

CURRENT PRESCRIBING PRACTICES FOR ANTIBIOTIC PROPHYLAXIS: A  
SURVEY OF DENTAL PRACTITIONERS

A Thesis

By

LEAH S. SPITTLE

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Chair of Committee, Kathleen Muzzin  
Committee Members, Patricia Campbell  
Janice DeWald  
Francisco Rivera-Hidalgo  
Head of Department, Van Gene Wilson

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## ABSTRACT

Antibiotic prophylaxis, administered prior to dental treatment, has been important in the prevention of infective endocarditis. The American Heart Association (AHA) and the American Academy of Orthopaedic Surgeons (AAOS) have developed guidelines for the use of antibiotic prophylaxis in healthcare and dentistry. However, various changes in the antibiotic prophylaxis guidelines in recent years have caused confusion for many healthcare providers, dentists, and patients. Currently, there is limited research on United States dental practitioner's prescribing practices of antibiotic prophylaxis. The purpose of this study was to examine whether dental practitioners in Texas, Oklahoma, and Kansas were following the 2007 guidelines of the AHA and AAOS regarding the use of antibiotic prophylaxis. A questionnaire was sent to 600 dentists in varying areas of dental practice with a response rate of 28.7% (n=172). Data analysis was performed using descriptive statistics, weighted logistic regression, and quadratic polynomial regression analysis. In addition, a scoring system was created to analyze dentists' antibiotic prophylaxis prescribing practices for specific survey questions. This study found that 56% (n=97) of the respondents were following the current 2007 AHA antibiotic prophylaxis guidelines. Results of this study also revealed that 71.7% (n=119) of respondents prescribed antibiotic prophylaxis within the first two years after total prosthetic joint replacement, while 57.8% (n=96) continued to prescribe antibiotic prophylaxis beyond two years. The respondents of this study were asked if the patient was an integral part of the decision making process when discussing an antibiotic

prophylaxis regimen. The majority of respondents (72.4%, n=123) stated that the patient was included in the decision to take antibiotic prophylaxis if needed. In regard to antibiotic resistance, the majority of respondents (73.2%, n=120) stated they believed there is a risk for antibiotic resistance if a patient is taking the required antibiotic prophylaxis regimen for each dental visit. Approximately 92% (n=155) of respondents believed there was confusion regarding antibiotic prophylaxis protocols used in dentistry, specifically including data suggesting that dentists and physicians do not agree on which conditions should be covered prophylactically. Future studies need to include a larger sample size to determine compliance with antibiotic prophylactic guidelines.

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## NOMENCLATURE

AAOS	American Academy of Orthopaedic Surgeons
ADA	American Dental Association
AHA	American Heart Association
IRB	Institutional Review Board
MVP	Mitral Valve Prolapse
NICE	National Institute for Health and Clinical Excellence
US	United States

## CHAPTER I

### INTRODUCTION AND REVIEW OF LITERATURE

In recent years, there has been constant change and confusion regarding antibiotic prophylactic protocols. Confusion about prophylactic guidelines may explain the large number of antibiotic prescriptions being written in dentistry.<sup>1</sup> With the emergence of systemic side effects caused by antibiotics, and the increased awareness of antibiotic resistance, there has been debate on the appropriateness of the scope of antibiotic prophylaxis used in dentistry.

#### **History of Antibiotic Prophylaxis and Dosing Regimens**

The development of the American Heart Association (AHA) guidelines for antibiotic prophylaxis has been a “process of evolution for more than fifty years.”<sup>2</sup> In 1955, the AHA published their first document stating the protocol that healthcare practitioners should use when prescribing antibiotic prophylaxis.<sup>3</sup> However, it was not until 1960 that the AHA recognized the emergence of penicillin-resistant oral microflora as a result of prolonged therapy for the prevention of infective endocarditis.<sup>4</sup> In 1972, the AHA recommendations were endorsed by the American Dental Association (ADA).<sup>5</sup> This document stressed the importance of maintaining good oral hygiene.<sup>5</sup> From 1977 through 1990, the AHA made further modifications to antibiotic prophylaxis protocols and categorized patients and dental procedures into low-risk and high-risk categories.<sup>6-8</sup>



In 1997, the AHA stratified cardiac conditions into high, moderate, and low-risk categories and stated that patients in the low-risk cardiac category did not require antibiotic prophylaxis.<sup>9</sup> The 1997 document also stated that the majority of infective endocarditis cases were not attributed to an invasive dental procedure.<sup>9</sup> Instead, the AHA felt infective endocarditis was most likely the result of randomly occurring bacteremias produced during routine daily activities such as brushing, flossing, and eating.<sup>9</sup>

The most recent revision from the AHA came in 2007.<sup>10</sup> The AHA found that the antibiotic prophylaxis protocols from previous recommendations were not well established and the evidence was limited to case-control studies, expert opinions, clinical experience, and descriptive studies.<sup>10</sup> Retrospectively, the AHA also felt that the antibiotic prophylactic guidelines had become difficult for patients and healthcare professionals to interpret, and that the previous guidelines contained some inconsistencies and were ambiguous.<sup>10</sup> The 2007 AHA cardiac conditions associated with the highest risk of endocarditis for which prophylaxis for dental procedures is recommended is summarized in Table A-1.

Iterations of the AHA antibiotic prophylaxis regimens have also changed throughout the years. From 1955 through 1977, aqueous penicillin and procaine penicillin supplemented with or without crystalline penicillin in varying dosages, were prescribed to patients requiring antibiotic prophylaxis.<sup>3-6, 11, 12</sup> In 1984, the antibiotic regimen was penicillin V, in a 2 gram dosage, taken orally one hour before dental treatment then 1 gram six hours after the initial dose.<sup>7</sup> While penicillin V does have a

similar effect to amoxicillin in the reduction of bacteria, a much higher serum antibiotic level is achieved with amoxicillin when compared to penicillin V two to nine hours after the 2 gram dose is provided.<sup>13</sup>

In 1990, amoxicillin was the antibiotic of choice, and the regimen consisted of 3 grams taken orally one hour before a dental procedure, then 1.5 grams 6 hours after the initial dose.<sup>8</sup> However, the need for the second dose has never been substantiated and a 2 gram dosage of amoxicillin was found to be sufficient to provide proper prophylactic coverage, a reduction in gastrointestinal side effects, and better compliance with prophylaxis.<sup>14</sup> In 1997, the antibiotic prophylaxis regimen was changed to amoxicillin 2 grams taken orally one hour before a dental procedure.<sup>9</sup> In 2007, the administration and dosage of amoxicillin remained the same as in 1997.<sup>10</sup> For patients allergic to penicillin, or a derivative of penicillin, the current 2007 AHA guidelines recommend one of the following regimens orally one hour prior to dental treatment: 1) 2 grams of cephalexin; 2) 600 milligrams of clindamycin; or 3) 500 milligrams of azithromycin or clarithromycin.<sup>10</sup> However, even though allergic reactions and systemic side effects are risks associated with the use of amoxicillin, it still remains the drug of choice for antibiotic prophylaxis for patients with high-risk cardiac conditions.

### **Relation of Infective Endocarditis and Dentistry**

The mucosal surfaces within the oral cavity could be a potential point of entry for bacteria to enter the blood stream which could lead to infective endocarditis.<sup>15, 16</sup> Studies have found that transient bacteremias from the oral cavity have been associated with the manipulation of teeth and periodontal tissues.<sup>17-21</sup> Over the years, investigators

have focused on dental procedures as a potential cause of infective endocarditis.<sup>17-21</sup> However, there is a wide variation in the reported frequencies of bacteremia leading to infective endocarditis as a result of dental treatment.<sup>22, 23</sup> Transient bacteremias also frequently occur during daily activities that are unrelated to dental procedures. Multiple studies suggest bacteremias can occur from tooth brushing and flossing, oral irrigation, and chewing food.<sup>24-27</sup>

### **Relation of Antibiotic Prophylaxis with Prosthetic Joint Replacements**

There has been an ongoing discussion between the ADA and the American Academy of Orthopaedic Surgeons (AAOS) concerning the relationship between dental procedures and prosthetic joint replacement.<sup>28-30</sup> In 2012, a panel of experts from the AAOS and ADA published the clinical practice guideline “Prevention of Orthopaedic Implant Infection in Patients Undergoing Dental Procedures.”<sup>31</sup> The guideline was created as an educational and decision making tool that dentists and physicians could use when prescribing prophylactic antibiotics. However, dental practitioners raised concerns regarding the guidelines and requested further clarification from the ADA.<sup>32</sup> In 2014, the ADA Council on Scientific Affairs assembled their own panel of experts and instructed them to reexamine the 2012 AAOS/ADA guidelines.<sup>32</sup> The 2014 ADA panel found that the current evidence “failed to demonstrate an association between dental procedures and prosthetic joint infection.”<sup>32</sup> The panel also stated that “repeated exposure to antibiotics could contribute to antibiotic resistance and that some patients may experience adverse drug reactions and systemic side effects.”<sup>32</sup>

Although the 2007 AHA recommendations are more straightforward than previous ones, confusion is still present among dental practitioners regarding appropriate prescribing practices. The trend among dentists and physicians appears to be a misunderstanding and improper compliance to the 2007 AHA antibiotic prophylactic protocols. This confusion may have led many dental practitioners to violate longstanding expectations and practice patterns.<sup>33</sup> In 2008, the National Institute for Health and Clinical Excellence (NICE) in the United Kingdom revised their recommendations for antibiotic prophylaxis based on the “best available evidence.”<sup>34</sup> These recommendations included discontinuing antibiotic prophylaxis for patients considered at risk for infective endocarditis after dental procedures.<sup>34</sup> Researchers from the United States (US) and other countries have examined how dentists are prescribing antibiotic prophylaxis and found that dental practitioners were not always following the 2008 NICE or the 2007 AHA antibiotic prophylaxis protocols.<sup>33, 35-41</sup>

Tong et al. surveyed 458 Singapore dentists and found that 39.8% (n=168) had followed the 2007 AHA guidelines and could accurately identify which dental procedures required antibiotic prophylaxis, while 12.4% (n=52) of the dentists followed the 1997 AHA guidelines.<sup>35</sup> However, 30.2% (n=127) of the dentists reported their prescribing practices were based solely on the patient’s cardiologist’s recommendations.<sup>35</sup>

Lauber et al. conducted a survey of 450 Canadian dentists and 245 Canadian family physicians.<sup>33</sup> They found that there was a significant difference between dentists and physicians in selecting the correct “first-line” antibiotic for prophylaxis.<sup>33</sup> Lauber et

al. reported that dentists in Canada were more familiar with the 2007 AHA antibiotic prophylaxis protocols than Canadian physicians.<sup>33</sup>

Zadik et al. surveyed 118 Israeli dentists concerning their knowledge regarding the 2007 AHA antibiotic prophylaxis guidelines.<sup>39</sup> Zadik et al. found that the majority of dentists (81.3%, n=96) identified the ten cardiac conditions that require antibiotic prophylaxis.<sup>39</sup> However, 42% (n=50) of the dentists stated they would prescribe antibiotic prophylaxis for patients with mitral valve prolapse (MVP) with regurgitation.<sup>39</sup> In 2007, the AHA removed MVP with regurgitation from the list of cardiac conditions requiring antibiotic prophylaxis.<sup>10</sup> These findings suggested that some Israeli dentists were still following the 1997 AHA guidelines.<sup>39</sup> The dentists were also given a list of dental procedures and were asked which ones they would routinely prescribe antibiotic prophylaxis for prior to dental treatment. The majority of the dentists stated they would prescribe antibiotic prophylaxis for periodontal surgery (96.6%, n=114), tooth extraction (96.6%, n=114), and scaling (90.7%, n=107).<sup>39</sup>

In 2009, Coutinho et al. examined the knowledge and practices of dentists in preventing infective endocarditis in children.<sup>40</sup> The study included 21 dentists working in two public hospitals in Brazil that specialized in treating children with special needs, who also have cardiac conditions. Both qualitative and quantitative analysis was used to determine the dentist's knowledge and practices for antibiotic prophylaxis. Of the 21 respondents, 33% (n=7) stated they followed the 2007 AHA antibiotic prophylaxis guidelines.<sup>40</sup> Thirty three percent (n=7) of respondents stated they had offered an explanation about the risk associated with bacteremia and the patients' inadequate oral

health.<sup>40</sup> In addition, 14% (n=3) of respondents felt there was not enough time to discuss the details, such as the risks versus the benefits, regarding the use of antibiotic prophylaxis with the patient.<sup>40</sup> Finally, to avoid the overuse of antibiotics, 33% (n=7) of respondents stated they performed multiple dental procedures during one appointment.<sup>40</sup>

In 2011, Soheilipour et al. conducted a qualitative study and examined attitudes and perceived barriers to the implementation of the 2008 NICE guidelines for antibiotic prophylaxis in clinical practice.<sup>37</sup> Seven dentists, two cardiologists, and one cardiac nurse were interviewed. The practitioners believed that patients, who had a history of infective endocarditis, would be reluctant to follow the 2008 NICE guidelines because patients see antibiotic prophylaxis as “a safety net.”<sup>37</sup> The dentists interviewed believed that the changes in the 2008 NICE guidelines violated not only their credibility, but also the patient’s trust because they had to “go back on advice they had previously given to patients.”<sup>37</sup> However, from a practical standpoint, the practitioners found the 2008 NICE guidelines were straightforward and easy to adopt.<sup>37</sup> The practitioners also agreed there was a lack of quality evidence to support prescribing antibiotic prophylaxis given before dental treatment.<sup>37</sup>

Soheilipour et al. also surveyed patients for their perspectives and understanding of the 2008 NICE guidelines in part II of their qualitative research.<sup>38</sup> Nine patients were interviewed and asked their personal views and opinions on the implementation of the updated 2008 NICE guidelines.<sup>38</sup> Soheilipour et al. found that some patients understood the risk for infective endocarditis was less than the adverse reaction to antibiotic prophylaxis.<sup>38</sup> However, other patients felt the adverse reactions to the antibiotics were

negligible when compared to the risk for infective endocarditis post dental treatment.<sup>38</sup> In addition, the patients felt there was a lack of consensus among health care professionals in regard to the antibiotic prophylaxis guidelines.<sup>38</sup>

Lockhart et al. surveyed 878 US dentists regarding their compliance with the 2007 AHA recommendations for antibiotic prophylaxis.<sup>36</sup> A majority of the dentists (70.0%, n=615) stated they had patients in their practice who took antibiotic prophylaxis prior to dental treatment even though the 2007 AHA guidelines no longer recommended it.<sup>36</sup> Approximately 67% (n=398) of the dentists surveyed indicated that antibiotic prophylaxis was given to patients who had MVP.<sup>36</sup> Lockhart et al. also noted six other cardiac conditions in which patients were still incorrectly taking antibiotic prophylaxis including ventricular septal defect, atrial septal defect, and hypertrophic cardiomyopathy (36.9%, n=219), rheumatic heart disease (30.3%, n=179), aortic or mitral stenosis (22.4%, n=133), and bicuspid valve disease (22.1%, n=131).<sup>36</sup> They also found that the majority of the patient's prescriptions for antibiotic prophylaxis came from either the patient's physician or were due to patient preference.<sup>36</sup> Only 5% (n=30) of the dentists surveyed stated that they administered antibiotic prophylaxis when it was not recommended based on the 2007 AHA guidelines.<sup>36</sup> Lockhart et al. stressed that "further education of physicians and patients is needed to address the overuse of antibiotics for the prevention of infective endocarditis."<sup>36</sup>

In 2015, a study from Alberta, Canada surveyed the knowledge and implementation of the 2007 AHA guidelines among dentists and dental hygienists. Jain et al. performed a cross-sectional survey of 450 dental hygienists and 450 dentists.<sup>41</sup>

The survey analyzed whether the practitioner would recommend antibiotic prophylaxis to a high-risk cardiac patient undergoing various dental procedures.<sup>41</sup> The majority of dentists (89.2%, n=173) and dental hygienists (89.9%, n=107) deferred any antibiotic prophylaxis prescription decisions to the patients' cardiologist.<sup>41</sup>

Currently, there is limited research of US dental practitioners' prescribing practices of antibiotic prophylaxis. Therefore, the purpose of this study was to examine the antibiotic prophylactic prescribing practices of dentists in the south central region of the US. Specifically, this study investigated if dentists were: 1) following the 2007 AHA, as well as the AAOS antibiotic prophylaxis guidelines, 2) involving the patient in the decision to take antibiotic prophylaxis, 3) confident in their prescription decisions for antibiotic prophylaxis, 4) concerned that dentistry is indirectly contributing to antibiotic resistance, and 5) confused about the appropriate use of antibiotic prophylaxis.



## CHAPTER II

### METHODS AND MATERIALS

#### **Survey Instrument**

The questionnaire for this investigation was modified based on a survey originally developed by Tong et al. (Appendix B).<sup>35</sup> The survey consisted of 25 questions, and contained multiple choice, yes/no responses and space for additional comments. The items in the survey included questions regarding demographics, current antibiotic prophylaxis prescribing practices, and tables in which the respondents identified various health conditions and medical and dental treatments they would prescribe antibiotic prophylaxis. The respondents were asked which antibiotic prophylaxis regimen they followed, as well as questions regarding their confidence in their prescribing decisions and their opinion regarding antibiotic resistance.

#### **Pre-testing Survey**

A pre-testing survey was administered to a group of three dentists from varying specialties (oral surgery, periodontics, and general dentistry). The surveys were emailed to each dentist that was invited to participate. Each pre-testing respondent was asked to provide the following feedback: 1) record the time it took to complete the survey, 2) provide any feedback regarding the clarity of the survey questions, and 3) provide any additional feedback as they saw fit.

Modifications to the survey instrument were made based on the pre-testing survey. Suggestions included adding gender as a demographic question, as well as

adding additional health conditions and medical treatments to survey questions six and seven. All recommendations were included in the final survey. The research proposal was submitted to the Institutional Review Board (IRB) at Texas A&M Health Science Center, Baylor College of Dentistry which granted an expedited status (2015-0406-BCD-EXP) on July 8, 2015 (Appendix C).

### **Sample Population**

The sample population for this study consisted of a randomized sample of dentists from the south central states of Texas, Oklahoma, and Kansas. The state dental board for each state was contacted and a request for the current electronic address list of their licensed dentists was gathered. Approximately 200 dental practitioners were randomly selected from each state dental board list. The sample population was based on a 50% response rate, and to reduce error, a 95% confidence interval was used.

### **Conducting the Survey**

Once the contact lists from each of the three state dental boards was obtained, a randomized group of 200 dentists from each state was identified and placed in an Excel spreadsheet. To maintain anonymity of the respondents, each survey was assigned an identification number based on the state the respondent was from. Each respondent received a cover letter that explained the study and an invitation to participate (Appendix D). In addition, the survey and a stamped return envelope addressed to the investigator at Texas A&M University Baylor College of Dentistry were provided. After four weeks, all non-respondents were sent a second cover letter (Appendix E), an additional survey, and a stamped return envelope.

## **Statistical Analysis**

A scoring system was created to analyze knowledge and practice based questions. This system analyzed dentists' antibiotic prophylaxis prescribing practices for survey questions 6, 7, 8, 9, 10, 11, and 13. The questions were a combination of data tables utilizing "yes/no/per physician request" and multiple choice responses. As these were "right and wrong" answers, a scoring system was created to analyze the data. If the respondent followed the 2007 AHA guidelines it was worth one point. If the respondent did not follow the guidelines a point was taken away. If the respondent selected "per physician request" it was neither right nor wrong, therefore it was given a score of zero. Any surveys that had four or more responses left blank out of this set of survey questions was considered "non-responsive"; therefore, the responses were left out of the data analysis, so as not to skew the data to the score of zero. The total score a respondent could receive was 71 points. The total score was calculated based on the total number of response options for this group of survey questions.

Statistical tests used included descriptive statistics, weighted logistic regression, and quadratic polynomial regression analysis. Statistical software used to analyze survey data included R Version 3.2.2, copyright 2015, for all graphs, exploratory analysis, weighted least squared regression, and to ascertain confidence intervals. Statistical software SAS 9.4, copyright 2012, was used for weighted logistic regression analysis.

## CHAPTER III

### RESULTS

#### **Demographics**

Of the 600 surveys mailed, 29 were undeliverable. From the total sample population of N=600, the response rate was 28.7% (n=172). Details of the response rate for the study are summarized in Table A-2. Since not all respondents answered every question, the number of responses to each question vary.

Demographic information was collected in survey questions 21-25. Of the five demographic questions asked, three were chosen to avoid redundancy and for ease of analysis and reporting. These three questions included: how long have you been practicing clinical dentistry (Table A-3), what is your primary area of practice (Table A-4), and what is your gender (Figure F-1). The majority of the respondents (62.8%, n=108) had been practicing dentistry for 16-20+ years. Based on the responses, the most chosen primary areas of practice were general dentistry (73.8%, n=127), oral surgery (5.2%, n=9), and periodontics (4.7%, n=8). All other practice options were then consolidated into the “other” category (15.7%, n=27). The majority of the respondents were male (76.6%, n=132); however, female respondents were more prevalent in Texas, particularly within older age groups (Figure F-1). Female respondents also had a more even distribution of responses per age category.

## **Antibiotic Prophylaxis Protocols Followed by Dental Practitioners**

A large portion of the survey questions, tables, and data analyzed whether dentists were following the 2007 AHA antibiotic prophylaxis protocols. Survey question one asked what primary antibiotic prophylaxis guideline each respondent followed (Table A-5). The majority of respondents (56.4%, n=97) followed the 2007 ADA Guidelines to determine antibiotic prophylaxis needs for their patients. Approximately, 38% (n= 65) of the respondents reported that they followed the patient's physician/specialist order or recommendation as their guideline. Of the respondents who reported "other", 12.2% (n=21), wrote that they followed the 2007 AHA guidelines.

## **Results of Scoring System Analysis**

Survey questions six and seven lists health conditions and cardiac treatments for which dentists may have prescribed antibiotic prophylaxis. Table A-6 summarizes the conditions and treatments recommended by the AHA for antibiotic prophylaxis the respondent should have chosen. The majority of the respondents (95.2%, n= 159) were prescribing antibiotic prophylaxis for patients with a previous history of infective endocarditis, prosthetic heart valve or had heart valve repaired with prosthetic material (75.9%, n= 126), and prosthetic heart valve or had heart valve repaired with either animal or human donor tissue (61.4%, n=102). These conditions are recommended by the AHA to receive antibiotic prophylaxis prior to dental treatment. The results also found that a majority of respondents (50.3%, n= 84) were not prescribing antibiotic prophylaxis for MVP with valvular regurgitation, ventricular septal defect (50.6%, n=85), bicuspid heart valve disease (61.1%, n=102), and for patients with hypertrophic

cardiomyopathy (84.5%, n=142). These conditions are no longer recommended by the 2007 AHA guidelines to receive antibiotic prophylaxis prior to dental treatment.

Survey question seven also included orthopaedic conditions that dentists may have prescribed antibiotics. Although there has been debate on the prescribing guidelines for total joint replacements, results showed that 71.7% (n=119) of respondents chose to prescribe antibiotic prophylaxis for total prosthetic joint replacement within the last two years, and 57.8% (n=96) chose to prescribe antibiotic prophylaxis for patients who have had a total prosthetic joint replacement for two years or more.

Survey questions eight and nine asked the respondents which antibiotic prophylaxis regimen they prescribed. For patients not allergic to penicillin, 92.3% (n=156) selected amoxicillin 2 grams orally 1 hour prior to procedure. For patients who were allergic to penicillin, a majority of the respondents (80.6%, n=133) selected clindamycin 600 mg orally 1 hour prior to procedure. Survey question 10 asked the respondents which antibiotic prophylaxis regimen they would prescribe to prevent transient bacteremia for a patient with a total joint replacement. The respondents (4.21%, n=7) chose cephalexin 2 grams orally 1 hour prior to procedure, while approximately 80% (n=122) chose amoxicillin 2 grams orally 1 hour prior to dental procedure.

Survey question 11 was designed to be a “case based question” discussing antibiotic prophylaxis regimen of choice. In the scenario, a patient who has a history of infective endocarditis, was taking amoxicillin 500 mg four times per day for four days

for another systemic condition. The respondents were asked if the amoxicillin the patient was currently taking provided a therapeutic level of antibiotic prophylactic coverage. Approximately, 46% (n=77) selected “yes” this was enough therapeutic antibiotic coverage for the dental procedure. However, the majority of respondents (52.0% , n=86) selected “no”. The current antibiotic regimen the patient was on would not provide a therapeutic dose of prophylactic antibiotics needed for the dental procedure. Anecdotal comments included suggestions that additional coverage was needed in the form of a different type of antibiotic.

Survey question 13 listed 19 dental procedures that dentists may prescribe antibiotic prophylaxis if they anticipated bleeding to occur (Table A-7). The majority of the respondents chose dental procedures that could be covered with antibiotic prophylaxis if needed. However, results showed that the majority of respondents (51.1%, n=71) would not prescribe antibiotic prophylaxis for laser periodontal therapy.

Based on the total score of 71 points from survey questions 6, 7, 8, 9, 10, 11, and 13, a quadratic polynomial regression was conducted to compare the total score to the respondent’s graduation year. Figure F-2 shows that there is a general increase in score as graduation year increases.

### **Patient Involvement in Decision to Take Antibiotic Prophylaxis**

Survey questions 2, 3, 4, and 5 asked respondents if they involve the patient in the decision to take antibiotic prophylaxis (Table A-8). Question two asked if educational literature on antibiotic prophylaxis was provided to patients; the majority of the respondents (79.5%, n=136), stated “no”. Question four asked the respondents if a

patient refused to take antibiotic prophylaxis that was recommended, would they refuse to treat him/her; the majority (53.2%, n=82), stated “yes”. If a patient required antibiotic prophylaxis, a majority of the respondents (89%, n=151), stated they do not have their patients sign an informed consent discussing the risk versus the benefit of antibiotic prophylaxis. Finally, the respondents were asked if the patient was an integral part of the decision making process when discussing an antibiotic prophylaxis regimen. The majority of respondents (72.4%, n=123), stated that the patient was included in the decision to take antibiotic prophylaxis.

### **Confidence of Dentists in their Prescription Decisions for Antibiotic Prophylaxis**

In survey question 12, dentists were asked if they felt confident in their personal prescription decisions in regards to antibiotic prophylaxis and preventing infective endocarditis. The majority of respondents (80.1%, n=129) stated “yes”. Further analysis was used to discover if any of the demographics were related to the responses of question 12. Demographics analyzed included gender (Q22), year graduating from dental school (Q23), and primary area of practice (Q25). Weighted logistic regression was utilized to relate the demographic variables to a binary outcome (Table A-9). The results showed no significant differences in relation to gender ( $p=0.7549$ ), year graduating from dental school ( $p=0.7091$ ), and primary area of practice ( $p=0.2987$ ) and the dentist’s confidence level when prescribing antibiotic prophylaxis.

### **Dental Practitioners’ Perception of Dentistry Contributing to Antibiotic Resistance**

Survey questions 18 and 19 were utilized to discover if dentists believed that dentistry indirectly contributes to antibiotic resistance (Table A-10). Question 18 asked



if dentists believed there is a risk for antibiotic resistance if a patient is taking a required antibiotic prophylaxis regimen for each dental visit; a majority of respondents (73.2%, n=120) stated “yes”. Question 19 asked if dentists’ believed that antibiotic prophylaxis promotes the emergence of antibiotic resistant microorganisms; the majority of respondents (72%, n=120) stated “yes”.

### **Confusion Among Dentists Regarding Antibiotic Prophylaxis Protocols**

Survey question 20 asked respondents if they believed there was confusion regarding antibiotic prophylaxis protocols used in dentistry; the majority of respondents (92%, n=155) stated “yes”. Common themes for anecdotal comments include statements about simply giving antibiotic prophylaxis to avoid a lawsuit regardless of what the proper guidelines were, as well as dentists and physicians not agreeing what conditions should be covered with antibiotic prophylaxis.

Additional statistical analysis was also used on question 20 in relation to demographics. Demographics analyzed included gender (Q 22), years practicing clinical dentistry (Q24), and primary area of practice (Q25). Weighted logistic regression was utilized to relate demographic variables to a binary outcome. Results showed that dentists who specialized in an area other than general practice were significantly less likely to be confused in regards to the 2007 AHA antibiotic prophylaxis protocols ( $p=0.0299$ ).

## CHAPTER IV

### DISCUSSION

This study sought to examine the antibiotic prophylaxis prescribing practices of dentists in the south central region of the United States and found that 56% of the respondents followed the current 2007 AHA antibiotic prophylaxis guidelines. These results are encouraging as they are higher than the percentage of dentists determined to be following the 2007 AHA guidelines by researchers Tong et al. (40%) and Coutinho et al. (33%).<sup>35, 40</sup> Coutinho et al. found that older dentists in their study were unaware of the 2007 guidelines while some dentists in the study by Tong et al. were following the 1997 guidelines.<sup>35, 40</sup> It is imperative that dentists keep up with the latest antibiotic prophylaxis protocols established by the AHA as they represent the appropriate standards of care.

#### **Dentists' Antibiotic Prophylaxis Prescribing Practices for the 2007 AHA Guidelines**

Even though the majority of the dentists in this study followed the 2007 AHA guidelines, 38% of the respondents stated they preferred to follow the patient's physician/specialist orders when determining the need for antibiotic prophylaxis. Previous research has found that dentists often consult with physicians for advice on the need for antibiotic prophylaxis for their patients.<sup>33, 35, 36, 40, 41</sup> Tong et al. reported that some dentists need confirmation from the physician that their prescribing decisions were appropriate, while others tend to error on the side of caution and prefer that the physician make the decision in regards to antibiotic prophylaxis.<sup>35, 36, 41</sup> Studies have also found

some patients are reluctant to stop taking antibiotic prophylaxis even when it is no longer needed and insist that their dentist consult with their physician prior to receiving care.<sup>35, 38, 41</sup> Unfortunately, dentists may have received inappropriate antibiotic prophylaxis recommendations by the patient's physician.<sup>42</sup> According to Tong and Rothwell, this becomes an ethical dilemma for dental practitioners because they may feel obligated to prescribe an incorrect antibiotic regimen or provide unnecessary antibiotic coverage.<sup>42</sup> In an effort to help physicians in their decision to prescribe appropriate antibiotic prophylaxis coverage for dental treatment the dentist should 1) explain that the patient's cardiac condition falls under the 2007 AHA guidelines; 2) describe the planned dental procedure; and 3) state the risk for bleeding that is anticipated during treatment.

The 2007 AHA recommendations for the prevention of infective endocarditis have significantly changed since the 1997 guidelines. In response to new evidence, the AHA found that the majority of low to moderate risk cardiac conditions such as mitral valve prolapse with valvular regurgitation, ventricular septal defect, bicuspid valve disease, and hypertrophic cardiomyopathy no longer indicate the need for antibiotic prophylaxis prior to dental treatment.<sup>10</sup> Lockhart and colleagues reaffirm the 2007 AHA guidelines and concluded that "administering antibiotic prophylaxis for every patient with valvular disorder undergoing a dental procedure is neither safe nor effective".<sup>36</sup> However, some dentists continue to prescribe antibiotic prophylaxis for these cardiac conditions in spite of the new guidelines.<sup>1, 36</sup> Tong et al. stated that the reason why many dentists continue to follow outdated guidelines is their reliance on old prescribing habits or they rely on their memory when making prescription decisions.<sup>35</sup> Uncertainty by

dentists may also lead them to prescribe prophylactic antibiotics as a “safety net”.<sup>37, 38</sup>

Unlike previous research, the dentists in this study were not prescribing antibiotic prophylaxis for patients with valvular disease independent of regurgitation or for patients with hypertrophic cardiomyopathy.

Under the current 2007 AHA guidelines, antibiotic prophylaxis is recommended for cardiac conditions that are associated with the highest risk for developing infective endocarditis. In this study, the dentists correctly identified these cardiac conditions, and stated they would prescribe antibiotic prophylaxis prior to dental treatment. These results are similar to previous research.<sup>35, 39</sup> Although the dentists in this current study demonstrated they understood the risk factors and principles underlying the 2007 AHA guidelines, uncertainty is still evident. Approximately 48% of dentists in this study would not prescribe antibiotic prophylaxis for patients with a congenital heart defect repaired with prosthetic material or device placed during the first six months after the procedure. This is considered a high risk cardiac condition. This cardiac condition is uncommon; therefore, it may explain why the dentists in the current study chose not to provide antibiotic prophylactic coverage. To avoid uncertainty, Jain et al. suggest that dental practitioners should keep the 2007 AHA guidelines somewhere readily accessible or incorporate them into the electronic health record.<sup>41</sup>

### **Dentists’ Antibiotic Prophylaxis Prescribing Practices for Joint Replacements**

There has been ongoing debate between the ADA and the AAOS on the antibiotic prophylaxis prescribing guidelines for total joint replacements. In this study, 72% of the respondents stated they would prescribe antibiotic prophylaxis for patients

who had a total joint replacement within the last two years. Based on these findings, it appears that the respondents in this study were following the 1997ADA/AAOS antibiotic prophylaxis recommendations. Previous research has suggested that “bacteremias can cause hematogenous seeding of a total joint implant both in the early postoperative period and for many years following implantation”.<sup>43</sup> In addition, research also stated that the most crucial period for a bacterial infection in a joint can occur up to two years after joint placement.<sup>43</sup> The AAOS has reported there is no scientific evidence that suggests the routine use of antibiotic prophylaxis is needed to prevent hematogenous infections within a joint.<sup>29</sup>

The 2014 ADA guidelines for antibiotic prophylaxis for total joint replacement allow more autonomy on the part of the dental practitioner when prescribing antibiotic prophylaxis. In 2014, the clinical recommendations made by the ADA suggested that patients with prosthetic joint replacements do not require antibiotic prophylaxis prior to dental treatment.<sup>32</sup> However, dental practitioners still had concerns when providing dental treatment on patients with total joint replacements. Therefore, as part of evidence-based approach to care, dental practitioners were advised to consider possible clinical circumstances that may warrant prophylactic coverage.<sup>32</sup> Additionally, the ADA stated the decision to provide antibiotic prophylaxis should be based on the patient’s medical history and the evaluation of specific comorbidities that may justify the need for antibiotic coverage.<sup>32</sup>

It is essential for dental practitioners to also be aware of the current antibiotic prophylaxis dosing regimens that are recommended by the AAOS for patients with a

total joint replacement.<sup>29</sup> This study found that only 4.21% of the respondents chose cephalexin 2 grams orally 1 hour prior to dental procedure for patients who had a total joint replacement. Cephalosporins are the most widely used antibiotic in orthopedic surgery, and have been shown to be effective in preventing *Staphylococcus* infections prior to hip and knee surgery.<sup>44</sup> Therefore, cephalexin has been shown to be the first line antibiotic when needing prophylactic coverage for a total joint replacement prior to dental treatment. It appears that dental practitioners in this study were referring to the 2007 AHA guidelines for total joint replacements and not considering the AAOS antibiotic prophylaxis dosing recommendations.

### **Dentists' Antibiotic Prophylaxis Dosing Regimen**

The AHA has also outlined the appropriate antibiotic prophylactic dosing regimens for patients with high-risk cardiac conditions. The first correct antibiotic line for preventing infective endocarditis is amoxicillin. Dajani and his colleagues found that 2 grams of amoxicillin provides several hours of antibiotic coverage.<sup>14</sup> The appropriate second line drug for patients who are allergic to amoxicillin is clindamycin. The results of this study found that the dentists were following the current 2007 AHA antibiotic prophylaxis dosing regimens which support the findings by Lauber et al.<sup>33</sup> However, Epstein et al. found that dentists in their study were inappropriately using “pre-1997 dose recommendations”.<sup>1</sup> Epstein et al. reported dentists were prescribing antibiotics for up to seven days after dental treatment which they indicated was a misuse of antibiotic prophylaxis.<sup>1</sup>

## **Dental Procedures Requiring Antibiotic Prophylaxis**

Previous guidelines from the AHA have listed dental procedures that were likely to cause transient oral bacteremia. The 2007 AHA guidelines have replaced the list with a broad statement that states “all dental procedures that involve manipulation of the gingival tissue or periapical region of teeth or perforation of the oral mucosa” require antibiotic prophylaxis for those high-risk patients.<sup>10</sup> The current 2007 AHA guidelines provide dentists with more autonomy when deciding which dental procedures could cause bleeding and would require antibiotic prophylactic coverage for high-risk patients.

This study found that the majority of the respondents would prescribe antibiotic prophylaxis for dental extractions, scaling and root planing, endodontic treatment that would go beyond the apex of the tooth, restorative work requiring a retraction cord, placement of dental implants, periodontal probing, and dental prophylaxis. Tong et al. and Zadik et al. found similar findings stating that these procedures were clearly invasive and the dentists in their studies agreed that they should be covered by antibiotic prophylaxis if patients were at risk for infective endocarditis.<sup>35, 39</sup> Overall dentists in this study appear to be knowledgeable in regards to when it is appropriate to prescribe antibiotic prophylaxis for high-risk patients undergoing invasive dental procedures.

More than one half of the respondents in this study were not prescribing antibiotic prophylaxis for laser periodontal therapy which can be considered an invasive dental procedure. This result suggests that many dentists may not provide this dental treatment and could be unaware of the possible bacteremia that may occur due to bleeding. Epstein et al. found that dentists prescribed antibiotic prophylaxis for

restorative procedures in which bleeding was not anticipated to occur.<sup>1</sup> According to Tong et al., dentists who were following the 2007 AHA guidelines were incorrectly prescribing antibiotic prophylaxis for post-operative suture removal, intraligamental injections, and placement of orthodontic bands.<sup>35</sup>

### **Dentists' Antibiotic Prophylaxis Knowledge and Practice Patterns**

When comparing the knowledge and practice patterns with respondent's graduation year, this study found that the respondents who graduated from approximately 1980-2014 were more likely to follow the 2007 AHA antibiotic prophylaxis protocols (Figure 2). Epstein et al. found that recent graduates prescribed antibiotic prophylaxis at a lower rate than earlier graduates.<sup>1</sup> Epstein et al. suggested that recent graduates may have more knowledge on evidence based approaches to dental care including current antibiotic prophylaxis protocols.<sup>1</sup> Zadik et al., suggest that dentists' knowledge of the 2007 AHA guidelines improved after the 1997 version because the guidelines for antibiotic dosing regimens were simplified and there was a clearer delineation on which patients were at the highest risk for developing infective endocarditis.<sup>39</sup>

### **Involving the Patient in Decision to Take Antibiotic Prophylaxis**

It is important that the patient be educated on the risks versus benefits of antibiotic prophylaxis. However, the decision to take antibiotic prophylaxis should not be made solely by the dentist. Soheilipour et al., suggest that patients should be given an opportunity to make their own decision about their dental care and treatment.<sup>37</sup> In this study, 72% of the respondents stated that patient's input was an integral part of the



decision making process when discussing antibiotic prophylaxis. However, when asked if educational literature on antibiotic prophylaxis was provided to their patients, approximately 80% stated “no”. Coutinho et al. reported that the dentists from their survey felt there was not enough time to discuss the details, such as the risk versus the benefit of antibiotic prophylaxis, as well as the role that poor oral hygiene plays in developing a transient bacteremia.<sup>40</sup> If the patient does not understand the need for prophylaxis coverage, then this may cause the patient to decline the dentist’s recommendations. In this study, more than half of the respondents stated they would refuse to treat a patient if they did not follow their orders for antibiotic prophylaxis. It appears that dentists in this study were not truly integrating the patient in the decision making process if educational literature was not provided. Researchers recommend that the dental practitioner’s clinical and professional judgment, as well as the patient’s preferences should be considered together before providing antibiotic prophylaxis.<sup>29, 32</sup>

### **Dentists’ Confidence in Antibiotic Prophylaxis Prescription Decisions**

Approximately 80% of the respondents in this study stated they felt confident in their prescription decisions in regard to antibiotic prophylaxis and preventing infective endocarditis. This is a much higher percentage than that of Tong et al. who found that 67% of dentists in their study felt confident in their decision to prescribe antibiotic prophylaxis.<sup>35</sup> Tong et al. also reported that there was no statistical difference between general dentists and specialists in their confidence level.<sup>35</sup> According to Tong et al., even though the dentists in their study reported being confident in their decisions this was not correlated with the accuracy of the prescription decisions.<sup>35</sup> In this current study, there

was no significant differences between gender, year graduating from dental school, and primary area of practice and dental practitioner's confidence level when prescribing antibiotic prophylaxis.

### **Overuse and Misuse of Antibiotic Prophylaxis**

The broad use of antibiotic prophylaxis is no longer recommended by the AHA and the decision to use antibiotics should be made on a case by case basis. Prescribing antibiotics in a judicious and prudent manner is an essential strategy to reduce the spread of antibiotic resistance. However, previous studies have found that dental practitioners have been overprescribing antibiotic prophylaxis.<sup>1, 45, 46</sup> As mentioned previously, the number of cardiac conditions requiring antibiotic prophylaxis has decreased; therefore, one would assume there would be a reduction in the number of written prescriptions. However, Marra et al. did not find that to be the case.<sup>46</sup> Their study found that dental practitioners were not adopting the 2007 AHA prescribing recommendations which suggests there is poor translation of the guidelines into clinical practice.<sup>46</sup> In this study, the respondents believed that there is a risk for antibiotic resistance if a patient is taking a required antibiotic prophylaxis regimen for each dental visit. In addition, they also believed that antibiotic prophylaxis promotes the emergence of antibiotic resistance. Due to an increase in awareness of antibiotic resistance, this issue has reached the attention of health care professionals and the public. However, there is currently limited research on dentistry's contribution to antibiotic resistance.

## **Confusion Regarding Antibiotic Prophylaxis in Dentistry**

It is well known that there is controversy and inconsistencies in understanding which patients should be covered with antibiotic prophylaxis prior to dental treatment.<sup>1</sup> In this study, 92% of respondents stated they believed there was confusion regarding antibiotic prophylaxis protocols used in dentistry. One anecdotal comment that was reported by some respondents was the lack of agreement between dentists and physicians on which cardiac conditions should be covered with antibiotic prophylaxis. Jain et al. reported that dental practitioners felt the 2007 AHA guidelines were too vague, difficult to remember, and/or disagreed with the current recommendations.<sup>41</sup> Therefore, it has been suggested that more continuing education courses should be available to dental practitioners.<sup>41</sup>

## **Limitations and Future Research**

Due to budget constraints, this study was limited to sampling only three states leading to a small sample size. This limitation, coupled with a lower response rate, may not be representative of dentists nationwide. With so much change, confusion, and new evidence being brought forth on the subject of antibiotic prophylaxis use in dentistry, the topic of antibiotic prophylaxis could be considered a controversial topic. Therefore, some of the respondents may have chosen not to answer all the survey questions, or chose to forgo participation altogether, for fear of being “inaccurate” in their responses. A final limitation included some respondents either choosing not to answer all questions or not completing all survey tables leaving only partial data for analysis.

Future studies should include a larger sample size of dentists from varying regions in the US. Also, future research should include surveying US physicians/specialists in an effort to analyze their current knowledge, practices, and attitudes of the 2007 AHA antibiotic prophylaxis guidelines and the AAOS recommendations in relation to dentistry. According to the 2007 antibiotic prophylaxis guidelines and recommendations, this analysis could ask dentists and physicians: 1) which dental procedures they believe would be considered invasive enough to warrant antibiotic prophylaxis and 2) which patients they believe are considered “high-risk” and in need of antibiotic prophylaxis prior to dental treatment.

## CHAPTER V

### CONCLUSION

Confusion in regards to antibiotic prophylaxis protocols has accompanied the many antibiotic prophylaxis guideline changes throughout the years. This study sought to examine the antibiotic prophylaxis prescribing practices of dentists in the south central region of the United States and found that the majority of the respondents were appropriately following the 2007 AHA guidelines. However, there is still debate regarding antibiotic prophylaxis needs for patients with total joint replacements. The 2014 ADA guidelines offer more autonomy on the part of the dental practitioner. This study also showed that various demographic factors, such as the dentist's graduation year, had some influence over the respondent's knowledge and practice patterns in regard to antibiotic prophylaxis.

Ultimately, it is the responsibility of the dental practitioner to involve the patient in the decision to take antibiotic prophylaxis. Education on current research and antibiotic prophylaxis protocols is imperative when considering the misuse and overuse of antibiotics. While controversy still remains around the use antibiotic prophylaxis, it is vital that dentists keep up with the latest antibiotic prophylaxis protocols. By doing so, it ensures that dentists are providing the best evidence based dentistry to their patients.

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## APPENDIX A

### TABLES

**Table A-1 2007 American Heart Association Cardiac Conditions Requiring Antibiotic Prophylaxis**

<b>AHA cardiac conditions associated with the highest risk of endocarditis for which prophylaxis for dental procedures is recommended</b>
Prosthetic cardiac valve or prosthetic material used for cardiac valve repair
Previous history of infective endocarditis
<b>Congenital heart disease (CHD)</b> -Unrepaired cyanotic CHD, including palliative shunts and conduits -Completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or by catheter intervention, during the first 6 months after the procedure -Repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which included endothelialization)
Cardiac transplantation recipients who develop cardiac valvulopathy

**Table A-2 Response Rates by State**

STATE	Surveys Sent (N)	Surveys Returned Frequency (n)	Response Rate (%)
Texas	200	51	25.5%
Oklahoma	200	59	29.5%
Kansas	200	60	30%
State Unknown*		2	
<b>Total</b>	600	172	28.7%

\*The respondents for two surveys removed the identification number.

**Table A-3 Number of Years Practicing Dentistry**

<b>YEARS</b>	<b>n</b>	<b>%</b>
<b>0-3</b>	14	8.1%
<b>4-7</b>	16	9.3%
<b>8-11</b>	22	12.8%
<b>12-15</b>	10	5.8%
<b>16-20+</b>	108	62.8%
<b>Missing</b>	2	1.2%
<b>Total</b>	172	100%

**Table A-4 Primary Area of Practice**

<b>AREA OF PRACTICE</b>	<b>n</b>	<b>%</b>
<b>General Dentistry</b>	127	73.8%
<b>Oral Surgery</b>	9	5.2%
<b>Periodontics</b>	8	4.7%
<b>Other</b>	27	15.7%
<b>Missing</b>	1	0.6%
<b>Total</b>	172	100%

**Table A-5 Primary Guideline Followed When Prescribing Antibiotic Prophylaxis**

<b>ANTIBIOTIC PROPHYLAXIS GUIDELINES</b>	<b>n</b>	<b>%</b>
<b>Current American Dental Association Guidelines</b>	97	56.4%
<b>A patient's physician/specialist orders or recommendation</b>	65	37.8%
<b>Based on the patient's history and desire</b>	3	4.1%
<b>Other</b>	21	12.2%
<b>Missing</b>	4	2.3%

\*Sum of the percentages may exceed 100% since the respondents could select multiple options.

**Table A-6 Prescribing Practices for Cardiac Conditions and Cardiac Treatments that Require Antibiotic Prophylaxis**

<b>CARDIAC CONDITIONS AND TREATMENTS</b>	<b>n</b>	<b>%</b>
<b>Previous History of Infective Endocarditis</b>		
Followed AHA Guidelines	159	95.2%
Did Not Follow AHA Guidelines	2	1.2%
Per Physician Request	6	3.6%
<b>Prosthetic Heart Valve or had heart valve repaired with prosthetic material</b>		
Followed AHA Guidelines	126	75.9%
Did Not Follow AHA Guidelines	16	9.6%
Per Physician Request	24	14.5%
<b>Prosthetic Heart Valve or had heart valve repaired with either animal or human donor tissue</b>		
Followed AHA Guidelines	102	61.4%
Did Not Follow AHA Guidelines	43	25.9%
Per Physician Request	21	12.7%
<b>Congenital Heart Defect Prosthetic Material or Device placed during the first 6 months after the procedure</b>		
Followed AHA Guidelines	58	34.9%
Did Not Follow AHA Guidelines	79	47.6%
Per Physician Request	29	17.5%
<b>Cyanotic Congenital Heart Disease that has not been repaired</b>		
Followed AHA Guidelines	58	35%
Did Not Follow AHA Guidelines	97	58%
Per Physician Request	12	0.1%
<b>Organ Transplant</b>		
Followed AHA Guidelines	95	57%
Did Not Follow AHA Guidelines	49	29.3%
Per Physician Request	23	13.8%

\*Sum of responses may be less than 172 since “non-responsive” respondents were excluded

**Table A-7 Prescribing Practices for Dental Procedures Requiring Antibiotic Prophylaxis**

<b>DENTAL PROCEDURE</b>	<b>n</b>	<b>%</b>
<b>Periodontal Probing</b>		
Followed AHA Guidelines	97	63.8%
Did Not Follow AHA Guidelines	55	36.2%
Per Physician Request	0	0%
<b>Routine Oral Prophylaxis</b>		
Followed AHA Guidelines	85	55.6%
Did Not Follow AHA Guidelines	67	43.8%
Per Physician Request	1	0.6%
<b>Advanced Periodontal Therapy (Scaling and Root Planing)</b>		
Followed AHA Guidelines	131	86.2%
Did Not Follow AHA Guidelines	21	13.8%
Per Physician Request	0	0%
<b>Laser Periodontal Therapy</b>		
Followed AHA Guidelines	68	48.9%
Did Not Follow AHA Guidelines	71	51.1%
Per Physician Request	0	0%
<b>Restorative dentistry (crowns, bridge work that requires a retraction cord)</b>		
Followed AHA Guidelines	83	55%
Did Not Follow AHA Guidelines	68	45%
Per Physician Request	0	0%
<b>Endodontic Instrumentation or endodontic surgery that goes beyond the apex</b>		
Followed AHA Guidelines	120	80%
Did Not Follow AHA Guidelines	30	20%
Per Physician Request	0	0%

**Table A-7 Continued**

<b>DENTAL PROCEDURE</b>	<b>n</b>	<b>%</b>
<b>Endodontic Instrumentation that will not go beyond the apex</b>		
Followed AHA Guidelines	79	52.7%
Did Not Follow AHA Guidelines	71	47.3%
Per Physician Request	0	0%
<b>Non-Surgical extraction of teeth</b>		
Followed AHA Guidelines	128	83.7%
Did Not Follow AHA Guidelines	25	16.3%
Per Physician Request	0	0%
<b>Surgical extraction of teeth</b>		
Followed AHA Guidelines	142	92.2%
Did Not Follow AHA Guidelines	11	7.1%
Per Physician Request	1	0.6%
<b>Dental Implant Placement</b>		
Followed AHA Guidelines	137	92.6%
Did Not Follow AHA Guidelines	11	7.4%
Per Physician Request	0	0%

\*Sum of responses may be less than 172 since “non-responsive” respondents were excluded

**Table A-8 Patient Involvement in the Decision to Take Antibiotic Prophylaxis**

<b>QUESTION</b>	<b>n</b>	<b>%</b>	<b>Missing</b>
<b>Do you provide your patients educational literature on antibiotic prophylaxis?</b>			
Yes	35	20.5%	1
Sometimes/Maybe	0		
No	136	79.5%	
<b>Is the patient an integral part of the decision making process when you are prescribing an antibiotic prophylaxis regimen?</b>			
Yes	123	72.4%	2
Sometimes/Maybe	4	2.4%	
No	43	25.3%	
<b>If the patient refuses to take antibiotic prophylaxis that you recommend, do you refuse to treat him/her?</b>			
Yes	82	53.2%	18
Sometimes/Maybe	3	2%	
No	69	45%	
<b>If one of your patients requires antibiotic prophylaxis, do you have them sign an informed consent discussing the risk verses the benefits of antibiotic prophylaxis?</b>			
Yes	19	11.2%	2
Sometimes/Maybe	0		
No	151	89%	

**Table A-9 Analysis of Maximum Likelihood Estimates for Confidence levels of Dentists in their Prescription Decisions for Antibiotic Prophylaxis in Relation to Demographics**

<b>Parameter</b>	<b>DF</b>	<b>Standard Error</b>	<b>Wald Chi-Square</b>	<b>Pr&gt;ChiSq</b>
<b>Intercept</b>	1	41.4740	0.1657	0.6839
<b>Q 22</b>	1	0.7101	0.0974	0.7549
<b>Q23</b>	1	0.0208	0.1392	0.7091
<b>Q25</b>	1	0.6923	1.0800	0.2987

\*p≤ 0.05



**Table A-10 Dentists Belief that Dentistry Indirectly Contributes to Antibiotic Resistance**

<b>QUESTION</b>	<b>n</b>	<b>%</b>	<b>Missing</b>
<b>Do you believe there is a risk for antibiotic resistance if a patient is taking a required antibiotic prophylaxis regimen for each dental visit?</b>			
Yes	120	73.2%	8
Sometimes/Maybe	2	1.2%	
No	42	26%	
<b>Do you think the use of antibiotic prophylaxis promotes the emergence of antibiotic resistant microorganisms?</b>			
Yes	120	72%	5
Sometimes/Maybe	3	1.8%	
No	44	26.3%	

## APPENDIX B

### SURVEY INSTRUMENT

#### Texas A&M University Baylor College of Dentistry Current Prescribing Practices for Antibiotic Prophylaxis: A Survey of Dental Practitioners

Directions: Please read each question carefully and select the answer that **BEST** fits your point of view, or fill in the blanks with written answers as needed. This survey has 25 questions and will take approximately 20 minutes to complete. Additional space has been allocated for comments. Please write any comments as you see fit. Your answers will be completely anonymous. This survey has been approved by the Texas A&M University Baylor College of Dentistry Institutional Review Board (IRB# 2015-0406-BCD-EXP ). By completing and submitting the survey you are implicitly giving your informed consent. Thank you for your time.

1. The primary guideline I use when prescribing antibiotic prophylaxis is:  
 A patient's physician/specialist order or recommendation  
 Current American Dental Association Guidelines  
 Based on the patient's history and desire  
 Other \_\_\_\_\_
  
2. Do you provide your patients educational literature on antibiotic prophylaxis?  
 Yes  No  
Comment \_\_\_\_\_
  
3. Is the patient an integral part of the decision making process when you are prescribing an antibiotic prophylaxis regimen?  
 Yes  No  
Comment \_\_\_\_\_
  
4. If a patient refuses to take antibiotic prophylaxis that you recommend, do you refuse to treat him/her?  
 Yes  No  
Comments \_\_\_\_\_

5. If one of your patients requires antibiotic prophylaxis, do you have them sign an informed consent discussing the risk versus the benefits of antibiotic prophylaxis?

Yes  No

Comments \_\_\_\_\_

6. For which of the following conditions do you prescribe antibiotic prophylaxis?

	YES	COMMENTS
HIV with no comorbidities		
AIDS		
Rheumatoid Arthritis		
Systemic Lupus Erythematosus		
Atrial Fibrillation		
An unrepaired Atrial Septal Defect (Patent Ductus Arteriosus)		
Ventricular Septal Heart Defect		
Hypertrophic Cardiomyopathy		
Rheumatic Heart Disease		
Aortic or Mitral Stenosis		
Bicuspid Heart Valve Disease		
Artificial heart valves		
Heart murmurs		
Mitral valve prolapse <b>without</b> regurgitation		
Mitral valve prolapse <b>with</b> regurgitation		
Coronary Artery Bypass Graft surgery		
Coronary Artery Stents		
Cyanotic Congenital Heart Disease that has not been repaired		
History of heart attack		
History of stroke		
Liver Disease		
Intravenous drug abuse		
Active Herpetic Lesions (either extra oral or intraoral)		
Uncontrolled Diabetes		
Uncontrolled Alcoholism		

Organ Transplant		
Previous history of Infective Endocarditis		
Sickle Cell Anemia		
Cancer		

7. Would you prescribe antibiotic prophylaxis for patients who are taking any of the following medications, or who have undergone any of the following treatments?

	<b>YES</b>	<b>COMMENTS</b>
Total prosthetic joint replacement within the last 2 years		
Total prosthetic joint replacement 2 years or more		
Fixation plates and screws not involving the synovium		
Congenital Heart Defect Prosthetic Material or Device placed within the first 6 months		
Congenital Heart Defect Prosthetic Material or Device placed after 6 months		
Prosthetic heart valve or had a heart valve repaired with prosthetic material		
Prosthetic heart valve or had heart valve repaired with either animal or human donor tissue		
Chemotherapy		
Radiation therapy		
History of IV bisphosphonates		
Oral bisphosphonates with no comorbidities		
Organ transplant anti-rejection drugs		
Anticoagulant Therapy		
Hemodialysis		
Cardiac pace-makers		
Implanted cardiac defibrillators		
Shunts used to treat hydrocephalus		
Immunosuppressive drugs (i.e. Methotrexate)		

Chronic corticosteroid use		
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8. If not otherwise contraindicated and antibiotic prophylaxis was needed to prevent infective endocarditis, what would be your regimen of choice if the patient **WAS NOT** allergic to penicillin?
- Amoxicillin 2 grams orally 1 hour prior to procedure
  - Amoxicillin 2 grams orally 1 hour prior to procedure; then 1 gram 6 hours after initial dose
  - Penicillin VK 2 grams orally 1 hour prior to procedure; then 1 gram 6 hours after initial dose
  - Other (Please Specify)\_\_\_\_\_
9. If not otherwise contraindicated and antibiotic prophylaxis was needed to prevent infective endocarditis, what would be your regimen of choice if the patient **WAS** allergic to penicillin?
- Cephalexin 2 grams orally 1 hour prior to procedure
  - Clindamycin 600 mg orally 1 hour prior to procedure
  - Azithromycin 500 mg orally 1 hour prior to procedure
  - Other(Please Specify)\_\_\_\_\_
10. If not otherwise contraindicated and antibiotic prophylaxis was needed to prevent a transient bacteremia for a patient with a total joint replacement, what would be your regimen of choice?
- Amoxicillin 2 grams orally 1 hour prior to procedure
  - Cephalexin 2 grams orally 1 hour prior to procedure
  - Amoxicillin 2 grams orally 1 hour prior to procedure; then 1 gram 6 hours after initial dose
  - Penicillin VK 2 grams orally 1 hour prior to procedure; then 1 gram 6 hours after initial dose
  - Other (please specify)\_\_\_\_\_
11. A patient with a prior history of infective endocarditis presents for an invasive dental procedure. She is currently taking amoxicillin 500mg 4 times per day for 4 days for another systemic condition. Do you think the amoxicillin they are currently taking provides a therapeutic level of prophylactic antibiotics?
- Yes
  - No
- Comment\_\_\_\_\_

12. Do you think that the antibiotic prophylaxis regimen you choose is effective at preventing infective endocarditis?

Yes  No

Comment \_\_\_\_\_

13. We know that antibiotic prophylaxis is used by dental practitioners for various dental procedures. Can you tell me for which of the following dental procedures would you prescribe antibiotic prophylaxis?

	<b>YES, if bleeding was anticipated</b>	<b>Comments</b>
Examine patient for caries		
Periodontal probing		
Coronal polishing		
Routine Oral Prophylaxis		
In office whitening		
Advanced periodontal therapy (Scaling and root planing)		
Laser Periodontal therapy		
Placement of chemotherapy subgingivally (i.e. Arestin®)		
Subgingival Oral irrigation		
Restorative dentistry (crowns, bridge work that requires a retraction cord to be placed)		
Routine restorative dentistry including composites and amalgam restorations		
Endodontic instrumentation or endodontic surgery that goes beyond the apex		
Endodontic instrumentation that will not go beyond the apex		
Routine local anesthetic injections through non infected sites		
Non-surgical extraction of teeth		
Placement of subgingival topical anesthetic (i.e. Oraqix)		
Surgical extraction of teeth		

Dental Implant placement		
Placement of orthodontic brackets or appliance adjustment		

14. Do you think infective endocarditis can be induced by routine dental care?

- Yes  No

Comment \_\_\_\_\_

15. Do you think daily activities such as brushing, flossing, or eating can induce a transient bacteremia?

- Yes  No

Comment \_\_\_\_\_

16. Do you think there is a connection between poor oral health and patients at risk for infective endocarditis?

- Yes  No

Comment \_\_\_\_\_

17. How effective do you believe an antibiotic regimen is at preventing a infective endocarditis if the antibiotic is **ONLY** taken **AFTER** routine dental or dental hygiene treatment?

- Very effective  Not effective at all

Comment \_\_\_\_\_

18. Do you believe there is a risk for antibiotic resistance if a patient is taking a required antibiotic prophylaxis regimen for each dental visit?

- Yes  No

Comment \_\_\_\_\_

19. Do you think the use of antibiotic prophylaxis promotes the emergence of antibiotic resistant microorganisms?

- Yes  No

Comment \_\_\_\_\_

20. Do you think there is confusion regarding antibiotic prophylaxis protocols used in dentistry?

- Yes  No

Comments \_\_\_\_\_

21. Your age is:  
 25-30  31-35  36-40  41-45  46-50  51-55  56-60  61-65  66+
22. Gender  
 Male  Female
23. What year did you graduate from dental school?  
\_\_\_\_\_
24. How long have you been practicing clinical dentistry?  
 0-3 years  4-7 years  8-11 years  12-15 years  16-20+years
25. What is your primary area of practice?  
 General  
 Pediatric  
 Prosthodontic  
 Periodontic  
 Orthodontic  
 Endodontic  
 Oral surgery  
 Public health clinic  
 Community or regional hospital dental clinic  
 Educational institution  
 Military  
 Retired  
 Other \_\_\_\_\_



## APPENDIX C

### IRB APPROVAL LETTER

DIVISION OF RESEARCH



**DATE:** July 08, 2015

**MEMORANDUM**

**TO:** Kathleen Muzzin  
TAMHSC - Health Science Center - Baylor College Of Dentistry

**FROM:** Dr. Emet Schneiderman, PhD  
Chair  
TAMU IRB

**SUBJECT:** Expedited Approval

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**Study Number:** 2015-0406-BCD-EXP

**Title:** Current Prescribing Practices for Antibiotic Prophylaxis: A Survey of Dental Practitioners

**Approval Date:** 07/08/2015

**Continuing Review Due:** 06/01/2016

**Expiration Date:** 07/01/2016

**Documents Reviewed and Approved:** Only IRB-stamped approved versions of study materials (e.g., consent forms, recruitment materials, and questionnaires) can be distributed to human participants. Please log into iRIS to download the stamped, approved version of all study materials. If you are unable to locate the stamped version in iRIS, please contact the iRIS Support Team at 979.845.4969 or the IRB liaison assigned to your area.

Submission Components			
Study Document			
Title	Version Number	Version Date	Outcome
Survey Instrument for Leah Spittle	Version 1.0	06/11/2015	Approved
Study Consent Form			
Title	Version Number	Version Date	Outcome
Cover letters	Version 1.0	06/19/2015	Approved

**Document of Consent:** Waiver approved under 45 CFR 46.117 (c) 1 or 2/ 21 CFR 56.109 (c)1

**Comments:** This study is approved for 600 participants. Stamped forms can be found in iRIS.

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Investigators assume the following responsibilities:

750 Agronomy Road, Suite 2701  
1186 TAMU  
College Station, TX 77843-1186  
Tel. 979.458.1467 Fax. 979.862.3176  
<http://rcb.tamu.edu>

## APPENDIX D

### INITIAL COVER LETTER

July, 2015

Dear Doctor,

My name is Leah Spittle and I am a graduate student at Texas A&M University Baylor College of Dentistry. A requirement for my graduate studies includes a thesis that relates to my field of study. I would like to conduct a research study examining how dentists in the Southwest region of the United States are prescribing antibiotic prophylaxis.

There have been a number of changes in the antibiotic prophylaxis guidelines made by the American Heart Association. This survey will attempt to discover dentists' experiences, practices, and opinions in relation to antibiotic prophylaxis protocols used in dentistry.

You have been randomly selected from a list of licensed dentists from your state dental board. I would like to invite you to participate in my research. As a dentist, your knowledge and opinions are valuable to my study. This survey has been approved by the Texas A&M University Baylor College of Dentistry Institutional Review Board (IRB # 2015-0406-BCD-EXP). The questionnaire should take about 20 minutes to complete and enclosed is a self-addressed stamped envelope for you to return the survey. By completing and returning the survey you are implicitly giving your informed consent. Please return the survey by \_\_\_\_\_.

All efforts will be made to keep your responses confidential. Each survey will be coded with an identification number and will be used for follow-up and data analysis purposes only. The only risk is the unlikely disclosure of your responses. There are no benefits for participating in this study. However, the results of my research may benefit society by encouraging adherence to the current antibiotic prophylaxis guidelines.

If you have any questions or comments about the study, I can be reached at [lspittle1@bcd.tamhsc.edu](mailto:lspittle1@bcd.tamhsc.edu). If you have any questions concerning your rights as a research participant to provide input regarding research, or if you have questions, complaints, or concerns about the research you may call the Texas A&M University Human Subjects Program Office at 1-979-458-4067 or toll free 1-855-795-8638, or by email at [irb@tamu.edu](mailto:irb@tamu.edu).

Thank you for taking the time to participate in this important study.

Sincerely,

Leah Spittle RDH, BSDH  
Candidate for MS-EDHP  
Texas A&M University  
Baylor College of Dentistry

Janice DeWald DDS, MS (Mentor)  
Professor  
Texas A&M University  
Baylor College of Dentistry

**APPENDIX E**  
**SECOND COVER LETTER**

July, 2015

Dear Doctor,

My name is Leah Spittle and I am a graduate student at Texas A&M University Baylor College of Dentistry. A requirement for my graduate studies includes a thesis that relates to my field of study. Last month you were invited to participate in my research. A survey was mailed to you in an attempt to discover dentists' experiences, practices, and opinions in relation to antibiotic prophylaxis protocols in dentistry.

If you have already completed and returned the survey, please accept my sincere thanks. If not, please complete the survey today. Enclosed is a replacement survey for you to complete and a self-addressed stamped envelope. The survey will take about 20 minutes of your time. This survey has been approved by the Texas A&M University Baylor College of Dentistry Institutional Review Board (IRB # 2015-0406-BCD-EXP). By completing and submitting the survey you are implicitly giving your informed consent. Your answers will be kept confidential.

Your response is very important to my study. Please return the survey by \_\_\_\_\_ . If you have any questions or concerns about the study, I can be reached at [lpittle1@bcd.tamhsc.edu](mailto:lpittle1@bcd.tamhsc.edu). If you have any questions concerning your rights as a research participant to provide input regarding research, or if you have questions, complaints, or concerns about the research you may call the Texas A&M University Human Subjects Program Office at 1-979-458-4067 or toll free 1-855-795-8638, or by email at [irb@tam.u.edu](mailto:irb@tam.u.edu).

Sincerely,

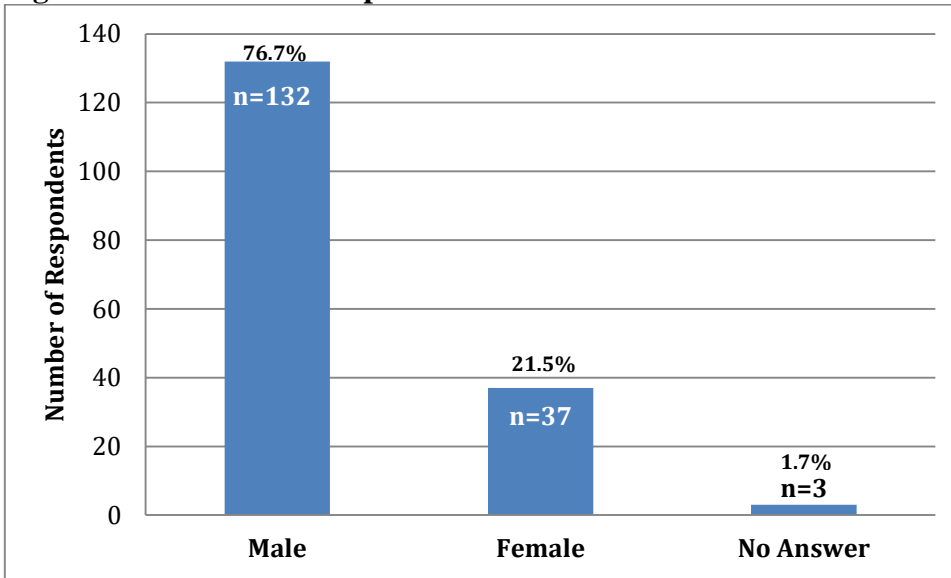
Leah Spittle RDH, BSDH  
Candidate for MS-EDHP  
Texas A&M University  
Baylor College of Dentistry

Janice DeWald DDS, MS (Mentor)  
Professor  
Texas A&M University  
Baylor College of Dentistry

## APPENDIX F

### FIGURES

**Figure F-1: Gender of Respondents**



**Figure F-2: Score and Graduation Year**

