

**Measuring Differences of Interpretation among Dentists on Antibiotic**

**Prophylaxis Guidelines**

BY

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THESIS

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This thesis is dedicated to my family who supported me throughout this process and managed through my absence at home.

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## **LIST OF ABBREVIATIONS**

ADEA	American Dental Education Association
AHA	American Heart Association
AP	Antibiotic Prophylaxis
IE	Infective Endocarditis

## SUMMARY

Antibiotics are widely used to treat infections on a multitude of levels. They are also used prophylactically to prevent infection, such as in dentistry to reduce the risk of infective endocarditis. The identification of infective endocarditis dates back many centuries and was first linked to a dental procedure in the 1920s (Wilson et al., 2008; Thornhill et al., 2017). While guidelines from the American Heart Association (AHA) existed as early as 1955, the American Dental Association did not endorse them until 1972 (Wilson et al., 2008). Since 1972, there have been many updates.

The most recent update was in 2007 and this is the guideline used today. The previous 1997 guidelines list various dental procedures that required antibiotic prophylaxis prescribing while the updated 2007 leaves them vague. The 2007 guideline was simplified to state prophylaxis is recommended for dental procedures that produce gingival manipulation (Wilson et al., 2008).

This study surveyed a convenience sample of dental school faculty from accredited dental schools in the United States and Canada. An emailed survey was created in Qualtrics and asked dental school faculty two categories of questions, the likelihood to prescribe prophylactic antibiotics based on dental procedure type and the likelihood that the same dental procedure produced gingival manipulation. The survey was distributed through the Clinical Administrative American Dental Education Association (ADEA) listserve asking dental school



## **SUMMARY (continued)**

administrators to share the link with dental faculty. The data included all persons who were faculty at an accredited North American dental school and excluded any responses from non-faculty.

A percentage for each procedure type was determined by collapsing the responses into binary responses and a score of 75% was used to determine agreement or not. Procedure percentages were then ranked in order highest to lowest. Those procedures with a score of 75% and above and procedures with a score of 25% and below were considered to achieve consensus. Wilson Score Interval testing determined a 95% confidence interval and removed those scores close the 75% margin.

Only a third of the procedures (n=24) reached consensus for antibiotic prescribing and one eighth, or four procedures reached consensus producing gingival manipulation. For several procedures, the survey revealed that while there was a consensus for gingival manipulation, there was not a consensus for that same procedure when it came to prescribing. With the change to the 2007 guidelines, both categories of questions should have elicited similar responses.

This study is reflective of a convenience sample. With a limited number of responses, it is unclear how representative the sample is of the targeted audience. This study also did

### **SUMMARY (continued)**

not factor in outside pressures to prescribe nor varied training techniques. Lastly, it could not gauge how a prescriber's clinical experience may influence the response.

## 1. INTRODUCTION

### 1.1 Background

Reports of links between infective endocarditis (IE) and invasive procedures such as dental procedures date back as far as a century ago. The first cases were identified in the 1920s (Thornhill et al., 2017). Okell and Elliot, demonstrated that, “following a dental extraction, 61% of patients had a positive blood culture for oral viridans group Streptococci” (Wilson et al., 2008; Thornhill et al., 2017). This discovery influenced the American Heart Association’s (AHA) first recommendation for antibiotic prophylaxis (AP) to prevent IE (Wilson et al., 2007; Thornhill et al., 2017). The first AHA guidelines identified persons with rheumatic or congenital heart disease as being at increased risk of IE. “[D]ental extraction or other procedures in which the gums are manipulated” were included as procedures where antibiotic prophylaxis was indicated (“Prevention of Rheumatic Fever,” 1960) (Thornhill et al., 2017). In 1955, the AHA published the first document discussing the prophylaxis of IE (Wilson et al., 2008).

Over the next two decades, there were many updates to the guidelines changing the type of antibiotic recommended, number of doses and route of administration (Wilson et al., 2008; Thornhill et al., 2017). The 1960’s and 1970’s brought about the emergence of valve replacement surgery and in 1975, it was recognized that bacteremia with oral organisms could occur in the absence of dental procedures (Thornhill et al., 2017). In 1972, for the first time, the American Dental Association (ADA) endorsed the published AHA guidelines (Wilson et al.,

2008). There were four more reiterations of the guidelines between 1972 and 1997 (Wilson et al., 2008).

In August of 2007, the American Heart Association updated the guidelines for infective endocarditis prophylaxis related to dental procedures to the guideline used today (Figure 1) (Wilson et al., 2008). This was the first update since 1997. The 1997 guideline detailed which dental procedures were likely to cause a bacteremia (Figure 2) (Dejani et al., 1997). In contrast, the current guideline relies on the provider to distinguish whether dental procedures involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa (Wilson et al., 2008).

The rationale for the 2007 change considered the significant increase in the strains of viridans group streptococci resistant to antibiotics (Wilson et al., 2008). There has been much focus on antimicrobial stewardship and decreasing the amount of antibiotic prescriptions written over the last 10 years. In 2013, the CDC reported that “each year in the U.S., at least 2 million people get an antibiotic-resistant infection, and at least 23,000 people die” (Centers for Disease Control and Prevention, 2019). An essential strategy in the fight against antibiotic resistance is engaging appropriate prescribing habits. A 2011 study on antibiotic prescribing habits by specialty identified that dentists prescribe 10% of all antibiotic prescriptions written (Hicks et al., 2015)

Although antibiotic guidelines were revised to be less inclusive, a 2016 study revealed that dentists are, prescribing more than historically (Marra et al., 2016). A study surveying American Dental Association (ADA) dentists in 2013, reported that 70% of respondents (n=901) admitted to prescribing antibiotic prophylaxis even though the updated 2007 guidelines no longer recommended it (Lockhart et al., 2013). Another study in 2018 reviewed antibiotic prescribing among general dentists over a three year period and discovered that more than 14% of antibiotic prescriptions were incorrect in some way (Durkin et al., 2018). Another study found that 58-81% of all antibiotic prescriptions by dentists are inconsistent with published guidelines (Suda et al., 2019).

A possible explanation is that dental professionals disagree with the guidelines or deem them too vague (Jain et al., 2015). The 2007 published guideline emphasized that transient viridans group streptococcal bacteremia may result from procedures involving manipulation of the gingiva, periapical region or perforation of mucosa (Wilson et al., 2007). While the 2007 guidelines decreased the number of heart condition categories for endocarditis prophylaxis (Durkin et al., 2018), the dental procedures qualifying for the need of AP became more subjective. The “renewed” guideline relies on the prescriber’s interpretation of gingival manipulation. While there have been many studies regarding compliance with the updated prescribing guidelines, none were found examining their reliance on provider judgement of gingival manipulation.

**Figure 1.**

2007 Guideline
<b>Dental procedures for which endocarditis prophylaxis is reasonable for patients</b>
All dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa.*
*The following procedures and events do not need prophylaxis: routine anesthetic injections through noninfected tissue, taking dental radiographs, placement of removable prosthodontic or orthodontic appliances, placement of orthodontic brackets shedding of primary teeth, and bleeding from trauma to the lips or oral mucosa.

Wilson et al., 2008

**Figure 2.**

1997 Guideline
<b>Endocarditis prophylaxis recommended<sup>1</sup></b>
Dental extractions Periodontal procedures including surgery, scaling and root planing, probing, and recall maintenance Dental implant placement and reimplantation of avulsed teeth Endodontic (root canal) instrumentation or surgery only beyond the apex Subgingival placement of antibiotic fibers or strips Initial placement of orthodontic bands but not brackets Intraligamentary local anesthetic injections Prophylactic cleaning of teeth or implants where bleeding is anticipated
<b>Endocarditis prophylaxis not recommended</b>
Restorative dentistry <sup>2</sup> (operative and prosthodontic) with or without retraction cord <sup>3</sup> Local anesthetic injections (nonintraligamentary) Intracanal endodontic treatment; post placement and buildup Placement of rubber dams Postoperative suture removal Placement of removable prosthodontic or orthodontic appliances Taking of oral impressions Fluoride treatments Taking of oral radiographs Orthodontic appliance adjustment Shedding of primary teeth
1 Prophylaxis is recommended for patients with high- and moderate-risk cardiac conditions. 2 This includes restoration of decayed teeth (filling cavities) and replacement of missing teeth. 3 Clinical judgment may indicate antibiotic use in selected circumstances that may create significant bleeding.

Dejani et al., 1997

## 1.2 Objectives

To determine if there is an agreement among dental school faculty on procedures justifying antibiotic prophylaxis for infective endocarditis.

To demonstrate whether dental school faculty recognize gingival manipulation as a deciding factor in determining antibiotic prophylaxis for infective endocarditis.

## 1.3 Hypotheses

### 1.3.1 First Hypothesis

**H<sub>0</sub>:** There is agreement among dental school faculty on dental procedures justifying prescription of antibiotic prophylaxis.

**H<sub>A</sub>:** There is a lack of agreement among dental school faculty on dental procedures justifying prescription of antibiotic prophylaxis.

### 1.3.2 Second Hypothesis

**H<sub>0</sub>:** There is agreement among dental school faculty on which dental procedures produce gingival manipulation.

**H<sub>A</sub>:** There is a lack of agreement among dental school faculty on which dental procedures produce gingival manipulation.

## 2. METHODS AND MATERIALS

### 2.1 Subjects

In this cross sectional study, we surveyed dental faculty from accredited dental schools within the United States and Canada. Approval for the study was obtained through the

University of Illinois at Chicago Office for the Protection of Research Subjects and exemption granted, Protocol # 2019-0756 (Appendix A). The survey was distributed through the Clinical Administrative American Dental Education Association (ADEA) listserve asking dental school administrators to share the link with dental faculty. ADEA is the national organization that represents the voice of dental education. The survey was created using Qualtrics software through the University of Illinois and distributed via an anonymous link (Qualtrics and all other Qualtrics product or service names are registered trademarks or trademarks of Qualtrics, Provo, UT, USA. <https://www.qualtrics.com>). The survey remained active for four weeks with two periodic reminders sent to participate.

Dental School faculty were selected to be the subjects, for convenience and because they are the individuals training graduating dentists.

The survey asked two categories of questions. The first category asked about the likelihood of prescribing antibiotic prophylaxis for a list of procedures. The second category asked the likelihood of the same procedures to produce gingival manipulation. The procedures were listed in identical order.

See Appendix B for the questionnaire.

**2.1.1 Inclusion Criteria:** All persons who were faculty at an accredited North American dental school.



2.1.2 Exclusion Criteria: Any responses from non-faculty. This was determined by questions within the questionnaire.

## 2.2 Analytical Dataset

Data was collected within Qualtrics and exported as an SPSS file. Not all questions were answered by every participant and manual tabulation was performed to obtain percentage of responses of likelihood to prescribe and produce manipulation.

## 2.3 Consensus on Prescribing and Gingival Manipulation

First, the results were analyzed to review agreement on which procedures faculty were likely to prescribe. Once likelihood percentages were obtained, results were sorted in Excel ranking them from highest to lowest. Since 75% was used to determine consensus, those results falling under 75% but above 25% were marked in red. The Wilson Score Interval test calculated the 95% confidence interval and excluded those procedures that fell close to the 75% cut off level.

This was repeated for likelihood to produce gingival manipulation. Theoretically, both questions should have been answered the same since the 2007 antibiotic prophylaxis guideline specifically states that procedures involving gingival manipulation are reasonable for antibiotic prophylaxis. Both sets of answers were reviewed against each other. Lastly, concordance

between those who answered Likely To Prescribe yet Not Likely to Cause Gingival Manipulation for a procedure and vice versa were compared.

## 2.4 Statistical Analysis

Data were analyzed to determine consensus for which procedures are likely to cause academic dentists to prescribe prophylactic antibiotics. Responses were collapsed into binary responses, with 50/50 likelihood, moderate likelihood and very likely collapsed into “yes” would prescribe and not likely and some likelihood collapsed into “no” would not prescribe. Consensus was determined by 75% of academic dental faculty deciding to prescribe. Data were also analyzed in the same manner to determine the likelihood that a procedure would produce gingival manipulation. Again, 75% was utilized to define a consensus.

Once the percentages were obtained, a Wilson Score Interval test was determined a 95% confidence interval. This was done by using the Statistics Kingdom proportion confidence interval calculator website tool.

### 3. RESULTS

#### 3.1 Descriptive Statistics

The questionnaire was sent to 78 accredited dental schools located in the United States and Canada via the ADEA Clinical Administration listserve. The total number of faculty who received the questionnaire is unknown. There were 134 responses received. Four were removed due to incomplete responses, leaving 130 responses for analysis.

Table I displays the demographic information of the respondents. Responses were not required on the survey and a few respondents did not answer any or all of the demographic questions. The majority of respondents were dentists, with 10% representing hygienists and others. Fifty-one percent reported general dentistry as their scope of practice. Sixty-six percent reported they were full time faculty and 34% reported part time. In addition, 91% reported that they prescribe or recommend antibiotics. The survey did not define the definition of full versus part time nor ask how often an individual prescribed antibiotics. Slightly more men responded than women did.

**Table I**

CHARACTERISTICS OF DENTAL FACULTY RESPONDING TO SURVEY OF ANTIBIOTIC PRESCRIBING AND GINGIVAL MANIPULATION BASED ON PROCEDURE TYPE			
<b>Profession</b>		<b>n (%)</b>	
Dentists		109 (89%)	
Hygienists		9 (7%)	
Other		4 (3%)	
Total		122	
<b>Faculty Status</b>		<b>n (%)</b>	
Full time		80 (66%)	
Part time		42 (34%)	
Total		122	
<b>Specialty or Scope</b>		<b>n (%)</b>	
General Dentistry		62 (51%)	
Endodontics		9 (7%)	
Oral Medicine		2 (2%)	
Oral Surgery		2 (2%)	
Orthodontics		3 (3%)	
Pediatric Dentistry		4 (3%)	
Prosthodontics		14 (12%)	
Public Health		2 (2%)	
Other		24 (20%)	
Total		122	
<b>Sex</b>		<b>n (%)</b>	
Male		69 (57%)	
Female		53 (43%)	
<b>Do you ever recommend or prescribe antibiotics ?</b>		<b>n (%)</b>	
Yes		116 (91%)	
No		11 (9%)	
Total		127	

Table II reflects the length of time since the respondent graduated and how many days a week they spent supervising or providing clinical care. The majority, 51 percent, were graduated for 30 years or greater, indicating that most graduated before the 1997 guidelines were implemented. Days in clinical practice were scattered, 42 percent being 3-4 days, followed by 31 percent at 1-2 days.

Table II

<b>CHARACTERISTICS OF DENTAL FACULTY RESPONDING TO SURVEY OF ANTIBIOTIC PRESCRIBING AND GINGIVAL MANIPULATION BASED ON PROCEDURE TYPE</b>	
<b>Years since professional school graduation</b>	<b>n (%)</b>
0-5 years	8 (7%)
6-10 years	10 (15%)
11-15 years	8 (7%)
16-20 years	13 (11%)
21-25 years	8 (7%)
26-30 years	12 (10%)
< 30 years	62 (51%)
Total	121
<b>Days per week providing or supervising clinical dentistry</b>	<b>n (%)</b>
None	11 (9%)
1-2 days	38 (31%)
3-4 days	51 (42%)
5+ days	22 (18%)
Total	122

### 3.2 Statistical Analysis

Category One questions asked the likelihood to prescribe for various procedures in a scenario in which the patient medically qualifies for antibiotic prophylaxis. Responses were collapsed into binary responses, with 50/50 likelihood, moderate likelihood and very likely collapsed into “yes” would prescribe and not likely and some likelihood collapsed into “no” would not prescribe. Table III displays these results ranked by percentage who would prescribe. Using the definition of consensus as 75%, there were 13 procedures out of twenty-four in which 75% of faculty had a consensus on whether or not to prescribe for that procedure. Performing the Wilson Score Interval removed five procedures that were on the cusp of 75% leaving consensus for only one third of the procedures.

**Table III**

\*Procedures in red denote non-agreement or no consensus

<b>LIKELIHOOD TO PRESCRIBE ANTIBIOTIC PROPHYLAXIS BASED ON PROCEDURE TYPE (95% CONFIDENCE INTERVAL)</b>	
Implant placement	91% (85-95%)
Extraction of permanent teeth	91% (85-95%)
Scaling and root planning	90% (84-94%)
Extraction of primary teeth	85% (78-90%)
Treatment of cervical caries extending below the gingival margin	79% (71-85%)
Crown Preparation	76% (68-83%)
Oral exam WITH probing	75% (68-81%)
Routine prophylaxis	74% (66-81%)
Root canal therapy	70% (62-77%)
Treatment of proximal caries on a posterior tooth	63% (55-71%)
Placement of stainless steel crown on primary tooth	63% (57-73%)
Procedure involving placement of rubber dam	62% (54-70%)
Restorative procedure involving an implant	57% (49-66%)
Treatment of proximal caries on an anterior tooth	56% (47-64%)
Treatment of cervical caries 1mm above the gingival margin	45% (37-54%)
Placement of Orthodontic bands	40% (31-48%)
Crown delivery	39% (31-47%)
Treatment of caries on a buccal pit	28% (21-36%)
Treatment of caries on an occlusal surface	25% (17-31%)
Taking Oral Impressions	18% (12-25%)
Oral exam without probing	4% (2-9%)
Taking 1 PA radiograph	4% (2-10%)
Fluoride treatment	3% (1-8%)
Taking 1 panoramic radiograph	3% (1-8%)



Category 2 questions asked the likelihood a procedure would produce gingival manipulation. These questions were listed in the same order as Category 1. Once again, all responses were collapsed into binary variables by 50/50 likelihood, moderate likelihood, and very likely into “yes” and not likely and some likelihood into “no” answers. Table IV displays them ranked by percent agreement.

**Table IV** \*Procedures in red denote non-agreement or no consensus

<b>LIKELIHOOD TO PRODUCE GINGIVAL MANIPULATIONBASED ON PROCEDURE TYPE (95% CONFIDENCE INTERVAL)</b>	
Implant placement	98% (94-100%)
Extraction of permanent teeth	97% (93-99%)
Scaling and root planning	95% (89-98%)
Extraction of primary teeth	89% (91-99%)
Treatment of cervical caries extending below the gingival margin	89% (82-93%)
Crown Preparation	86% (87-91%)
Routine prophylaxis	84% (76-90%)
Oral exam WITH probing	83% (75-88%)
Treatment of proximal caries on a posterior tooth	83% (65-80%)
Procedure involving placement of rubber dam	75% (67-82%)
Placement of stainless steel crown on primary tooth	75% (67-82%)
Treatment of proximal caries on an anterior tooth	67% (58-75%)
Root canal therapy	67% (58-75%)
Restorative procedure involving an implant	66% (57-74%)
Placement of Orthodontic bands	54% (45-63%)
Crown delivery	50% (41-59%)
Treatment of cervical caries 1mm above the gingival margin	49% (40-58%)
Taking Oral Impressions	28% (20-37%)
Treatment of caries on an occlusal surface	16% (10-23%)
Treatment of caries on a buccal pit	16% (10-24%)
Oral exam without probing	4% (2-10%)
Taking 1 PA radiograph	4% (2-10%)
Fluoride treatment	3% (0-7%)
Taking 1 panoramic radiograph	2% (0-6%)

Table V displays procedures the reached consensus for both likelihood to produce gingival manipulation and likelihood to prescribe antibiotic prophylaxis.

**Table V DENTAL PROCEDURES THAT REACHED CONSENSUS ON LIKELIHOOD TO PRODUCE GINGIVAL MANIPULATION AND LIKELIHOOD TO PRESCRIBE ANTIBIOTIC PROPHYLAXIS.**

<b>Consensus on Likelihood to Produce Gingival Manipulation and Likelihood to Prescribe Antibiotic Prophylaxis</b>
<ul style="list-style-type: none"> <li>❖ Implant placement</li> <li>❖ Extraction of permanent teeth</li> <li>❖ Scaling and root planning</li> <li>❖ Extraction of primary teeth</li> <li>❖ Treatment of cervical caries extending below the gingival margin</li> <li>❖ Crown Preparation</li> <li>❖ Routine prophylaxis</li> <li>❖ Oral exam WITH probing</li> <li>❖ Root canal therapy</li> </ul>
<b>Consensus on Not Likely to Produce Gingival Manipulation and Not Likely to Prescribe Antibiotic Prophylaxis</b>
<ul style="list-style-type: none"> <li>❖ Taking Oral Impressions</li> <li>❖ Treatment of caries on a occlusal surface</li> <li>❖ Treatment of caries on a buccal pit</li> <li>❖ Oral exam without probing</li> <li>❖ Taking 1 PA radiograph</li> <li>❖ Fluoride treatment</li> <li>❖ Taking 1 panoramic radiograph</li> </ul>

Four procedures did not reach consensus for likelihood to prescribe, yet there was consensus on likelihood to produce gingival manipulation. These procedures can be seen in Table VI.

**Table VI DENTAL PROCEDURES THAT REACHED CONSENSUS ON LIKELIHOOD TO PRODUCE GINGIVAL MANIPULATION BUT NO CONSENSUS ON LIKELIHOOD TO PRESCRIBE ANTIBIOTIC PROPHYLAXIS.**

- |  |
|--|
| <ul style="list-style-type: none"> <li>❖ Treatment of proximal caries on a posterior tooth</li> <li>❖ Procedure involving placement of rubber dam</li> <li>❖ Placement of stainless steel crown on primary tooth</li> <li>❖ Treatment of proximal caries on an anterior tooth</li> </ul> |
|--|

Another four procedures showed no consensus for either antibiotic prophylaxis nor for gingival manipulation. This is reflected in Table VII.

**Table VII DENTAL PROCEDURES THAT REACHED NO CONSENSUS ON LIKELIHOOD TO PRODUCE GINGIVAL MANIPULATION AND NO CONSENSUS ON LIKELIHOOD TO PRESCRIBE ANTIBITIC PROPHYLAXIS.**

- ❖ Restorative procedure involving an implant
- ❖ Placement of Orthodontic bands
- ❖ Crown delivery
- ❖ Treatment of cervical caries 1mm above the gingival margin

#### 4. DISCUSSION

A survey was conducted to determine whether dental faculty from accredited dental schools within the United States and Canada reached consensus on when they would prescribe antibiotic prophylaxis based on procedure type and whether the procedure produced gingival manipulation. Gingival manipulation was identified as the key factor to determining if prophylactic prescription was warranted in certain susceptible individuals in the 2007 guidelines. The survey revealed disagreement in prescribing practices but consensus in the judgement the procedure would produce gingival manipulation.

Hypothesis 1 is supported because only 66% of procedures obtained faculty agreement on prescribing. There was more agreement among faculty as to when gingival manipulation is produced. Only four or 17% of the procedure types did not reach consensus while 83% of procedures did reach agreement to produce gingival manipulation. Based on the results, hypothesis two is also supported.

It is interesting to note that while there is more agreement about procedures that produce gingival manipulation, there is still a significant lack of agreement on when to prescribe. Root canal therapy barely achieved the status of consensus for antibiotic treatment. This is notable because the 1997 guidelines specifically recommend antibiotic prophylaxis for root canal instrumentation beyond the apex. The 2007 guidelines recommend antibiotic prophylaxis for dental procedures involving the apexes of teeth. In essence, both guidelines

recommend antibiotic prophylaxis for root canal procedures, yet there is barely a consensus among faculty about premedication for those procedures.

The same can be said about routine prophylaxis. There was 84% agreement that a routine prophylaxis produced gingival manipulation but likelihood to prescribe barely made consensus. This is remarkable because the 1997 guidelines explicitly recommend antibiotic prophylaxis for routine prophylaxis. The 2007 guidelines do not mention routine prophylaxis.

A few other noteworthy procedures that did not achieve agreement to produce manipulation nor prescribe were restorative procedure involving an implant, placement of Orthodontic bands, crown delivery, and treatment of cervical caries 1mm above the gingival margin. Again, the 1997 guidelines specifically state prophylaxis is recommended for initial placement of orthodontic bands. The 2007 update does not mention orthodontic bands; it only states that prophylaxis is not recommended for placement of orthodontic brackets. It is evident that the guidelines have left prescribing for antibiotic prophylaxis unclear for dentists.

It is interesting that while treatment of proximal caries on a posterior tooth, a procedure involving placement of rubber dam, placement of stainless steel crown on primary tooth, and treatment of proximal caries on an anterior tooth all achieved consensus to produce gingival manipulation, they did not reach consensus to prescribe. The 2007 guidelines recommend prophylaxis for procedures that involve gingival manipulation, therefore, all four procedures should have reached consensus for antibiotic prescribing. The 1997 guidelines

specifically list restorative dentistry (operative and prosthodontic) with or without retraction cord, as a procedure that prophylaxis is not recommended. A plausible explanation for the variance in response could be that dentists still refer to the 1997 guidelines.

These findings are consistent with previous studies that have found inconsistency and controversy regarding when to prescribe antibiotic prophylaxis (Lockhart et al., 2013). Many dentists disagree with current guidelines and feel they are too vague (Jain et al., 2015). In one study, dentists defined invasive procedures to include extractions, periodontal procedures, implant placement, and dental cleanings (Tomczyk et al., 2018). This study concluded that prophylaxis (dental cleaning) does not produce gingival manipulation yet there was near consensus to prescribe. In addition, the literature reflected that 70% of respondents reported still prescribing antibiotics even though the 2007 guidelines no longer indicated it (Lockhart et al., 2013).

Clinical compliance as it relates to prescribing antibiotic prophylaxis is unclear (Lockhart et al., 2013). Some dentists and hygienists admit to prescribing AP even though it is not recommended due to patient or caregiver pressure (Tomczyk et al., 2018). Often, the pressure to write the prescription may come from the physician or cardiologist even though the cardiologist lacks the necessary understanding of dental procedures to make that recommendation (Jain et al., 2015; Tomczyk et al., 2018).



In addition to pressure to prescribe, dentists also reported that nonclinical factors, such as precautionary measures for patients going on vacation, legal concerns and patient demands contributed to noncompliance with recommended guidelines (Tomczyk et al, 2018). While there is no mention of bleeding in the 2007 guidelines, one study, states that dentists prescribe when bleeding is anticipated (Jain et al., 2015). Random exposures to bacteremia from daily activities is more likely to cause infective endocarditis than those related to a dental procedure (Tomczyk et al, 2018). One source suggests that regular tooth brushing creates a greater risk of IE than a single dental procedure due to repetitive bacteremia (Dar-Odeh et al., 2010). Adverse effects of antibiotics and possibility of antibiotic resistance were not reported as influencing prescribing decisions (Tomczyk et al, 2018).

There are limitations to this study. This study is reflective of a convenience sample. In addition, the sample was small. It is unclear how representative the sample is of the targeted faculty. There was no way to calculate the total number of all faculty who received the questionnaire, nor if the questionnaire was distributed in all of the dental schools.

Another limitation was that the faculty could interpret the procedures differently or have varied training techniques for a particular procedure that involve more or less gingival manipulation. The questionnaire posed the question as hypothetical scenarios. Clinical experience or patient influence impact the dentist's decision to prescribe on a case-by-case basis. Additionally, dentists may prescribe out of fear of an adverse outcome related to treatment even though prescribing was not indicated.

More studies need to be completed on interpretation of the AHA guidelines and when providers are prescribing. Specifically these studies need to focus on the determining factors when to prescribe. There is minimal data on the efficacy of the guidelines themselves. The National Institute for Health for Health and Clinical Excellence in the United Kingdom has not recommended antibiotic prophylaxis for at risk patients since 2008 (Roberts et al., 2013). Lastly, there are no studies determining the prevalence of an adverse outcome related to prophylactic antibiotic prescribing such as antibiotic resistance or allergic reaction.

## 5. CONCLUSION

In a convenience sample of dental school faculty, a lack of agreement was found about which dental procedures justify prescribing prophylactic antibiotics. While there were fewer procedure types that lacked consensus for gingival manipulation, both categories of questions should have provided similar results. The lack of concordance between the two categories suggests that the 2007 guidelines are unclear for the dental faculty members. This conclusion likely extends to all dentists. With the growing efforts of antimicrobial stewardship, the AHA guidelines should be expanded to be more definitive or further studies should be performed to determine adverse outcomes from prescribing antibiotic prophylaxis or lack thereof. This would help dentists to prescribe less and follow the guidelines more appropriately.

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## APPENDICES

## APPENDIX A

**Exemption Granted**

July 22, 2019

Jennifer Bereckis

Restorative Dentistry

RE: **Protocol # 2019-0756**  
**“Measuring Differences of Interpretation among Dental School Faculty on Antibiotic Prophylaxis Guidelines”**

Dear Jennifer Bereckis:

Your application was reviewed on **July 22, 2019** and it was determined that your research meets the criteria for exemption as defined in the U.S. Department of Health and Human Services Regulations for the Protection of Human Subjects [45 CFR 46.104(d)]. You may now begin your research.

**Exemption Granted Date:** July 22, 2019

**Sponsor/Funding Source:** None

**The specific exemption category under 45 CFR 46.104(d) is: 2**

You are reminded that investigators whose research involving human subjects is determined to be exempt from the federal regulations for the protection of human subjects still have responsibilities for the ethical conduct of the research under state law and UIC policy.

Please remember to:

- Use your research protocol number (2019-0756) on any documents or correspondence with the IRB concerning your research protocol.

**APPENDIX A (continued)**

- Review and comply with the [policies](#) of the UIC Human Subjects Protection Program (HSPP) and the guidance [\*Investigator Responsibilities\*](#).

We wish you the best as you conduct your research. If you have any questions or need further help, please contact me at (312) 355-2908 or the OPRS office at (312) 996-1711. Please send any correspondence about this protocol to OPRS via [OPRS Live](#).

Sincerely,

Charles W. Hoehne, B.S., C.I.P.  
Assistant Director, IRB #7

Office for the Protection of Research Subjects

cc: Lee Jameson  
Anne Koerber



## APPENDIX B

### Welcome to the research study!

Dear Respondent,

I am inviting you to participate in a research project to study prophylactic antibiotic prescribing in dentistry. You are being asked to participate because you are faculty at an accredited dental school and educating the future dentists emerging into the work force. This project involves completing a survey that will take approximately 4 minutes. The survey questions will be about the likelihood of prescribing antibiotics relative to dental procedure descriptions. Through your participation, I hope to understand antibiotic prescribing habits of dental school faculty. You must be at least 18 years old to participate.

To help protect your confidentiality, the survey will not contain information that will personally identify you. I will not ask for your name or the name of the College where you are faculty. All information collected in this study will be kept completely confidential to the extent permitted by law.

There is minimal risk in participating in this survey but please note that absolute confidentiality cannot be guaranteed due to the limited protections of Internet access. Your participation in this online survey involves risks similar to a person's everyday use of the Internet.

This project has been approved by the Institutional Review Board (IRB) at the University of Illinois at Chicago.

Your participation is voluntary and there is no penalty if you do not participate. You may stop the survey at any time or skip any questions you do not wish to answer.

If you have any questions about completing the questionnaire or about being in this study, you may contact me at [bereckis@uic.edu](mailto:bereckis@uic.edu). You may also contact my research advisor at [akoerber@uic.edu](mailto:akoerber@uic.edu).

By clicking the button below, you acknowledge that your participation in the study is voluntary, you are 18 years of age, and that you are aware that you may choose to terminate your participation in the study at any time and for any reason.

Please note that this survey will be best displayed on a laptop or desktop computer. Some features may be less compatible for use on a mobile device.

**APPENDIX B (continued)**

I consent, begin the study

I do not consent, I do not wish to participate

Please consider the following questions:

Do you ever recommend or prescribe prophylactic antibiotics to patients ?

Yes

No

### APPENDIX B (continued)

Given a patient who medically qualifies for antibiotic prophylaxis

	Determine the likelihood you would prescribe antibiotic prophylaxis for each procedure listed:				
	Not Likely	Some Likelihood	50/50 Likelihood	Moderate Likelihood	Very Likely
Oral exam WITHOUT probing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Oral exam WITH probing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taking 1 PA radiograph	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taking 1 panoramic radiograph	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Routine Prophylaxis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Scaling and root planing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taking oral impressions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fluoride treatment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Treatment of caries on a occlusal surface	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
treatment of caries on a buccal pit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Treatment of proximal caries on a posterior tooth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Treatment of proximal caries on an anterior tooth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Treatment of cervical caries 1mm above the gingival margin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Treatment of cervical caries extending below the gingival margin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Crown preparation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Crown delivery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Root canal therapy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Procedure involving placement of rubber dam	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Placement of stainless steel crown on primary tooth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Placement of orthodontic bands	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extraction of primary tooth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extraction of permanent tooth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Implant placement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restorative procedure involving an implant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## APPENDIX B (continued)

Please answer the following questions

	Rate how likely the following procedures would produce gingival manipulation:				
	Not Likely	Some Likelihood	50/50 Likelihood	Moderate Likelihood	Very Likely
Oral exam WITHOUT probing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Oral exam WITH probing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taking 1 PA radiograph	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taking 1 panoramic radiograph	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Routine Prophylaxis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Scaling and root planing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taking oral impressions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fluoride treatment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Treatment of caries on a occlusal surface	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
treatment of caries on a buccal pit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Treatment of proximal caries on a posterior tooth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Treatment of proximal caries on an anterior tooth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Treatment of cervical caries 1mm above the gingival margin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Treatment of cervical caries extending below the gingival margin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Crown preparation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Crown delivery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Root canal therapy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Procedure involving placement of rubber dam	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Placement of stainless steel crown on primary tooth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Placement of orthodontic bands	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extraction of primary tooth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extraction of permanent tooth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Implant placement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Restorative procedure involving an implant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**APPENDIX B (continued)**

Please share a little about yourself:

Dentist

Hygienist

Other

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Sex:

Male

Female

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Faculty Status:

Full time

Part time

**APPENDIX B (continued)**

How many years since your professional school graduation?

0-5 years

6-10 years

11-15 years

16-20 years

21-25 years

26-30 years

>30 years

**APPENDIX B (continued)**

Scope or Specialty:

General Dentistry

Endodontics

Oral Medicine

Oral Surgery

Orthodontics

Pediatric Dentistry

Prosthodontics

Public Health

Other

Number of days per week providing or supervising clinical dentistry?

None

1-2 days

3-4 days

5+ days

## VITA

NAME: Jennifer Bereckis Jacobucci

EDUCATION: A.A.S., Dental Hygiene, Kennedy King College, Chicago, Illinois, 2002

B.S., Biology, Benedictine University, Lisle, Illinois, 2005

TEACHING: Department of Restorative Dentistry, University of Illinois at Chicago College of Dentistry, 2012-2020

Dental Hygiene Department, Kennedy King College, 2009-2012

PROFESSIONAL Illinois State Dental Society

MEMBERSHIP: American Dental Education Association  
Organization for Safety and Asepsis