Preference of North Carolina (USA) paediatric cardiologists for the American Heart Association guidelines for prevention of infectious endocarditis prior to invasive dental procedures

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Abstract
Purpose: An updated Prevention of Infective Endocarditis guideline was published by the American Heart Association (AHA) in 2007. Our study examined whether paediatric cardiologists in North Carolina preferred the previous 1997 or the more recent 2007 guideline recommendations prior to invasive dental procedures.

Methods: A cross-sectional study design was used to assess guideline preference among sixty-eight identified paediatric cardiologist in North Carolina (USA). The survey instrument contained questions relative to their preference for the AHA 1997 or 2007 guidelines, their age and sex, number of years in practice, practice profile and location.

Results: Completed surveys were received from 32 paediatric cardiologists (4 females/28 males) for a response rate of 47%. There was no difference found between genders or in the number of years in practice in their prescribing preferences relative to antibiotic prophylaxis before invasive dental procedures. All but one (97%) preferred the 2007 guidelines but numerous exceptions were noted. Most of the responding paediatric cardiologists (27/32) were associated with a university/hospital, and practicing in an urban setting (19/32).

Conclusions: An overwhelming majority of paediatric cardiologists in North Carolina who responded to our survey endorsed the 2007 AHA guidelines. However, exceptions were identified by some study respondents.

Keywords: Infective endocarditis, cardiology, dental, antibiotic prophylaxis

Introduction
Infective endocarditis (IE), formerly known as bacterial endocarditis, is fortunately a relatively uncommon life threatening disease. However, even though there have been advances in diagnosis, surgical techniques, and management of complications, high morbidity and mortality rates related to IE continues to exist in at-risk individuals.

IE is the result of a complex interaction between blood-borne pathogens with matrix molecules and platelets at the site of endocardial cell damage. Turbulent blood flow produced by certain congenital or acquired heart disease predisposes the deposition of platelets and fibrin on the surface of the heart valve. This initially causes a thrombotic endocarditis on the cardiac valve surface and adherence of bacteria in the bloodstream to the thrombosis resulting in a vegetation and proliferation of the bacteria. Many of the clinical manifestations of IE are the result of the patient’s immune response to the microorganisms with pathogenic potential.

Oral mucosal surfaces are covered by extensive and complex microflora including streptococcus viridans. A break in the mucosal surface permits many organisms to enter the blood stream. Only a few studies have been published that address the magnitude of bacteremia following a dental
The first American Heart Association (AHA) guidelines were published in 1955 regarding prevention of rheumatic fever and bacterial endocarditis through control of streptococcal infections [4]. There have been numerous revisions and recommendations published since [5–11]. In 1997, the AHA recommended antibiotic prophylaxis for prevention of bacterial endocarditis for both patients at high and moderate risk prior to certain dental procedures [12,13] Table 1.

Since the 1997 AHA guidelines were published, numerous studies have questioned the antibiotic recommendations regarding prophylaxis prior to invasive dental procedures. Authorities have noted that most incidences of IE were the result of bacteremia occurring from routine daily activities (i.e., tooth brushing) and not the result of an invasive medical/dental procedure. Previous recommendations regarding antibiotic prophylaxis were based primarily on what appeared to be a reasonable attempt to avoid a life-threatening infection. However, the administration of antibiotics has the risk of increasing the possibility of resistant strains of organisms developing. Indeed, an alarming number of resistant strains of streptococci viridians have emerged over time. In addition, the possibility of developing an allergy to the antibiotic by the patient does exist [14]. The recommendations regarding preventive antibiotic prophylaxis have over the years become complex often resulting in confusion among both health care providers and at-risk patients [15].

In 2007, the AHA published updated antibiotic prophylaxis guidelines for infective endocarditis that limited the prescription of antibiotics prior to defined invasive dental procedures and to only patients at high risk [16,17] Table 1. Although there were differences, between the 1997 and the 2007 guidelines, both recommended antibiotic prophylaxis for at-risk patients prior to all dental procedures that involve manipulation of gingival or other tissue or devices, whether placed by surgery or by catheter intervention, during the first six months after the procedure.

### Table 1. Cardiac conditions for which prophylaxis for dental procedures is recommended.

#### 1997 AHA Guidelines

**High-risk category**
- Prosthetic cardiac valves, including bioprosthetic and homograft valves
- Previous bacterial endocarditis
- Complex cyanotic congenital heart disease (e.g., single ventricle states, transposition of the great arteries, tetralogy of Fallot)
- Surgically constructed systemic pulmonary shunts or conduits

**Moderate-risk category**
- Most other congenital cardiac malformations (other than above and below)
- Acquired valvar dysfunction (e.g., rheumatic heart disease)
- Hypertrophic cardiomyopathy
- Mitral valve prolapse with valvar regurgitation and/or thickened leaflets

#### 2007 AHA Guidelines

- Prosthetic cardiac valve
- Previous infective endocarditis
- Congenital heart disease (CHD)
- 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 six 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 inhibit endothelialization)
- Cardiac transplantation recipients who develop cardiac valvulopathy

To make substantial changes in the recommendations regarding whether antibiotic prophylaxis was indicated prior to dental procedures in IE at-risk patients posed certain risks and potential consequences. These included reversing long-standing expectations and practice patterns, causing confusion among patients with cardiac risk factors, making fewer patients eligible for prophylaxis, reducing malpractice claims related to IE infections [16], and would hopefully stimulate prospective studies to better inform future guidelines. On the basis of the 2007 guidelines, many fewer patients are recommended for IE prophylaxis prior to invasive dental procedures.

Previous investigations have focused on physicians’ preferences to changes in clinical practice guidelines but none have examined this in the context of the AHA guideline changes regarding IE antibiotic prophylaxis. The risk for IE associated with a dental procedure in a patient with underlying cardiac condition is at best an estimate, but has been suggested to be 1:95,000–1:1 million depending upon the cardiac condition [17–19]. Anecdotal information has suggested that not all paediatric cardiologists agreed with the 2007 AHA changes in the guidelines regarding IE prophylaxis. The purpose of this study was to assess the IE prophylaxis preference prior to invasive dental procedures among a group of paediatric cardiologists in the United States (US).

### Methods

This survey was targeted toward paediatric cardiologists in North Carolina (USA) to determine their preferred practice in prescribing antibiotic prophylaxis prior to dental procedures for patients at risk for IE. No identifying patient information was requested. The names of paediatric cardiologists practicing in North Carolina were obtained from the North Carolina Medical Board, American Board of Pediatrics and by internet search. Prior to data collection, the development of a survey instrument was completed in two phases: 1) guideline review and 2) expert panel review. The expert panel consisted of two...
paediatric dentists, one of whom is an expert in survey design and a paediatric cardiologist. The data collection followed a three step process. The survey, along with a self-addressed envelope, was mailed to the 68 identified paediatric cardiologists (13 females and 55 males) Table 2. The name of the paediatric cardiologist who completed the survey was not linked to the survey once it was returned. A second copy of the survey was sent to those who did not respond to the first solicitation or redirected if the first mailing was returned as undeliverable. If no response was received from these two mailings, the non-responding paediatric cardiologist was phoned by a member of the study in attempt to gather the information requested on the survey. The ages of the cardiologists and their years in practice were obtained in order that maturity and experience could be assessed as potential confounding factors in guideline preference. The primary outcome measure was practice preferences among a group of paediatric cardiologists. The Wilcoxon Rank Sum Test was used to evaluate the response data. This study was approved by the University of North Carolina IRB #13-2949, dated September 23, 2013.

Results
Completed surveys were returned by 32 paediatric cardiologists (4 females/28 males) for a response rate of 47%. The response rate for females was 31% and 51% for males. Practice setting and description are presented in Table 3. Nineteen paediatric cardiologists reported to have an urban practice, 9 suburban and 4 rural. Twenty-seven of the responders practiced in a university/hospital setting. The remaining reported private/community practices. Neither age nor years in practice were significantly different for male and female respondents (Wilcoxon Rank Sum test: p=0.21 for age and years of practice) Table 4.

When the paediatric cardiologists were asked whether they preferred the 1997 or the 2007 AHA guideline, an overwhelming 97% (all but one) preferred the 2007 version Table 5. However, a number of the respondents did report practice exceptions. A list of these exceptions is displayed in Table 6.

Discussion
This is the first study to examine the preferences of paediatric cardiologists in the United States since the 2007 changes in the AHA guidelines for infective endocarditis antibiotic prophylaxis. Interestingly, the National Institute for Health and Care Excellence (NICE) published guidelines in 2008 in the United Kingdom (UK) that recommended complete cessation of antibiotic prophylaxis for prevention of IE [20]. However, the European Society of Cardiology continued to recommend antibiotic prophylaxis prior to invasive dental procedures for high-risk patients [21]. Nevertheless, similar investigations on the preference of the

Table 2. Survey instrument.

<table>
<thead>
<tr>
<th>Please circle or write your answer to the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. _____ Check here if you do not practice pediatric cardiology in North Carolina. Do not complete the survey but do return it in the enclosed envelope.</td>
</tr>
<tr>
<td>2. For your at risk cardiac patients, which one of the above guidelines (1997 or 2007) do you prefer to follow for preventative antibiotic prophylaxis prior to your patients having and invasive dental procedure?</td>
</tr>
<tr>
<td>1997</td>
</tr>
<tr>
<td>2007</td>
</tr>
<tr>
<td>No preference</td>
</tr>
<tr>
<td>3. If you prefer to follow the 1997 rather than the most recent 2007 antibiotic prophylaxis guidelines, why?</td>
</tr>
<tr>
<td>Easier to understand and follow</td>
</tr>
<tr>
<td>More comfortable with old guidelines</td>
</tr>
<tr>
<td>Did not appreciate that there was a difference between the two guidelines</td>
</tr>
<tr>
<td>Other: _____________________________________________________________</td>
</tr>
<tr>
<td>4. Are there exceptions to your usual antibiotic prophylaxis recommendations?</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>If yes, what are these exceptions: ______________________________________</td>
</tr>
<tr>
<td>5. What is your age? ______</td>
</tr>
<tr>
<td>6. What is your sex? Male ______ Female ______</td>
</tr>
<tr>
<td>7. What is your practicing setting? Urban ______ Rural ______ Suburban ______</td>
</tr>
<tr>
<td>8. How best to describe your practice? Private/community ______ University/hospital ______</td>
</tr>
<tr>
<td>9. How many years have you practiced as a pediatric cardiologist? ______</td>
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</table>
The 2007 guidelines regarding antibiotic prophylaxis for identified cardiac issues prior to invasive dental procedures reflected changes from the 1997 version due to a lack of evidence to support some of the earlier recommendations \[22-25\]. The validity of any of the various conflicting recommendations has not been confirmed by a randomized clinical trial \[26\]. While previously, a retrospective study initially failed to show an increase over and above the rising trend of the incidence of IE in England two years on from the publication of the NICE guidelines, along with nearly a 79% reduction in the number of prophylactic antibiotic dental prescriptions, \[27\] a more recent, sophisticated analysis has reported an increased incidence above the rising trend of IE among high and lower risk patients in England, together with a 90% reduction in prescribed antibiotic prophylaxis prescriptions over the last five years \[28\]. Although this study has statistically confirmed a temporal association between the onset of NICE’s 2008 IE guidelines and the increase in the number of cases developing this disease, caution has been advocated before jumping to any conclusions on a cause and effect association \[28\]. Prospective randomized controlled studies have been therefore been advocated to address the issue, recognizing that failing to do so perpetuate the confusion among both patients and health providers \[29\].

The 1997 AHA guidelines regarding recommended antibiotic prophylaxis prior to invasive dental procedures were based on a few case control studies, clinical observations, and expert opinion. The rationale for the guidelines was to avoid a life threatening infection, where prevention would be preferable to treatment. The 2007 guidelines regarding antibiotic prophylaxis for identified cardiac issues prior to invasive dental procedures reflected changes from the 1997 version due to a lack of evidence to support some of the earlier recommendations \[16,17\]. However, there have been challenges to these conclusions. Some cardiologists believe that patients with cardiac issues (especially those with mitral valve prolapse) should be allowed to choose whether to take or not take antibiotics prior to an invasive dental procedure after being informed of the current (2007) recommendations until additional clinical evidence is available \[30\].

So far, earlier studies have not found an increased incidence of endocarditis since the 2007 AHA guidelines were introduced and would appear to support the more recent recommendations \[31,32\]. Other studies have reported that bacteraemia after tooth brushing is significantly greater in patients with poor oral hygiene and periodontal disease \[33,34\]. This would suggest that improving oral hygiene may be a more effective means of reducing the incidence of IE caused by oral bacteria than prescribing antibiotic prophylaxis prior to invasive dental procedures \[35\].

The results of our study should be considered in the light of some limitations. Because the survey was self-completed and submitted, responses may be susceptible to response bias. Another limitation of our study is the power of the study. Although a few trends were evident, the sample size was small.

Despite these limitations, this study has several strengths including it being the first to report on this important topic.
of clinical relevance in the US. Only a little is known about cardiologists’ preferences to the changes in the infective endocarditis recommendations prior to invasive dental procedures, and almost nothing is known about recommendations in the paediatric arena.

The child’s paediatric cardiologist is in the best position to appreciate the circumstances that could alter recommended antibiotic prophylaxis requirements. Therefore, it would appear prudent that a dentist contact the child's paediatric cardiologist regarding recommendations for antibiotic prophylaxis prior to beginning an invasive dental procedure.

Conclusions
From the data collected in this present study, the following conclusions can be made:

1. An overwhelming majority of paediatric cardiologists in North Carolina who responded to our survey endorsed the AHA 2007 guidelines. However, there were exceptions identified by some study respondents.
2. There was no difference between female and male paediatric cardiologists in their prescribing preferences relative to antibiotic prophylaxis prior to dental procedures.
3. There was no difference between female and male paediatric cardiologists in their age or the number of years they had been practicing.

Competing interests
The authors declare that they have no competing interests.

Authors’ contributions
All authors made significant contributions to this paper.

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References


