5 and a standard deviation of .707. Also, those in the 30-39 age bracket scored a mean of 8.1 with a 2.27 standard deviation. The subjects that scored the highest (with perfect scores) were college graduates. The highest income bracket and oldest subjects (40-49 and 50-65) obtained mean scores of 9.6, SD .547, 9.7, SD .516 and 9.7, SD .577 respectively. The demographic data can be found in Table 4.

Table 4
Scoring by Demographics

<table>
<thead>
<tr>
<th>Income</th>
<th>Control Mean Score</th>
<th>Control Standard Deviation</th>
<th>Experimental Mean Score</th>
<th>Experimental Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;15,000</td>
<td>9.00</td>
<td>1.00</td>
<td>9.90</td>
<td>.333</td>
</tr>
<tr>
<td>15,001 – 25,000</td>
<td>8.40</td>
<td>1.59</td>
<td>9.70</td>
<td>.577</td>
</tr>
<tr>
<td>25,001 – 35,000</td>
<td>9.30</td>
<td>1.16</td>
<td>9.70</td>
<td>.577</td>
</tr>
<tr>
<td>35,000 – 50,000</td>
<td>9.20</td>
<td>1.30</td>
<td>9.80</td>
<td>.500</td>
</tr>
<tr>
<td>&gt; 50,000</td>
<td>9.60</td>
<td>.547</td>
<td>9.80</td>
<td>.405</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education</th>
<th>Control Mean Score</th>
<th>Control Standard Deviation</th>
<th>Experimental Mean Score</th>
<th>Experimental Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;high school</td>
<td>7.50</td>
<td>.707</td>
<td>9.50</td>
<td>.707</td>
</tr>
<tr>
<td>HS graduate</td>
<td>8.70</td>
<td>1.92</td>
<td>9.70</td>
<td>.488</td>
</tr>
<tr>
<td>Some college</td>
<td>8.50</td>
<td>1.05</td>
<td>9.80</td>
<td>.376</td>
</tr>
<tr>
<td>College grad</td>
<td>10.0</td>
<td>0.0</td>
<td>9.8</td>
<td>.441</td>
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<table>
<thead>
<tr>
<th>Age, Y</th>
<th>Control Mean Score</th>
<th>Control Standard Deviation</th>
<th>Experimental Mean Score</th>
<th>Experimental Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 - 29</td>
<td>8.80</td>
<td>1.07</td>
<td>9.80</td>
<td>.405</td>
</tr>
<tr>
<td>30 - 39</td>
<td>8.10</td>
<td>2.27</td>
<td>9.60</td>
<td>.535</td>
</tr>
<tr>
<td>40 - 49</td>
<td>9.70</td>
<td>.516</td>
<td>10.0</td>
<td>0.0</td>
</tr>
<tr>
<td>50 - 65</td>
<td>9.70</td>
<td>.577</td>
<td>10.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>Control Mean Score</th>
<th>Control Standard Deviation</th>
<th>Experimental Mean Score</th>
<th>Experimental Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>8.60</td>
<td>1.16</td>
<td>9.90</td>
<td>.258</td>
</tr>
<tr>
<td>Female</td>
<td>9.20</td>
<td>1.47</td>
<td>9.60</td>
<td>.479</td>
</tr>
</tbody>
</table>

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Chapter 5

DISCUSSION

It is well known that many physicians acquiesce to misguided patients who demand antibiotics to treat colds and other viral infections. This is estimated to account for 50 million of 150 million outpatient antibiotic prescriptions per year. One answer to this problem has been patient education.

While this study successfully interviewed patients with a wide range of incomes, education levels, and ages, there have not been other studies to compare with. Past studies have shown patient demand and subsequent receipt of antibiotics, but none have demonstrated what education can accomplish. The results of this study indicated that patients, when given educational material, will increase in their knowledge of the information given. Moreover, this need for antibiotic and resistance education may play a role in decreasing the widespread use of antibiotics for viral infections.

The statistical results were significant because they stated that if education did not increase knowledge, there was only a .0015 chance the data would have been obtained. This proved that education did increase the patients' knowledge.

Implications

There are several implications of increasing patient knowledge of antibiotics and resistance. First, appropriate knowledge about antibiotics and the type of infection they work for should decrease office visits for viral infections such as colds or acute bronchitis. Surveyed patients already admitted associating their recovery from viral infections with antibiotics. With upper respiratory infections accounting for 1 of the 5
most common diagnoses in office visits\textsuperscript{5}, a decrease in these visits would have a large impact on the health care industry overall.

Second, patient expectations would be affected. Currently, patients have been programmed to expect antibiotics.\textsuperscript{23} They have even believed it is their right to get one. However, it has been pointed out that patients' expectations of antibiotic therapy may be in conflict with optimal medical guidelines for antibiotic use.\textsuperscript{50} Increasing their understanding of antibiotics would decrease their expectation for one, especially in the case of a viral infection. Furthermore, most doctors prescribed antibiotics simply because of patient demands and pressure. This would help those physicians who said they prescribed more than they would like to for these types of conditions.\textsuperscript{22}

Third, because patient knowledge increased, a decrease in antibiotic use has implications in the widespread bacterial resistance problem. There has been general agreement that the best way to decrease selective pressure of antibiotics for bacterial resistance is to decrease antibiotic usage.\textsuperscript{42} Patient education advantages include, consistency of the message content, flexibility of delivery, portability, reusability, economical to produce and update, and permanence of the information.\textsuperscript{38} Besides these benefits, patient education will break an established cycle of taking antibiotics for viral respiratory infections. This education needs to inform patients that past practices are no longer optimal. Belongia and Swartz believe that information given at office visits is immediately relevant and likely received as authoritative.\textsuperscript{18} Another study called patient education an optimum strategy.\textsuperscript{20}

According to the data, a lower income level, age 30-39, and lower education level indicated less knowledge in the control group. The education level had greatest
significance on low mean score. Gender had no bearing on how much knowledge those in the control group had. No one characteristic affected the gaining of knowledge in the experimental group.

The test scores indicated a greater number of questions were missed altogether in the control group with 36 total incorrect answers. This is compared to the total number of questions missed in the experimental group with 6. To further assess patient knowledge, question number 4 was answered incorrectly, by 12 participants in the control group. This question read, "antibiotics are good medicine for colds or flu." Patients generally believe this to be true. This is contrasted with the experimental group where no one answered this incorrectly. Again patient confusion about viruses and antibiotics appeared with question 3, the second most missed question. It read, "both viruses and bacteria can be cured by antibiotics." Six of 34 in the control group and 0 in the experimental group missed this.

These results coincided with current literature detailing patient ideas about what illnesses benefit from antibiotics. These illnesses range from headaches in developing nations to viral upper respiratory infections in affluent suburbs of industrialized nations. Most patients are confused about antibiotics, bacteria, and viruses.

Validity and Reliability

To address validity or truthfulness, both internal and external validity was considered. The internal validity, because of the nature of the study, was unaffected by history, maturation, testing, subject mortality and instrumentation. The only factor possibly affecting internal validity was a small convenience sample of subjects who were surveyed. These subjects volunteered and may have been different from the others who
were selected. The external validity was not affected by most factors. The generalizability was accounted for by random selection of participants.

The reliability may have been affected by subject motivation. Some of the participants were ill and not feeling particularly interested in much else than feeling better. The other factor that may have affected reliability was the environment. Distractions did occur, and occasionally, the subject was called in for their appointment. Those subjects finished their survey after their appointment was over.

Limitations

Two limitations to the study should be noted. First, the cross section of subjects as far as age, educational level, and income was wide, but the sample was not representative according to race. Although several sites were used for data collection, the experimental group consisted of all white participants. Therefore, the results of this study cannot be applied to non-white populations. Second, the survey used was not a standardized instrument. Standardized tests have undergone a normalizing process where their validity and reliability have been established against the normal populations.

Conclusions

This study confirmed the view that patient education has an effect on patient knowledge. It was shown to be an effective tool as one solution to the rising misuse of antibiotics for viral infections, and the subsequent bacterial resistance problem. Although this study was small, it encourages further studies into larger and different population groups. The lack of understanding displayed is evidence that quality educational materials on antibiotics and bacterial resistance should be utilized.
Appendix A
PATIENT SURVEY

Age: _______  Sex: ____ Male  ____ Female

Race:  ____ White  
       ____ African American  
       ____ Hispanic  
       ____ Other

Occupation: _______________________

Education:  ____ Less than High School  Annual Income:  ____ Less than $15,000
       ____ High School Graduate  ____ $15,001 to $25,000
       ____ Some College  ____ $25,001 to $35,000
       ____ College Graduate  ____ $35,001 to $50,000
       ____ $50,000 or more

**TRUE or FALSE** (circle one)

1. Antibiotics are prescription drugs that attack bacterial germs..... T   F
2. Antibiotics work against all infections............................................ T   F
3. Both viruses and bacteria can be cured by antibiotics................... T   F
4. Antibiotics are good medicine for colds or flu.............................. T   F
5. Bacteria and viruses are pretty much the same............................. T   F
6. It is OK to save some of your antibiotic prescription for the next time that you are sick .......................................................... T   F
7. When bacteria find a way to fight the antibiotic that you are taking, and your infection won’t go away, this is called resistance.................................................... T   F
8. Our society does not have a bacterial resistance problem.............. T   F
9. You should not share your antibiotic with anyone else.................... T   F
10. Most common colds are caused by viruses..................................... T   F

Thank you for your participation.
Appendix B
**ANTIBIOTIC FACTS**

**What are antibiotics?**
Antibiotics are prescription drugs that help your body fight off bacterial infection.

**What are bacteria?**
Bacteria are germs called organisms. Most bacteria are helpful; a few are harmful and cause illness.

**Do antibiotics work against all infections?**
No. Antibiotics work in infections caused by bacteria. They don't work at all in infections caused by a virus, which is a different kind of organism.

**What's the difference between bacteria and viruses?**
Viruses cause colds, most coughs and sore throats. Infections caused by viruses cannot be cured with antibiotics. Bacterial infections can be cured by antibiotics.

**What are some common infections antibiotics are prescribed for?**
Antibiotics may be given for strep throat, ear infections, urinary tract infections, sinus infections, and bronchitis.

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**RESISTANCE FACTS**

**What is antibiotic resistance?**
Sometimes bacteria find a way to fight the antibiotic you are taking and your infection won't go away. This is called antibiotic resistance.

**What factors have contributed to antibiotic resistance?**
* Incorrect use and overuse of antibiotics in humans, animals, and farming.
* Failure to finish an antibiotic prescription.
* In some countries, antibiotics are available without a prescription.
* Patient demand for and receiving antibiotics when they are not called for.
* Overuse of anti-bacterial soaps.

**How does antibiotic resistance affect me?**
It is a very serious problem for everyone. You can be sicker for longer, and without knowing it you may have developed a dangerous form of resistant bacteria. Some of these resistant forms don't have any antibiotics that will work against them. This places all of us at risk for epidemics of bacterial disease where modern medicine may be powerless.

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**FREQUENTLY ASKED QUESTIONS**

**When should I take antibiotics?**
You should take them when your doctor prescribes them for you.

**Can I save some of the antibiotic for the next time I am sick?**
No. Left over antibiotics are not a complete dose. A complete dose of the antibiotic is needed to kill all the harmful bacteria.

**When I start feeling better can I stop taking the antibiotic?**
No. Your prescription is written to cover the time needed to help your body fight all the harmful bacteria. If you stop your medication early, the bacteria that have not yet been killed can restart an infection.

**If I forget a dose or two is that a problem?**
Yes. These drugs need to be taken on a frequent and consistent basis to achieve the best effect. If you don't take your medication as prescribed, the bacteria may not be killed and your illness may not improve.
Appendix C
February 18, 1999

Karen Niemchick
3946 Shorewood Ct.
Grandville, MI 49418

Dear Karen:

Your proposed project entitled "The Effects of Antibiotic and Resistance Education on Patient Knowledge" has been reviewed. It has been approved as a study which is exempt from the regulations by section 46.101 of the Federal Register 46(16):8336, January 26, 1981.

Sincerely,

[Signature]

Paul Huizenga, Chair
Human Research Review Committee
References


